Structure Plan

Pt Lot 4 and Lots 31 & 5 Darch Road, Margaret River

August 2026

PREPARED BY

LB PLANNING
TOWN PLANNING | URBAN DESIGN | LAND DEVELOPMENT CONSULTING

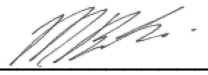
Endorsement page

This Structure Plan is prepared under the provisions of the Shire of Augusta – Margaret River Local Planning Scheme No.1

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

12 OCTOBER 2026

Signed for and on behalf of the Western Australian Planning Commission



an officer of the Commission duly authorised by the Commission pursuant to section 24 of the *Planning and Development Act 2005* for that purpose, in the presence of:

Anne Woodin Witness

Date: 20 OCTOBER 2026

Date of Expiry: 20 OCTOBER 2036

DISCLAIMER:

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Amendment Table

Amendment No.	Summary of the Amendment	Amendment type	Date approved by Commission

EXECUTIVE SUMMARY

This Structure Plan has been prepared to guide the subdivision and development of land contained within Pt Lot 4 and Lots 31 & 5 Darch Road, Margaret River (the site), as required by the provisions of the Shire of Augusta - Margaret River Local Planning Scheme No 1 (the Scheme).

The site is identified within (SPA 5) of the Scheme whereby various provisions are contained in Schedule 15 of the Scheme text, including a requirement for future land use and development to be in accordance with an endorsed Structure Plan.

Accordingly, the landowner of the site (Peringillup Nominees Pty Ltd) seeks approval to this Structure Plan, in order to subdivide the land into 10 low density residential lots, as envisaged by the Shire's Local Planning Strategy. The proposed Structure Plan Area, comprises 7.52 hectares and is located approximately 3.5 km south of the Margaret River townsite.

The Structure Plan has been prepared in conjunction with a proposed scheme amendment to rezone the land from 'Agriculture' and 'Priority Agriculture' to 'Future Development' zone. It also intends to delete 'Additional Use 55' (which relates to Lot 5) from Schedule 2 of the Scheme text and amend the Scheme Map accordingly.

The Structure Plan outlines an indicative special residential layout for the land and includes subdivision/development requirements to guide and control future land use in an appropriate manner. It is also supported by various technical investigations to address issues associated with environmental impact, bushfire management, servicing (including on-site effluent disposal) and noise attenuation due to its proximity to the Margaret River Perimeter Road.

This Structure Plan has been prepared in accordance with the relevant planning framework and will provide appropriate guidance to the future subdivision and development assessment of the land.

A table to reflect the key structure plan statistics, resulting from the proposed land use change, is provided below.

KEY STATISTICS TABLE

Item	**Data**		**Structure Plan Ref. (Section No.)**
Total area covered by the structure plan	7.52 hectares		
Area of each land use proposed: • Residential • Commercial • Industrial • Rural residential	Hectares 7.52 0 0 0	Estimated Lot yield 10 0 0 0	
Total estimated lot yield	10		
Estimated number of dwellings	10		
Residential Density	R5		

Estimated population	25 based on 2.5 people per dwelling		
Number of high schools	0		
Number of primary schools	0		
Estimated commercial floor space	0 hectares		
Estimated area and percentage of public open space given over to: • Regional open space • District open space • Neighbourhood parks • Local parks	 0 hectares 0 hectares 0 hectares 0 parks 0 hectares 0 parks	 0 % 0 %	
Estimated percentage of natural area	75 %		

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PART ONE

IMPLEMENTATION SECTION

1 STRUCTURE PLAN AREA

The Structure Plan applies to Pt Lot 4 and Lots 31 & 5 Darch Road, Margaret River, being the land contained within the inner edge of the broken black line shown on the Structure Plan map **(Plan 1)**.

2 STRUCTURE PLAN CONTENT

This Structure Plan comprises two parts being:

- **Part One (Implementation)** – This section contains the Structure Plan map including requirements to be applied when assessing subdivision and development applications within the Structure Plan Area.
- **Part Two (Explanatory Section)** – This section provides an explanation regarding the proposed Structure Plan and also includes general details in relation to site details, planning framework, constraints, land use and servicing. Part Two is a reference guide to interpret and justify the implementation of Part One and it incorporates an appendices section with technical reports and other information, as required.

3 OPERATION

This Structure Plan commences operation on the date it is approved by the WAPC and is valid for a period of ten years from such time. Due regard to its intent shall be given when considering future subdivision and development of the land.

4 STAGING

Due to the proposed low density residential development, it is envisaged subdivision and development of the land will be undertaken in either one or two stages.

5 SUBDIVISION AND DEVELOPMENT REQUIREMENTS

The following requirements are to be addressed at the subdivision and/or development stage:

1. Preparation of a new bushfire assessment and Bushfire Management Plan demonstrating compliance with the current version of State Planning Policy 3.7 – Bushfire.

2. Preparation of a site and soil evaluation (SSE) demonstrating effluent disposal capability and identifying suitable locations for effluent disposal systems.

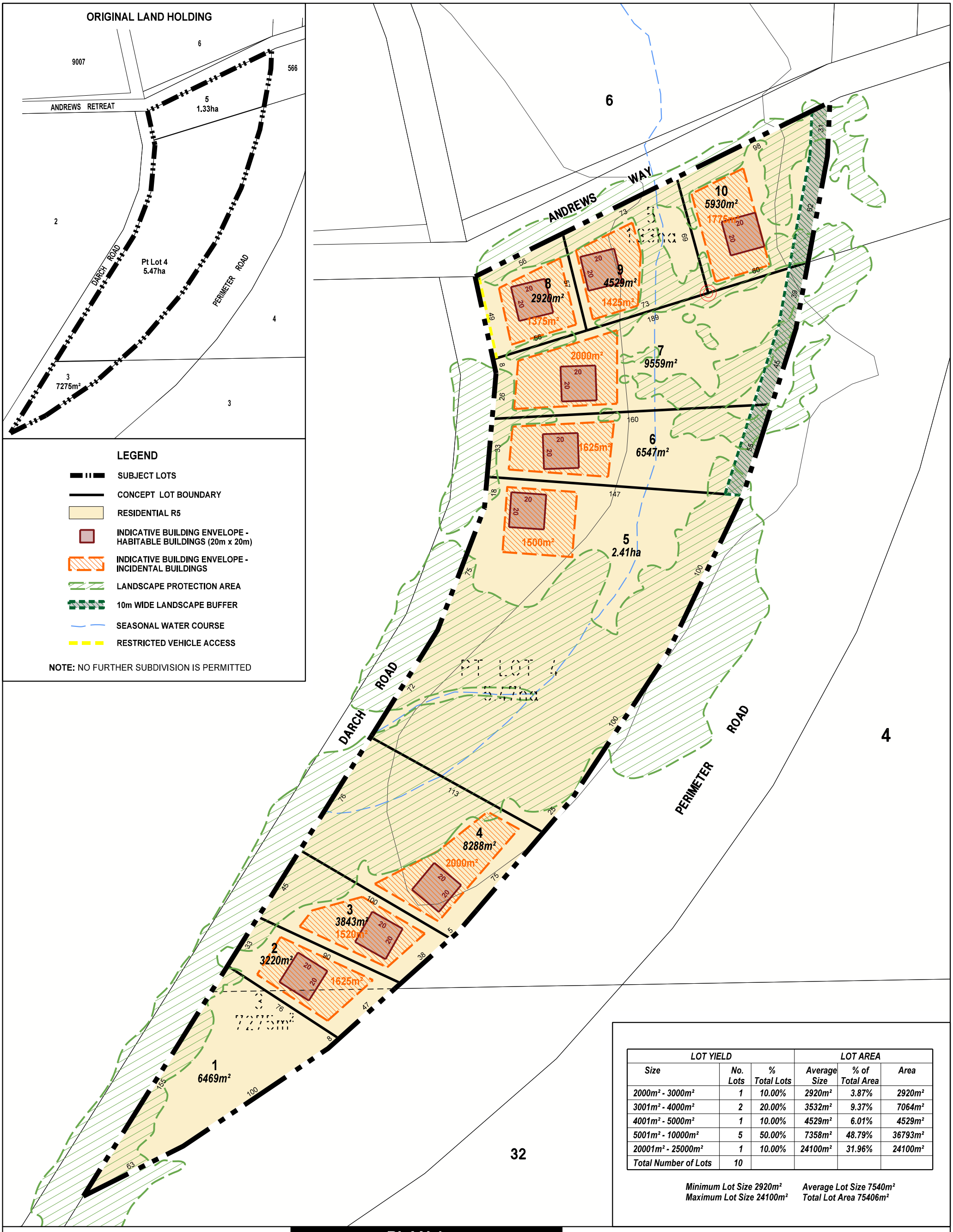
3. Implementation of noise mitigation measures required to comply with State Planning Policy 5.4 – Road and Rail Noise noting that noise walls will not be supported.

4. Implementation of landscape buffers as shown on the Structure Plan map.

5. Demonstration that impacts on the landscape protection area shown on the Structure Plan map will be minimised, including hollow bearing trees, trees containing WRP dreys, suitable DBH trees with no hollows, suitable DBH trees with hollows, and vegetation types 2, 3 and 4 as identified in Figure A-6 of the Environmental Assessment Report.

6. A local development plan will be required as a condition of subdivision to ensure the following is achieved at development stage:

i) Identification of building envelopes.
ii) Development setbacks to water courses and Perimeter Road.
iii) Measures for ongoing protection of vegetation to be retained on the site.
iv) Crossover locations.



LOT YIELD			LOT AREA		
Size	No. Lots	% Total Lots	Average Size	% of Total Area	Area
2000m² - 3000m²	1	10.00%	2920m²	3.87%	2920m²
3001m² - 4000m²	2	20.00%	3532m²	9.37%	7064m²
4001m² - 5000m²	1	10.00%	4529m²	6.01%	4529m²
5001m² - 10000m²	5	50.00%	7358m²	48.79%	36793m²
20001m² - 25000m²	1	10.00%	24100m²	31.96%	24100m²
Total Number of Lots	10				

Minimum Lot Size 2920m² Average Lot Size 7540m²
Maximum Lot Size 24100m² Total Lot Area 75406m²

0 20 40 60 80
metres

NOTES

Base data supplied by Landgate
Aerial Photography Date - January 2020
Coord - GDA94/MGA zone 50
Areas and dimensions shown are subject to final survey calculations.
All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.
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PLAN 1

CLIENT		N & K VEITCH
SCALE	:	1:2,000 @ A3
DATE	:	19 June 2026
PLAN No	:	LSP_V1_20260619
REVISION	:	A
PLANNER	:	SLB
DRAWN	:	BL

STRUCTURE PLAN

PT. LOT 4 & LOTS 31 & 5 DARCH ROAD, MARGARET RIVER

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Part Two

EXPLANATORY SECTION

1 INTRODUCTION AND PURPOSE

Pt Lot 4 and Lots 31 & 5 Darch Road, Margaret River (the site) is identified within Development Investigation Area M4 (DIA M4) of the current Shire of Augusta – Margaret River Local Planning Strategy (LPS). In short, DIAs facilitate ability to consider future rezoning and structure planning of specific areas in order to meet the demands of population growth within the Shire.

Following preliminary discussions with Shire planning staff and the landowner of the site, general support to progress rezoning and structure planning of the land was given, subject to the necessary investigations being carried out to validate a formal structure plan and scheme amendment proposal.

Accordingly, the landowner has done so and in conjunction with this proposal, also submits a formal request to amend the Scheme by rezoning the land from 'General Agriculture' and 'Priority Agriculture' to 'Future Development' zone in the form of proposed Scheme Amendment No 71. The proposed scheme amendment document refers to these actions in more detail and should therefore be read in conjunction with this Structure Plan.

This report and has generally been prepared in accordance with the WAPC's "Structure Plan Framework" pursuant to *The Planning and Development (Local Planning Scheme) Regulations 2015*. It provides a local design response to the site and will guide future subdivision to facilitate a sustainable special residential development outcome.

The Structure Plan is also informed by a number of technical investigations (i.e. environmental, geotechnical, servicing, noise and bushfire) prepared by an appointed consultant project team. A summary of each investigation is included within this section, with complete copies provided in the Appendices Section at the rear of this document.

2 LAND DESCRIPTION

2.1 LAND PARTICULARS

Lot/Plan No	Area	Registered Proprietor
Lot 31 on Plan 401791	7275m^2	P & M Middleton
Pt Lot 4 on Plan 403366	5.47 ha	Perringillup Nominees Pty Ltd
Lot 5 on Plan 403365	1.33 ha	NR & KA Veitch

2.2 LOCATION

As detailed above, the site incorporates two (2) single green title lot parcels and one (1) part lot, with a combined total area of 7.52 hectares. It is located approximately 3.5 km south east of the Margaret River townsite and is bordered by Darch Road to the west, Andrews Way to the north and the Margaret River Perimeter Road to the east **(refer Plan 2).**

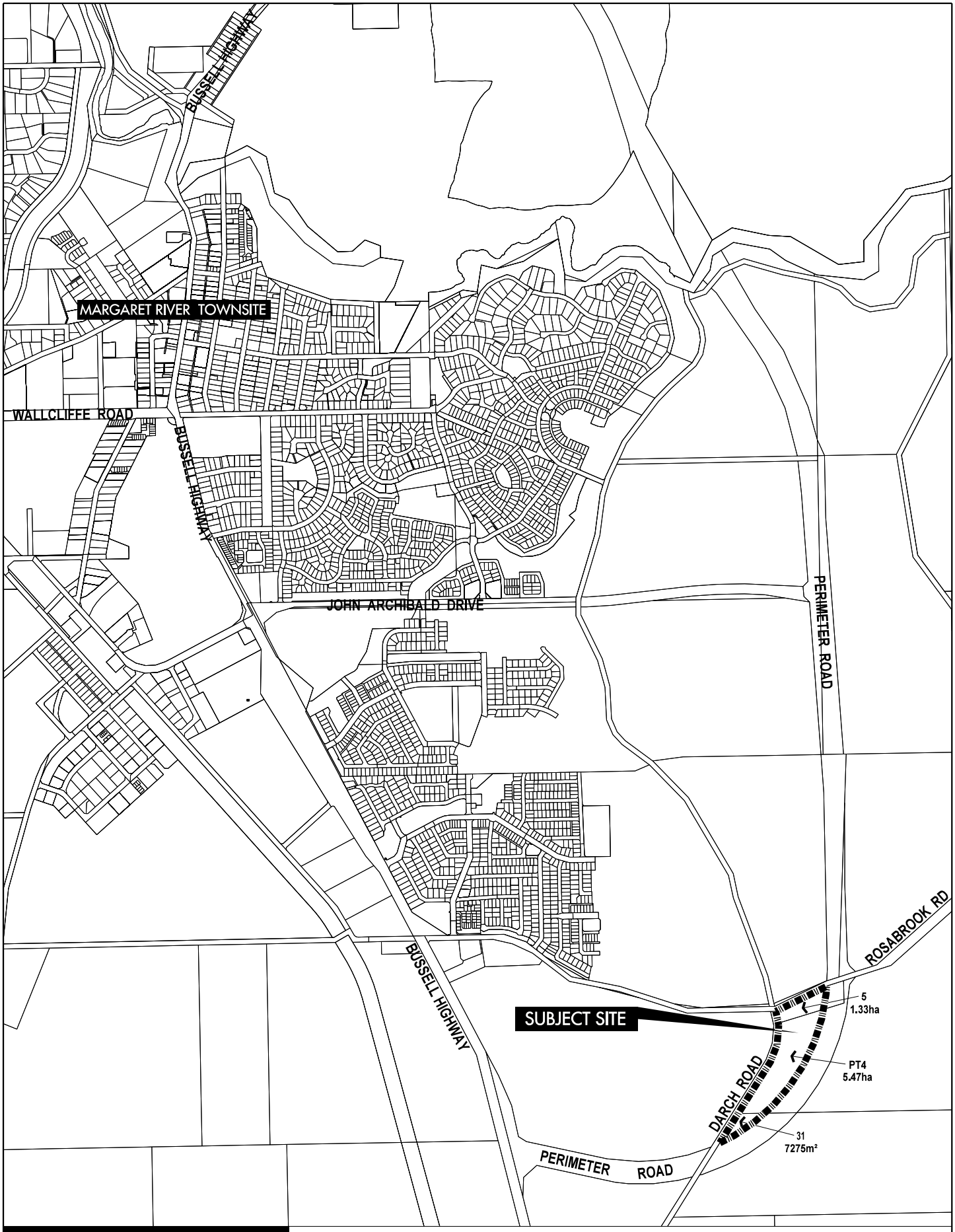
2.3 SITE DESRIPTION AND LANDUSE

The site incorporates three separate lot parcels, each of which contain a single dwelling and generally comprise a mix of cleared and vegetated land **(refer Plan 3)**.

Lot 31 forms the very southern extremity of the site and was created when the Perimeter Road Reserve was gazetted and consequently severed the land from the original lot parcel on the eastern side of the road reserve (i.e. Lot 32). By virtue of its creation, a single residence was permitted on the land, which has now been fully established. The land is generally cleared apart from a linear strip of remnant vegetation along the frontage of Darch Road to the west.

Pt Lot 4 has been actively grazed (cattle), with a small house/shed in the north western corner of the property. There are two farm (livestock) dams, one in the western part of the site and one in the north east. Lot 4 is fairly typical of the surrounding land, in that it has been mostly cleared for grazing with improved pastures although small patches of remnant and/or planted vegetation still exist. In terms of remnant vegetation, only a few individual trees remain including a single Karri, a few naturally regenerating Karris and several Peppermints in the centre and north of the property. The band of vegetation through the centre of the property has been planted as either a windbreak or for small scale silviculture.

Lot 5 includes a house and managed garden over the western half of the lot. A dam is located within the centre of the lot, with a chicken coop and derelict tennis court in the eastern section. Apart from some regenerating Peppermint trees along the drainage line, Lot 5 could be considered parkland cleared with wide variety of planted exotic trees and shrubs over a dense Kikuyu understorey. Despite this, it is noted that the road verge along Andrews Way contains some large native trees, Marri/Karri/Peppermint.



PLAN 2: LOCATION PLAN

PT. LOT 4 & LOT 31 DARCH ROAD & LOT 5 ROSABROOK ROAD , MARGARET RIVER

CLIENT	:	*N. VEITCH*
SCALE	:	*1:20,000*
DATE	:	*29 APRIL 2020*
PLAN No	:	*4 DARCH-5-001*
REVISION	:	*A*
PLANNER	:	*SLB*
DRAWN	:	*BL*

LEGEND

SUBJECT SITE

0 200 400 600 800
metres

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PLAN 3: AERIAL PLAN

PT. LOT 4 & LOTS 31 & 5 DARCH ROAD, MARGARET RIVER

CLIENT	:	***N. VEITCH***
SCALE	:	*1:3,000*
DATE	:	*28 June 2020*
PLAN No	:	*4 DARCH-5-002*
REVISION	:	*A*
PLANNER	:	*SLB*
DRAWN	:	*BL*

LEGEND

SUBJECT SITE

0 200 400 600 800

metres

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2.4 GROUND CONDITIONS AND LAND CAPABILITY

In 2016 an initial geotechnical and effluent disposal investigation was carried out in respect of the site. However, following public advertising of the proposal, an updated Site and Soil Evaluation was conducted in 2023 to address various issues raised and to align with the relevant planning framework. A copy of the 2023 Site and Soil Evaluation report is attached at **Appendix A** of this document.

In summary, the report concludes…"*there is enough land application area space available on the proposed new lots. Permeability is generally good, so at most 225 m^2 of irrigated area for a secondary treatment system is required on the new lots. Depending on Council regulations, there could be more or less footprint for leach drains/flatbeds.*

For secondary treatment systems the irrigation area can easily be located away from the dwellings. Effluent is typically pumped; hence drains can be a little longer than 20 m."

All of the necessary elements to validate the proposal and the site's suitability for on-site effluent disposal are detailed further in **Appendix A** and further confirmation to specific siting of any future treatment systems on the site, will continue to be addressed at the subdivision and/or building implementation stage.

3 PLANNING FRAMEWORK

3.1 SHIRE OF AUGUSTA – MARGARET RIVER LOCAL PLANNING SCHEME LOCAL PLANNING SCHEME NO 1

The site is zoned 'General Agriculture' and 'Priority Agriculture' by the Shire of Augusta – Margaret Local Planning Scheme No 1 (the Scheme) with Lot 31 and Pt Lot 4 being 'General Agriculture' and Lot 5 zoned 'Priority Agriculture'. Lot 5 also has an 'Additional Use' right (No. 55) placed over it, which allows 3 chalets to be established on the property, the details of which are contained in Schedule 2 of the Scheme text. It should be noted that 3 chalets used to exist on Lot 5, however they were removed to make way for construction of the Perimeter Road in 2018.

In conjunction with this proposal, it is also proposed via scheme amendment No. 71, to rezone the site to 'Future Development' zone, thus removing its current additional use right and requiring the preparation of a Structure Plan.

Clause 4.2.7 of the Scheme (outlined below) sets out the purpose and objectives of the Future Development Zone:

"Purpose of the Future Development Zone:

To provide for additional sustainable urban development within and around existing settlements within the Scheme area.

Objectives of the Future Development Zone:

(a)To designate land considered to be generally suitable for future urban development and to prevent such land being used or developed in a manner which could prejudice its possible future use for planned urban development;

(*b) To provide for the sustainable development of land in an orderly manner with appropriate levels of physical infrastructure and human services;*

(c) To require, as a pre-requisite to the local government's support for subdivision proposals and approval to development for urban purposes, the preparation and approval by the local government together with endorsement by the Western Australian Planning Commission of a Structure Plan in accordance with the provisions of Part 6 of the Scheme; and;

(d) To guide and control the development so as to achieve compact urban areas linked by open space, natural areas and functional open space consistent with the objectives"

The Scheme also states in Clause 4.2.9 (a) that:

"Prior to the local government granting approval to any development or supporting any proposal for the subdivision of land within the Future Development Zone, other than the erection of a single dwelling or minor changes in the use of land, a Structure Plan shall be prepared and approved pursuant to the provisions of Part 6."

In the context of this proposal, Part 6 of the Scheme specifically refers to preparation of Structure Plans and the subsequent adoption and approval process by the Council and Western Australian Planning Commission (WAPC). This Structure Plan has been prepared to fulfil these requirements and those necessary to support the proposed rezoning of the land.

The proposed Structure Plan identifies specific land use, residential density, and other development provisions to guide and control the area development. This Structure Plan has been prepared under the provisions of the Scheme and following public advertising and formal assessment, will be adopted by the Shire of Augusta – Margaret River and endorsed by the WAPC. The Structure Plan comprises an implementation section (Part One) and explanatory section (Part Two) consistent with the WAPC Structure Plan Framework.

Notwithstanding the above, the site is already identified by the Scheme within an overarching 'Structure Plan Area' (SPA 5) which relates to East Margaret River and its envisaged 'townsite expansion'. The SPA 5 provisions are outlined in a table contained within Schedule 11 of the Scheme, as shown below.

Area No. (SPA)	**Description of Land Area**	**Land Use Expectation**	**Matters to be Addressed in Structure Plans (in addition to Part 4 of the Deemed Provisions)**	**Associated Provisions**
5	East Margaret River AMD 43 GG 26/7/16	Townsite Expansion	Generally in accordance with the East Margaret River District Structure Plan 2015 or a subsequent Structure Plan approved by the Western Australian Planning Commission in accordance with the process set out in Part 4 of the Deemed Provisions	Land Use and development in accordance with the approved Structure Plan.

3.2 EAST MARGARET RIVER DISTRICT STRUCTURE PLAN

The current version of the East Margaret River District Structure Plan **(Plan 4)** was endorsed by the WAPC on 25 October 2017.

The District Structure Plan guides the preparation of more detailed structure plans and subsequent subdivision and development of the East Margaret River area.

In summary, it provides a framework for future urban development which will cater for growth of the Margaret River population until at least 2031. Its main features are:

- Provision for approximately 2000 new residential lots located within discreet neighbourhoods or hamlets;

- An alternative form of urban development recognising the principles of the Hamlet Design Guidelines in detailed planning;
- An interconnected road system which provides strong north/south and east/west options;
- The protection of natural assets including over 60ha of native vegetation;
- A focus on non-motorised forms of transport with multiple connections to the Darch and Rail trails which provide strong links to the Margaret River and other nature-based recreation facilities;
- Opportunities for local shopping;
- A primary school;
- District open space which in the future, will be developed to provide additional active recreation facilities such as playing fields;
- Provision for a range of lot types and sizes;
- Employment opportunities across a variety of sectors; and
- Best practice water management including treatment and reuse of wastewater for irrigation purposes.

In respect of the site, the District Structure Plan identifies the land as 'residential' with a buffer to the Perimeter Road and a vegetation linkage and buffer to the west, along the Darch Road interface.

As depicted on the plan, the existing and growing neighbourhoods of Rapids Landing and Brookfield will be complemented by 4 residential DIA areas forming in whole or in part, 4 discreet hamlets or neighbourhoods, which are defined by 400m-450m walkable catchments, and constitute areas of 50-63ha. For each hamlet to be functional and sustainable in its own right, it is necessary for residential development to be focussed around a central node (which may consist of commercial and retail elements), the location of which is indicatively shown on the plan.

In the context of this proposal, the site is identified within Hamlet 4 of DIA M4, contiguous with the existing Local Planning Strategy. Hamlet 4 which lies south of Andrews Way, is described by the District Structure Plan as high and predominantly dry cleared land to the west of Darch Road, with a small area of wetter and vegetated land to the east (i.e. the site). It is identified as being capable of sustaining a neighbourhood of up to 750 dwellings, with a lower density eastern fringe, consistent with this proposal.

3.3 SHIRE OF AUGUSTA – MARGARET RIVER LOCAL PLANNING STRATEGY

The Local Planning Strategy (LPS) was endorsed in 2011 and it identifies the site within Development Investigation Area (DIA M4) with specific reference to a 'Hamlet' style residential neighbourhood (approx. 420 lots).

The LPS also specifies that any potential subdivision and/or land use development within DIA M4 is

KEY

- Residential
- Civic/ Education
- Activity Node
- Industrial
- District Open Space
- Foreshore
- Significant Vegetation
- Vegetated Linkages & Buffers
- Perimeter Road Buffer
- Structure Plan Subject Area
- Regional Road
- Neighbourhood Connector Road
- Primary Path Network
- Wadandi Track

PLAN 4: EAST MARGARET RIVER STRUCTURE PLAN

PT. LOT 4 & LOTS 31 & 5 DARCH ROAD, MARGARET RIVER

CLIENT	:	***N. VEITCH***
SCALE	:	*1:3,000*
DATE	:	*2 JULY 2020*
PLAN No	:	*4 DARCH-5-003*
REVISION	:	*A*
PLANNER	:	*SLB*
DRAWN	:	*BL*

LEGEND

SUBJECT SITE

0 200 400 600 800

metres

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subject to an overall structure plan/scheme amendment process being carried out to ensure suitability for the envisaged land use, the need for that land use and the appropriate staged release of land.

In addition to the above, the following LPS policies apply to DIA M4:

- ***Hamlet style residential neighbourhoods are proposed in DIA's M1, M2, M3 and M4.***
- ***DIA's will be rezoned in the following sequence unless it can be demonstrated to the satisfaction of the local government and the WAPC that DIA areas need to be released earlier to meet housing demand or to ensure adequate competition in the market place or to meet a specific community need by way of additional facilities or alternative housing forms:***

  a. DIA M1;
  b. DIA M2;
  c. DIA M3;
  d. DIA M4.
- ***Comprehensive structure plans, to the satisfaction of the Local Government and WAPC, will be required to accompany any proposed DIA rezoning proposal.***
- ***Proposed development must be contiguous with, or directly linked to, existing development unless it can be demonstrated that the development design and urban form is not dependent on being contiguous and separation of urban villages/hamlets is by way of public open space. Landscaped areas or revegetation areas can be considered to be contiguous elements.***
- ***Scheme amendments within DIA M1 to M4 (Residential) and DIA M5 (Rural Small Holding) and DIA M6 (Light Industrial) should only be initiated when a funding and implementation policy for the eastern 'Perimeter Road' has been resolved.***

In light of the above and in the context of this proposal, it is important to understand that the site only forms a relatively small component of DIA M4 and is nestled in its very eastern portion between the now fully constructed Perimeter Road on its eastern edge and Darch Road to the west. It is also separated from the remainder of DIA M4 by the identified vegetation linkage along Darch Road and is therefore an independent development area in its own right. This view has been discussed with Council planning staff and is generally supported.

In addition, the envisaged residential land use is based on low density special residential type lots with strong emphasis placed upon retaining approximately 70% of the existing vegetation on the site. Therefore, the proposed development is considered low impact in the overall context of DIA M4 and can easily respond to the envisaged hamlet design focused residential land to the east when it is eventually developed in the future.

3.4 RURAL HAMLET DESIGN GUIDELINES

The Rural Hamlet Design Guidelines (the Guidelines) provide the Shire's aims, goals and urban design principles to which future development within identified development investigation areas will be assessed. In relation to rezoning and/or structure plans, all proposals are required to demonstrate that the requirements of the Guidelines have been satisfied.

The general philosophy behind the Guidelines is broadly focussed in using 30% of the overall land area for housing, 30% for ecological restoration and 40% for productive agricultural land. It also follows a general layered approach to site analysis and planning investigation to ensure the ultimate use, design and development of the land is thoroughly considered thus resulting in an appropriate design outcome and response. This includes aims, objectives and the use of check lists to address various elements such as sustainability, land capability, the street and block patterns, areas of ecological restoration, productive land patterns, open space networks, land use and densities to name a few.

In the context of the subject site, many of these elements are not entirely relevant or considered critical to its initial structure planning, largely due to relatively its small area, location at the edge of DIA M4, between the Perimeter Road, plus an identified vegetation link and its proposed low residential density (i.e. R5). However, this proposal is aligned with the Guidelines and its general philosophy in that its envisaged layout and residential function comfortably fits within and will not undermine the rural hamlet vision for East Margaret River and is also supported by various studies and investigations that have analysed and considered the crucial elements, such as environmental protection, servicing, noise, bushfire and dwelling locations.

3.5 STATEMENT OF PLANNING POLICY (WAPC)

Development of land must generally be consistent with any relevant Statements of Planning Policy (SPPs) introduced by the WAPC and due regard to the provisions of SPPs shall be given when preparing or amending structure plans.

Details of the SPPs relevant to this proposal are outlined below.

3.5.1 Residential Design Codes – Volume 1

The Residential Design Codes (**the Codes**) provides the basis for control of residential development through Western Australia.

The Codes are adopted by the Scheme and have the following objectives:

- ***To provide residential development of an appropriate design for the intended residential purpose, density, context of place and scheme objectives.***
- ***To encourage design consideration of the social, environmental and economic opportunities possible from new housing and an appropriate response to local amenity and place.***
- ***To encourage design which considers and respects heritage and local culture.***
- ***To facilitate residential development which offers future residents the opportunities for better living choices and affordability.***

The Scheme adopts the provisions of the Codes to guide the assessment of proposed development on residential of future development zoned land. In respect of this proposal, the proposed Structure Plan designates the R5 density code over the land, which is based on a minimum site are per dwelling of 2000m^2.

3.5.2 SPP3.7 – Bushfire

This policy provides the foundation for land use planning to address bushfire risk management in Western Australia. It is to be used to inform and guide decision-makers, referral agencies and landowners/ proponents to help achieve acceptable bushfire protection outcomes. It applies to all higher order strategic planning documents, strategic planning proposals, subdivision and development applications located in designated bushfire prone areas.

In this regard the entire site is identified as 'Bushfire Prone' and accordingly a Bushfire Management Plan (BMP) was prepared by 'Working on Fire Planning' in 2021 to inform and support this Structure Plan proposal. A copy of the BMP is contained in the appendices section of this document **(Appendix B)**

In summary the BMP confirms that future residential subdivision and development of the land, envisaged by the proposed Structure Plan, is consistent with the provisions of SPP 3.7.

In addition, various recommendations contained within the document, also confirm the following:

- The planning requirements for local government;
- Identification of bushfire risks using vegetation types and slopes as in AS3959:2018;
- Identification of assets at risk- life, property, infrastructure and the environment;
- Identification of bushfire risk mitigation measures as acceptable solutions within the WAPC's guidelines;
- Allocation of responsibilities to persons / entities for the implementation of recommendations and management measures; and
- Compliance with the Shire of Augusta Margaret River's Annual Firebreak & Fuel Hazard Reduction Notice.

Subsequent to preparation of the BMP contained in **Appendix B** (dated August 2021), an updated version of SPP 3.7 was implemented in 2024 thus rendering the document out of date. Accordingly, it has been resolved that preparation of a new bushfire assessment and BMP, to demonstrate compliance with the new version of SPP 3.7 – Bushfire is necessary. This requirement has been included within Part 1 (Section 5) of this document, to ensure this matter is suitably addressed at the subdivision and/or development stage.

3.5.3 SPP 5.4 - Road and Rail Noise

SPP 5.4 applies to all stages of planning in Western Australia, where a noise-sensitive land use is proposed within the policy's trigger distance of specified transport routes or when new or major upgrades of road and rail are proposed. The transport routes identified are considered of key economic importance due to their high vehicle movements and/or freight handling functions.

The objective of the policy is to:

- protect the community from unreasonable levels of transport noise

- protect strategic and other significant freight transport corridors from incompatible urban encroachment
- ensure transport infrastructure and land-use can mutually exist within urban corridors
- ensure that noise impacts are addressed as early as possible in the planning process
- encourage best practice noise mitigation design and construction standards.

SPP 5.4 is particularly relevant to this proposal in that the Perimeter Road, which flanks the eastern boundary of the site, is a specified transport route under the policy.

Accordingly, a Transportation Noise Assessment has been undertaken by Lloyd George Acoustics, to address the provisions of SPP 5.4 and to inform assessment of this proposal.

In summary the assessment concludes that indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses) are satisfactory, however outdoor noise levels will be exceeded. On this basis and given that it is not considered practicable to reduce the noise to below the target, as that would require a noise barrier along the entire property boundary in excess of 5.0m high, the following is recommended by the assessment report:

"Quiet House Packages are required to dwellings on lots shown on Figure 5-1 and Figure 5-2, being for ground floor and first floor levels respectively. Appendix A provides the Quiet House Packages, as taken from the SPP 5.4 Guidelines. Alternatives to the provided Packages can be accepted if supported by a report from a suitably qualified acoustical consultant (member firm of the Association of Australasian Acoustical Consultants (AAAC)) once the specific house plans for the lot are available. In addition, each of these lots will require a notification on title in accordance with SPP 5.4."

For further information please refer to the full copy of the Transportation Noise Assessment report contained in the appendices section of this document **(Appendix C)**.

4 SITE CONDITIONS AND CONSTRAINTS

4.1 BIODIVERSITY AND NATURAL AREA ASSETS

In order to inform and guide this proposal, an Environmental Assessment Report (EAR) was carried out by SW Environmental, a copy of which is contained in the appendices section of this report **(refer Appendix D)**.

In addition to a high-level desktop assessment, Level 1 fauna, flora and vegetation surveys were also carried out as part of the assessment.

The vegetation and flora of Lots 4 and 5 Darch Road was found to be highly disturbed and retained little value as representative native vegetation. It was noted that the study area had been historically cleared and grazed with virtually no native understorey retained. The understorey consisted of introduced grass and herbs. The overstorey/tree canopy was dominated by planted non-endemic Eucalypt species and mostly planted Karri.

In summary no critical environmental constraints were identified by EAR that would result in the project not proceeding and the following values were noted:

- ***Impacts to native vegetation within Lots 4 and 5 will be low, due to the Completely Degraded to Degraded condition of vegetation, including areas of planted exotic and non-endemic species.***
- ***No conservation significant flora or communities were found within the study area (Steam EW 2018).***
- ***Fauna habitat quality is Poor to Moderate over the site, with the majority of the lot areas providing Poor habitat quality.***
- ***The site contains Marri trees which are suitable black cockatoo foraging habitat. Foraging habitat within the lot boundaries was restricted to only six Marri DBH trees within the degraded habitat type 3. Marri Woodland over pasture / Poor fauna habitat quality and less than 0.2 ha of canopy area.***
- ***No evidence of black cockatoo breeding or roosting was recorded within the study area.***
- ***There is a limited potential for WRP to utilise individual tree hollows in 1. Cleared or parkland cleared with plantings / Poor fauna habitat quality. The species is unlikely to occur within 2. Mixed Eucalypt Forest (planted) / Poor fauna habitat quality due to the lack of refuge and mid-storey.***

The EAR also provides the following considerations:

- ***Activation of ASS is considered unlikely however the Completion of an ASS selfassessment form will be required and if necessary, the preparation and implementation of an ASSDMP at the subdivision stage.***

- ***Preparation of a LWMS and an UWMP is not recommended due to the small nature of the development and no change in stormwater behaviour associated with the site (Stantec 2021). The proposed development however should ensure that existing stormwater flow patterns are not disrupted or cut off.***

- ***Onsite effluent disposal systems should a have setback of more than 30 m from any well, bore, stream, river or water course intended for consumption by humans (including nonperennial streams). Subdivision design should be in line with the (then) Department of Water's Operational Policy 4.3: Identifying and establishing waterways foreshore areas (2012).***

- ***Extraction of surface water will require a license from DWER to ensure environmental requirements are met.***

- ***Drainage should be designed in line with the recommendations of the Site and Soil Evaluation report (E&LM 2023).***

- ***A Site Revegetation Plan should be considered to reduce residual impact on WRP, with appropriate native species to the specifications of the Local Government***

- ***Minimise clearing of native vegetation where possible, particularly the trees over 50 cm DBH and the vegetation complex Cowaramup (Cw1 – Valleys) along Darch Road.***

- ***Where clearing of potential black cockatoo and WRP habitat is proposed, impacts should be assessed against the EPBC Act at the subdivision stage.***

- ***Fauna management protocols and actions will need to be implemented prior to and during clearing activities, potentially through implementation of a Fauna Management Plan. An authorised fauna spotter should be present to manage the clearing of any potential WRP habitat.***

- ***Any Bushfire Management Plans prepared for this project should be read in conjunction with this EAR, with house locations sited to minimise clearing of vegetation.***

- ***Retain the five hollow trees if possible (two of which are in the road verge).***

4.2 GEOLOGY AND TOPOGRAPHY

The geology of the site comprises of roughly 150mm of topsoil, 800mm of sand underlined by sandy/clayey soil.

The topography of the site naturally grades north into a natural creek line that runs through the middle of the site. The south-west corner of the site is elevated at approximately RL 95m AHD and grades towards the creek line at approximately RL90m AHD.

4.3 GROUNDWATER AND SURFACE WATER

Based on the findings of the Site & Soil Evaluation report **(Appendix A)** the groundwater was measured between 1.6 to 2.0 metres from the various test pit locations. Accordingly, use of either dripline or inverted leach drains is recommended for future effluent disposal.

There are two seasonal drainage features that traverse the site. One originates on farming land to the west of the site and is better described as an artificial drainage channel. It then traverses to the north to a small dam that lies central to the property and then a detention basin toward the north with a second dam near the northern boundary. The second drainage feature originates on the eastern side of the Perimeter Road and traverses the north-eastern corner of the subject property before joining the other drainage feature and exiting the property through the northern boundary and crossing Andrews Retreat.

4.4 BUSHFIRE HAZARD

As mentioned in Section 3.4.1 of this report, a qualified fire management consultant (Working on Fire Planning') was engaged by the landowner to prepare a Bushfire Management Plan (BMP) to support the proposed Structure Plan.

In summary, the BMP informs and supports this proposal and a full copy of the document is contained within the appendices section of this report at **Appendix B**.

As a requirement of this Structure Plan, further bushfire assessment will also be carried out at the future subdivision/development stage.

4.5 HERITAGE

As stated in the EAR (**Appendix D**) the *Aboriginal Heritage Act 1972* (AHA) makes provision for the preservation on behalf of the community of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants. The closest registered site under the AHA is the Margaret River and its tributaries (ID 4495), a mythological site. The closest section of the registered site, as mapped, falls approximately 350 m north of the Project (PDLH, 2018). Given the degraded nature of the drainage features within the study area, they are not likely to be considered tributaries of the Margaret River nor would they be considered to form part of Site ID 4495.

The project also falls within the buffer zone of 'Rosa Brook Road (Margaret River Lore Ground) Other Heritage Place 4494' described as a *Ceremonial, Camp, Meeting Place, Battle ground*. It is listed as *Stored Data / Not a Site* under the AHA and therefore not a registered site. Accordingly, no actions are required under the AHA.

In respect of European Heritage, items or places of heritage significance are listed under the Australian Heritage Database (DotEE, 2018) State Heritage database (Government of WA, 2018), or at a local level under the Shire of Augusta – Margaret River Municipal Inventory (2012). There are no items or places listed on these inventories or databases associated with or near the Project site.

4.6 ACID SULFATE SOIL (ASS)

The EAR also provides comment to Acid sulfate soils (ASS) which occur in low-lying coastal areas and common in water-logged, groundwater dependant and high-groundwater-table environments.

In this regard, it states that the former Department of Environment Regulation (DER) has published ASS risk maps. Where a development cannot be redesigned to avoid disturbing ASS, the risk maps are used to trigger site-specific investigations and management strategies for ASS soil disturbance and/or lowering of the groundwater table.

The study area is mapped as Class 2 (2g, p4) risk of ASS (DER, 2010). Class 2 includes moderate to low risk of ASS occurring within 3m of the natural surface but a high to moderate risk of ASS occurring beyond 3m that could be disturbed by soil excavation and dewatering associated with infrastructure works including:

- works involving lowering of the water table (temporary or permanent);
- earthworks extending beyond 3m below the natural ground surface; and
- works within 500m of wetlands.

Given that water logged soils are likely to be associated with low lying areas and natural drainage shown in Figure 1-2, if any soil excavation and dewatering is likely to occur in or near these areas then further ASS investigations are recommended at the subdivision stage.

4.7 CONTAMINATION

There are no land uses associated with the site that are likely to cause contamination or mapped contaminated sites within 2.5 km of the project (SLIP 2018). No further actions are required in relation to this aspect.

4.8 NOISE

As mentioned in Section 3.4.2 of this report, a Transportation Noise Assessment has been undertaken by Lloyd George Acoustics, to address the issue of the Perimeter Road and its proximity to future dwellings on the site. In summary, the assessment concludes that proposed lots and indicative dwelling locations as shown on the Structure Plan, are acceptable and where any future dwellings are above the outdoor noise target, then various construction packages will need to be considered.

Further details regarding the noise assessment and its recommendations can be reviewed in the full report contained in the appendices section of this document **(Appendix C)**.

5 THE PROPOSED STRUCTURE PLAN

The proposed Structure Plan will provide planning direction to guide and control the proposed development of the site for future special residential development. The Structure Plan is a flexible means of assessing land capability and long-term opportunities for future development of the site in context with the strategic planning vision for the locality and its surrounds.

This Structure Plan will also provide a useful tool for assessing future subdivision and development proposals in respect of the land and various subdivision and development requirements are outlined in Part One of this report which read as follows:

1. **Preparation of a new bushfire assessment and Bushfire Management Plan demonstrating compliance with the current version of State Planning Policy 3.7 – Bushfire.**

2. **Preparation of a site and soil evaluation (SSE) demonstrating effluent disposal capability and identifying suitable locations for effluent disposal systems.**

3. **Implementation of noise mitigation measures required to comply with State Planning Policy 5.4 – Road and Rail Noise noting that noise walls will not be supported.**

4. **Implementation of landscape buffers as shown on the Structure Plan map.**

5. **Demonstration that impacts on the landscape protection area shown on the Structure Plan map will be minimised, including hollow bearing trees, trees containing WRP dreys, suitable DBH trees with no hollows, suitable DBH trees with hollows, and vegetation types 2, 3 and 4 as identified in Figure A-6 of the Environmental Assessment Report.**

6. **A local development plan will be required as a condition of subdivision to ensure the following is achieved at development stage:**

   i) Identification of building envelopes.
   ii) Development setbacks to water courses and Perimeter Road.
   iii) Measures for ongoing protection of vegetation to be retained on the site.
   iv) Crossover locations.

Part Two of the Structure Plan Report outlines site conditions, relevant constraints, means to address identified issues that can then be used to validate the proposed 'Residential R5' use and density of the site and to guide future subdivision and development assessment of the land as part of the ongoing planning process.

The Structure Plan has been designed with consideration to various planning principles, including the Shires Rural Hamel Design Guidelines and its objectives. In essence, the Structure Plan seeks to achieve an outcome whereby the ultimate use and development of the site is able to provide a functional and sustainable special residential enclave in context with the surrounding locality and its planned evolution towards becoming part of the broader rural hamlet-based vision for Margaret River.

In light of the above, the primary planning considerations and objectives that have been applied to formulate the plan and its design philosophy, are as follows:

- Consideration to indicative lot dimensions to be further reviewed at the subdivision stage, in order to minimise physical disturbance to the land, enable appropriate dwelling placement and limit clearing of significant remnant vegetation.

- Determine predicted noise levels resulting from the Perimeter Road and provide solutions to mitigate identified impacts in relation to any future dwellings on the site;

- Site topography and ability to manage stormwater in a sensitive and appropriate manner;

- Review flora and fauna values of the site and confirm any potential impacts;

- Ensure appropriate measures within the subdivision layout are established to mitigate fire risk;

- Review fire management requirements and establish indicative dwelling locations to assist future development assessment while minimising the impact on significant areas of remnant vegetation;

- Restrict traffic movement and associated road construction impacts on the natural environment by avoiding the need for an internal subdivisional road;

- Provide low density R5 residential development in order to retain the sites rural character and an appropriate transitional residential land use between the industrial zoned land to the east and proposed future urban development to the west, on the opposite side of Darch Road; and;

- Confirm geotechnical and land capability of the site to accommodate appropriate siting and installation of on-site effluent disposal systems.

6 SERVICES AND INFRASTRUCTURE

A detailed servicing report has been prepared for the Structure Plan Area by Stantec and a full copy of the document is contained in the appendices section of this report **(Appendix E**).

Key aspects of the servicing report are be summarised below.

6.1 EARTHWORKS

Due to the proposed large size of the lots and no internal subdivisional roads, it is not necessary to change the existing topography on the site to accommodate the envisaged residential development.

It is noted however that subject to future lot owner's personal preference in relation to residential house locations, minor filling below the future residences to accommodate floor slab construction may be a possible however this will be examined and confirmed at the building licence stage.

6.2 STORMWATER MANAGEMENT

The existing stormwater system on the site consists of an intermittent creek line with offline and online dams, overflow from stormwater tanks and natural overland flows. There is no internal pit and pipe system although culverts below the Perimeter Road to the east and Darch Road to the west direct minor external catchment flows to the existing stream system in the general locality.

In relation to the proposed use of the land as 'Residential R5', the proposed stormwater strategy for the site will match the current pre-development stormwater flow patterns by utilising the existing creek line and dams and minimising the use of pit and pipe systems. This is achievable due to the proposed low-density development of the site (including minimal earthworks, creek line redirection and no internal subdivisional road), the use of rainwater tanks and the predevelopment low permeability of the existing soil that will result in little or no change to the existing stormwater behaviour.

In light of the above, it has been determined that a Local Water Management Strategy is not required to support this proposal.

6.3 ROAD INFRASTRUCTURE

As mentioned previously, no internal subdivisional roads are proposed due to the low-density nature of the envisaged 'special residential' use of the site and that it is already bound by three existing roads being:

1. Darch Road to the west - (current gravel track which will require upgrading to enable suitable access to the proposed lots).

2. The Perimeter Road to the south and east – (MRWA sealed road with no lot access).

3. Andrews Way to the north – (sealed road which will provide access to some of the lots in the northern part of the site).

6.4 WASTE WATER MANAGMENT

Currently, no sewerage infrastructure exists within close proximity to the site, with the nearest existing gravity sewers being over 2km away to the North-West of the site in Rapid Landing Estate and this sewer is not planned to service this catchment. In fact, the Water Corporation's long-term sewer planning for the area conforms that gravity sewerage infrastructure will not be available to the site for many years, and accordingly the only waste water treatment option for the site is utilisation of Alternative Treatment Units (ATUs).

The SSE report contained in **Appendix A** provides advice in relation to the suitability of the existing soil profile and groundwater levels for onsite effluent disposal and concludes the site is considered suitable in this regard.

It should also be noted that further details in relation to site and soil evaluation on each of the proposed lots will be provided at the subdivision application stage in accordance "*Section 3.4 - For subdivision applications where on-site sewage disposal is proposed"*, of the 'Government Sewerage Policy' and as a requirement of this Structure Plan. Furthermore, all future lot buyers will also need to arrange approvals and installation of an ATU for each site at the building licence stage.

6.5 WATER SUPPLY

Currently, no water reticulation infrastructure exists within close proximity to the site and it is unlikely to be extended in the short to medium-term. Accordingly, water will need to be supplied by rainwater tanks fed from roof catchment, which is the case for the existing residences on the site and the surrounding locality.

6.6 GAS

No gas reticulation exists within the Perimeter Road or Andrews Retreat reserves, therefore servicing the site with gas reticulation is not considered viable due to lack of existing infrastructure in the region.

However, lot owners can install gas bottles on their properties to service future dwellings, if desired.

6.7 ELECTRICITY SUPPLY

An analysis of Western Powers DFIS system has been conducted by Stantec to determine the existing power supply configuration surrounding the proposed development site. In summary, the existing Western Power network surrounding the site consists of existing overhead LV and HV cables that traverse the site, as well as overhead infrastructure to the north of Andrews Way. There are also 3 x existing power supplies on the land that service the three existing dwellings and these existing supplies will be removed as part of the subdivision and the lots will be resupplied using underground cabling.

In relation to Infrastructure capacity and proposed upgrades it was found that based on the proposed development layout, the estimated demand load will be in the order of 65kVA.

Therefore, in order to service the proposed subdivision, it is anticipated that all existing overhead infrastructure (poles, conductor, transformers) will be removed and a new underground supply network will be established as per current Western Power policy. This will require a new single phase high voltage cable be installed along the existing road reserve boundary from the existing power pole on the northern side of Andrews Way to a location at the southern end of the site, within in the Perimeter Road reserve, where the cable will be jointed onto an existing underground cable.

Individual lots will be serviced from pillar units (green domes) located within alternate lots and the pillars will obtain power from pad mounted transformers located on four of the proposed lots.

The above works will require the developer to obtain permission from the landowner on the Northern side of Andrews Way for Western Power to undertake modifications to the existing overhead infrastructure on that land and further permission from MRWA for minor works to be undertaken in their road reserve at the southern end of the site will also be necessary.

6.8 TELECOMMUNICATIONS

An analysis of NBN's DBYD has been conducted in order to determine the location of the existing NBN network to service the site and its proposed land use.

In summary, it is expected the proposed subdivision 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 Andrews Way, from where Telstra/NBN will install fibre optic or copper cabling to the development.

7 CONCLUSION

The proposed Structure Plan has generally been prepared in accordance with the WAPC's "Structure Plan Framework" pursuant to *The Planning and Development (Local Planning Scheme) Regulations 2015.*

It has also been prepared in conjunction with proposed Scheme Amendment No. 71 to rezone the land from 'Agriculture' and 'Priority Agriculture' to 'Future Development' zone, pursuant to the Shire of Augusta - Margaret River Local Planning Scheme No 1.

The proposed Structure Plan identifies site conditions and constraints and provides the envisaged residential layout over the land, including intended land use areas, residential density and indicative lot boundaries. It has been prepared in accordance with the relevant planning framework and will provide appropriate guidance to future subdivision and development assessment of the land.

APPENDICES INDEX

Appendix A: Site and Soil Evaluation Report
Appendix B: Bushfire Management Plan
Appendix C: Transportation Noise Assessment
Appendix D: Environmental Assessment Report
Appendix E: Servicing and Electrical Report

Appendix A

Site and Soil Evaluation

Prepared by Environmental & Landscape Management

2023

Site and Soil Evaluation Lots 4, 5 and 31 Darch Road, Margaret River



Environmental & Landscape Management

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DOCUMENT STATUS

STATUS	DATE	ISSUED
Original	28 April 2023	SJS
Amended	4 May 2023	SJS
Amended	15 May 2023	SJS
Amended	23 May 2024	SJS

2. INTRODUCTION

Lots 4, 5 and 31 Darch Road, Margaret River, are being considered for subdivision. The Shire of Augusta-Margaret River generally requires that a site and soil evaluation be undertaken. The site is located approximately 3.7 kilometres south-east of the Margaret River town centre. The site location and context is shown in Figure 1 below.



Figure 1: Site context (image courtesy of the Shire of Augusta Margaret River online mapping).

SCOPE OF REPORT

The consultant was asked to provide an assessment of the soils to determine the suitability of the site for disposal of wastewater using either a conventional septic tank system or Secondary Treatment System (STS). The assessment has been carried out in accordance with the requirements of AS1547:2012 On-site domestic wastewater management.

3. BACKGROUND

WASTEWATER DISPOSAL

A number of options are available for wastewater disposal depending on the suitability of the site. The easiest and cheapest option to install consists of a septic tank with leach drains. Another option includes the use of a Secondary Treatment System (STS). Both of these options are controlled under Regulations or a Code of Practice overseen by the Health Department of WA.

The local government generally requires that a number of issues are addressed in such assessments to determine if the development proposal sites are suitable for effective disposal of wastewater. These issues include:

1. Depth to highest ground water from ground level;
2. Depth to bedrock or impervious clay;
3. Depth of free draining soil;
4. Set back from water bodies;
5. Soil structure and profile to a depth of 2 metres or more;
6. Phosphate Retention Index to 1 metre;

7. Infiltration rate of the soil (L/m²/day).

The State Government has adopted the Government Sewerage Policy in September 2019. The policy outlines the state government's position on the provision of reticulated sewerage for the rezoning, structure planning, subdivision and development of land. The policy seeks to promote reticulated sewerage over other forms of on-site treatment. The policy adopts a risk management approach to sewage management that is consistent with Australian/New Zealand Standard 1547 On-site domestic wastewater management. This risk management approach is to be used for guidance when assessing planning proposals where on-site sewage disposal is proposed.

The policy further sets out minimum requirements for on-site sewage disposal with regard to separation to groundwater, groundwater source areas, private bores, waterways, significant wetlands, surface drains and areas subject to flooding. Schedules attached to the policy outline the supporting information that is required where on-site sewage disposal is proposed.

The Australian Standard (AS1547:2012) On-site domestic wastewater management outlines a risk management process and details the various roles that are required to carry out assessments at a range of scales from planning stage to implementation. The process for site and soil evaluation is set out within the standard with performance requirements, a general methodology and soil categorisation with further details outlined in a number of appendices attached to the standard.

4. THE STUDY AREA

TENURE AND VESTING

The overall site consists of 3 lots, as shown in Table 1.

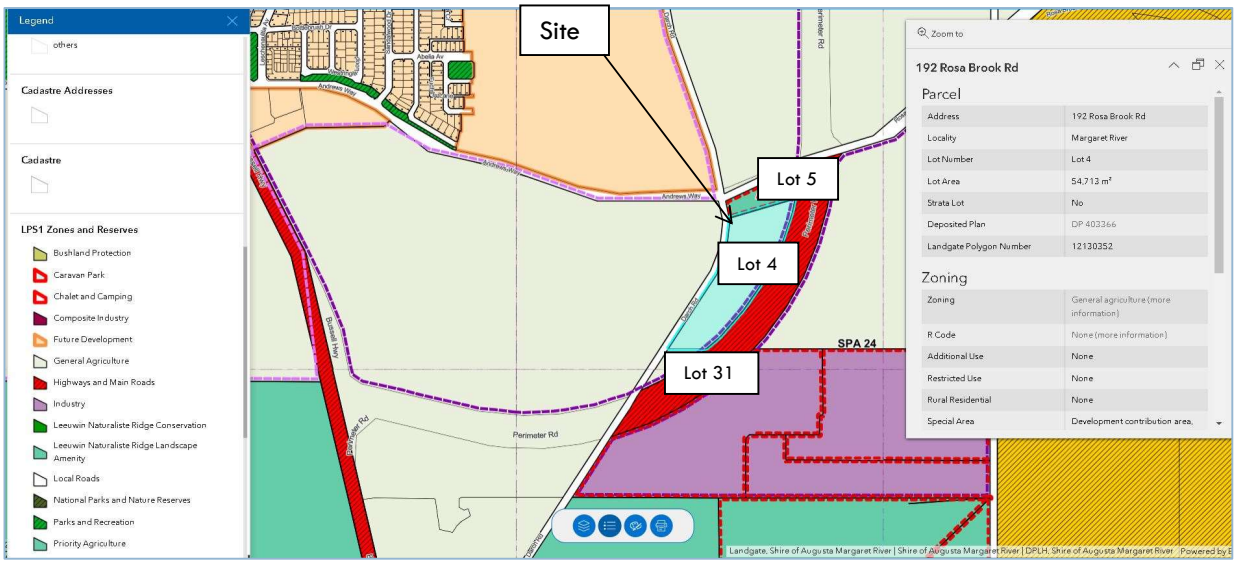


Figure 2: Town Planning Scheme zoning for the lot under consideration (source: Shire of Augusta-Margaret River)

LOT/NUMBER	SIZE	ZONING
Lot 5/Number 200 Darch Road	13,392m²	Priority Agriculture, Additional use A55, SPA5
Lot 4/Number 192 Rosa Brook Road	54,713m²	General Agriculture, SPA5
Lot 31, 164 Darch Road	7,275m²	General Agriculture, SPA5

The overall site is 7.54 hectares in size and the additional use A55 for Lot 5 allows for the establishment of 3 chalets. Structure Plan Area 5 (SPA5) relates to the town site expansion in general accordance of the East Margaret River District Structure Plan 2015.

HISTORICAL LAND USE

The site is likely to have been used for agriculture as part of a larger farm.

ADJACENT LAND USE

The site is located adjacent other rural lots that are also available for future development, and the Margaret River perimeter road.

5. THE NATURAL ENVIRONMENT

THE PHYSICAL ENVIRONMENT

LANDFORM

The site is located on the Leeuwin Block, a narrow area along the coast between Cape Naturaliste and Cape Leeuwin, which is dominated by a gently undulating lateritic plateau (Department of Agriculture, 2003). The plateau is dissected by a series of valley systems and has formed on lateritized granitic and gneissic basement rock (Tille and Lantzke, 1990).

LOCAL SOILS/GEOLOGY

Soils over the majority of the site are dominated by the Cowaramup wet vales phase (COvw) (DPIRD, 2023). These soils occur on broad, swampy floored drainage depressions on weathered mantle over granite in the Margaret River district between Dunsborough and Augusta. Soils are typically wet and semi-wet soils, grey deep sandy duplexes, loamy gravels and duplex sandy gravels. Typical vegetation includes marri, jarrah, paperbark and tea tree woodland and forest.

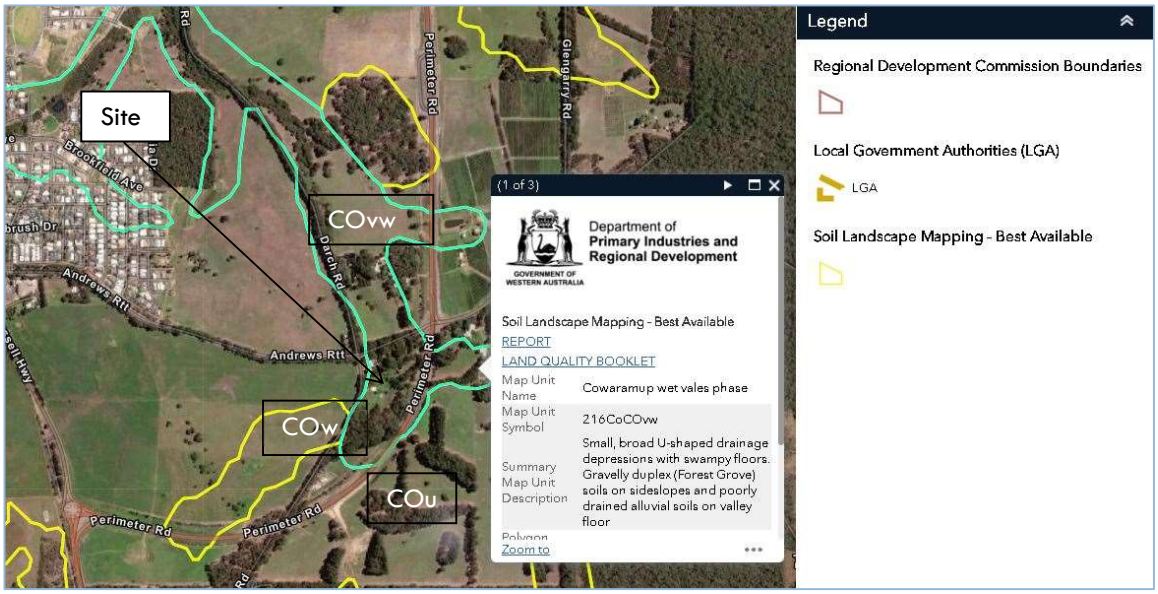


Figure 3: Delineation of soil classifications across the overall site (DPIRD, 2023).

The soils across the south western end of the site are characterized as the Cowaramup undifferentiated uplands phase (COu) (DPIRD, 2023). These soils occur on lateritic flats, low rises and gentle slopes on weathered mantle over granitic rocks in the Margaret River district between Eagle Bay and Augusta. Soils are generally loamy gravels, duplex sandy gravels, semi-wet soils and grey deep sandy duplexes. Typical vegetation includes marri-jarrah forest and woodland. There is a very high risk of phosphorous export for 4% of soils within this soil classification. Around 4% of the soil type has a high risk of waterlogging.

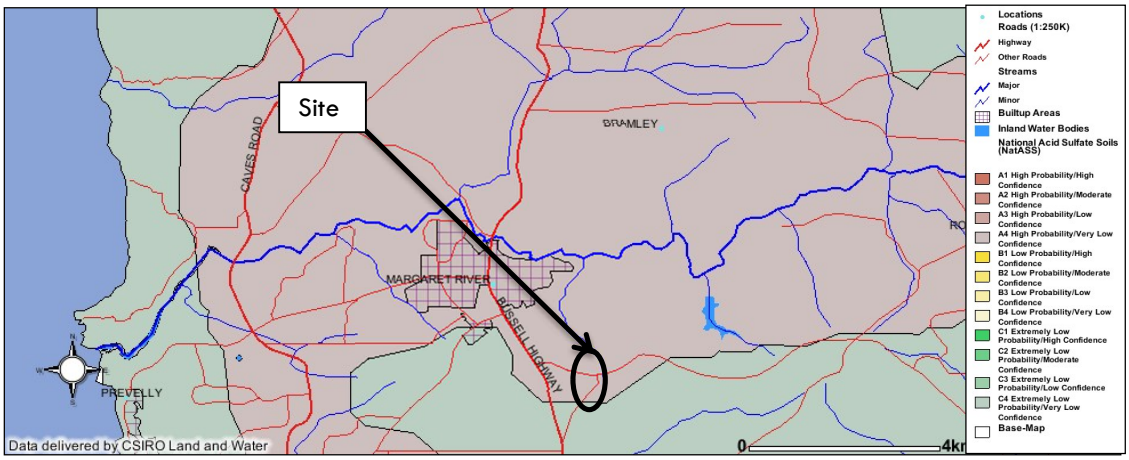


Figure 4: Acid sulphate soils risk in the local area (image courtesy of ASRIS, 2023).

There is a high probability with low confidence of acid sulphate soils (see Figure 4) occurring across the site (ASRIS, 2023). No testing for the presence of Acid Sulphate Soils was undertaken for the site.

HYDROLOGY

The overall area of the lot has a moderate slope and is approximately 88 to 94 metres above sea level. This equates to a slope of approximately 1.1% across the combined lots.

The site is located approximately 3.2 kilometres from the Margaret River. A tributary of the Darch Brook originates on the northern boundary of the property. There is minimal risk of flooding across the site according to mapping provided by the Department of Primary Industries and Regional Development (see Figure 6).



Figure 5: Contours across the site (source: DPIRD)

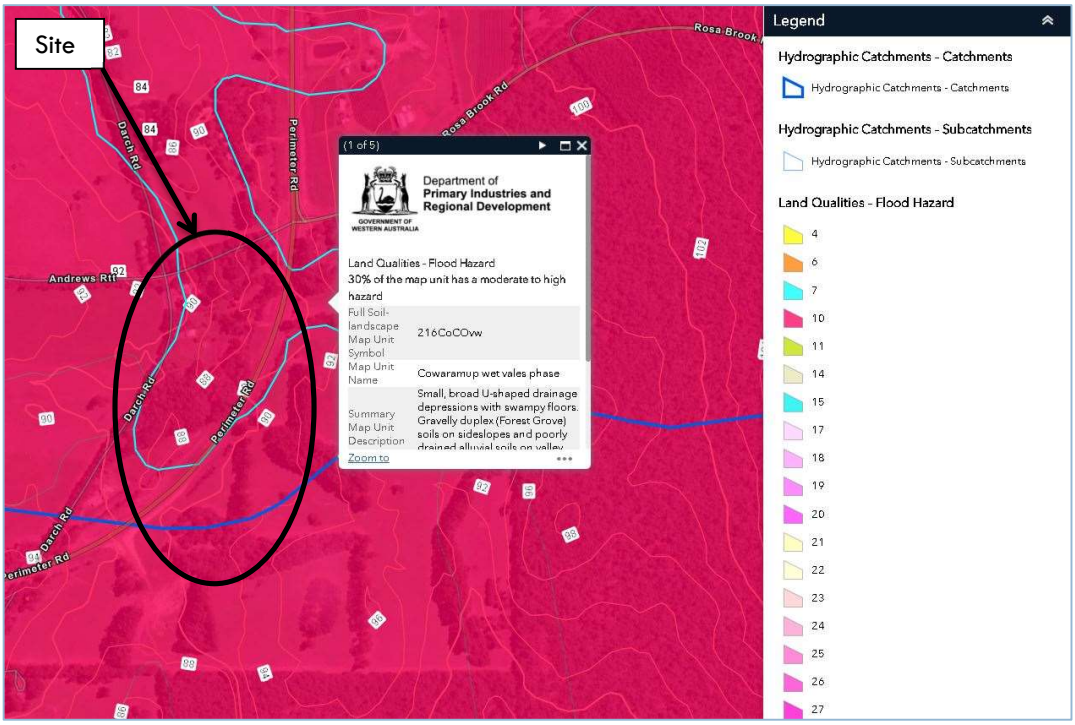


Figure 6: Nearby areas with increased flood hazard (source: DPIRD).

COMMENT ON FLOOD HAZARD RISK

Flood hazard mapping prepared by DPIRD (2023) is shown in Figure 6. The majority of the site is outside any major flooding risk, although there is a moderate to high hazard of some flooding for 30% of Cowaramup wet vales phase soil unit (CoCOvw – see Figure 3).

There are no Environmentally Sensitive Areas on or near the site (see Figure 8).

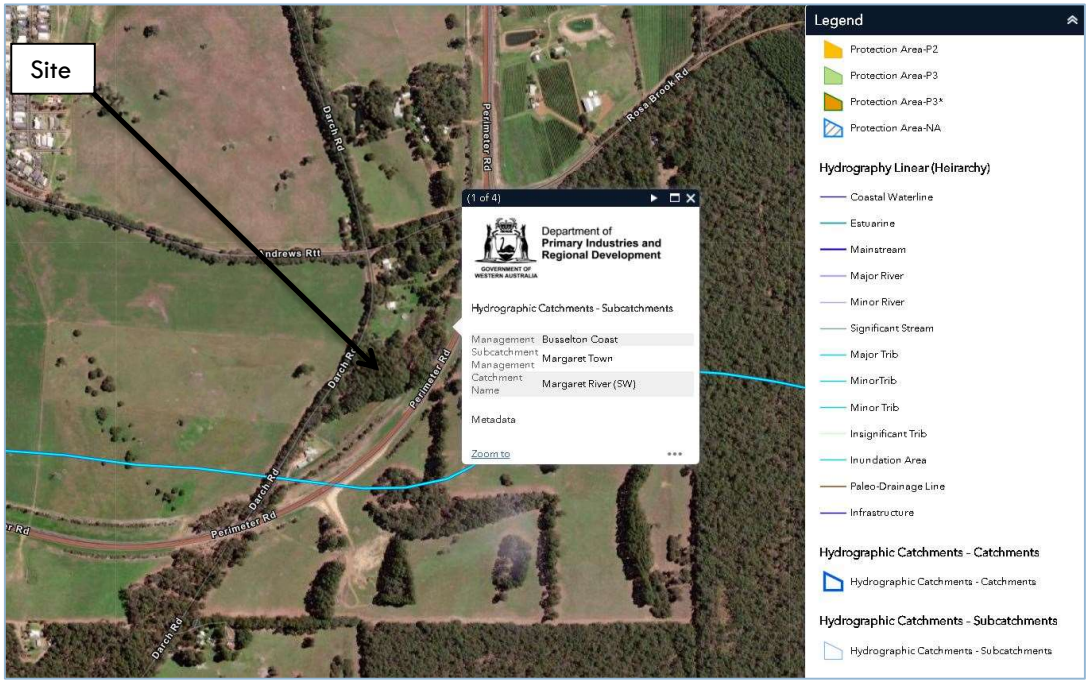


Figure 7: Local catchments



Figure 8: Environmentally Sensitive Area near the site (image courtesy of Department of Water).

LOCAL INFRASTRUCTURE

Reticulated sewerage is not available in the local area, nor is it planned

Table 1: Summary description of the site and/or development.

Development Characteristic	Description
Site Address	Lots 4, 5 and 31 Darch Road
Owner/Developer	Neville and Kerrie Veitch
Local Government	Shire of Augusta-Margaret River
Zoning	Priority and General Agriculture
Lot size	75,380 m²

Proposal	Subdivision into twelve lots
Water Supply	Water tank, scheme likely to be available at some point in the future
Anticipated Wastewater Load	Calculations in Section 8
Availability of Sewer	The area is unsewered and highly unlikely to be sewered for several years, if at all.
Development located within (tick as appropriate)	☐ Public drinking water source area ☐ Sewage sensitive area ☑ Neither

6. SITE ASSESSMENT

METHODOLOGY

The initial site investigation took place on November 23, 2022. A total of 4 test pits were dug with an excavator, aiming for a depth of at least 2 m. During the assessment, permeability determination was undertaken with a hand auger. Soil samples were randomly selected from the excavated spoil, but typically from the middle to lower areas of the soil profile. Topsoil was not included.

Location of test pits excavated during the initial assessment is shown in the image below (Figure 9).



Figure 9: Test pit locations (image courtesy Google Earth).

7. RESULTS

METHODS

The site's soils have been assessed for their capability for onsite sewage management by a combination of soil survey, permeability studies, laboratory assessment and a desktop review of published soil survey information as outlined in the pages that follow.

RESULTS

PUBLISHED SOILS INFORMATION

Suspected soils of the site have been investigated via a number of web-based sites (such as Dept. Primary Industries and Regional Development) and publications such as "Geology and soils of the Margaret River wine region".

From Figures 10 to 13, soils typically found in the region are sandy gravel, loamy gravel and grey sandy duplexes – as part of the Cowaramup Uplands System.

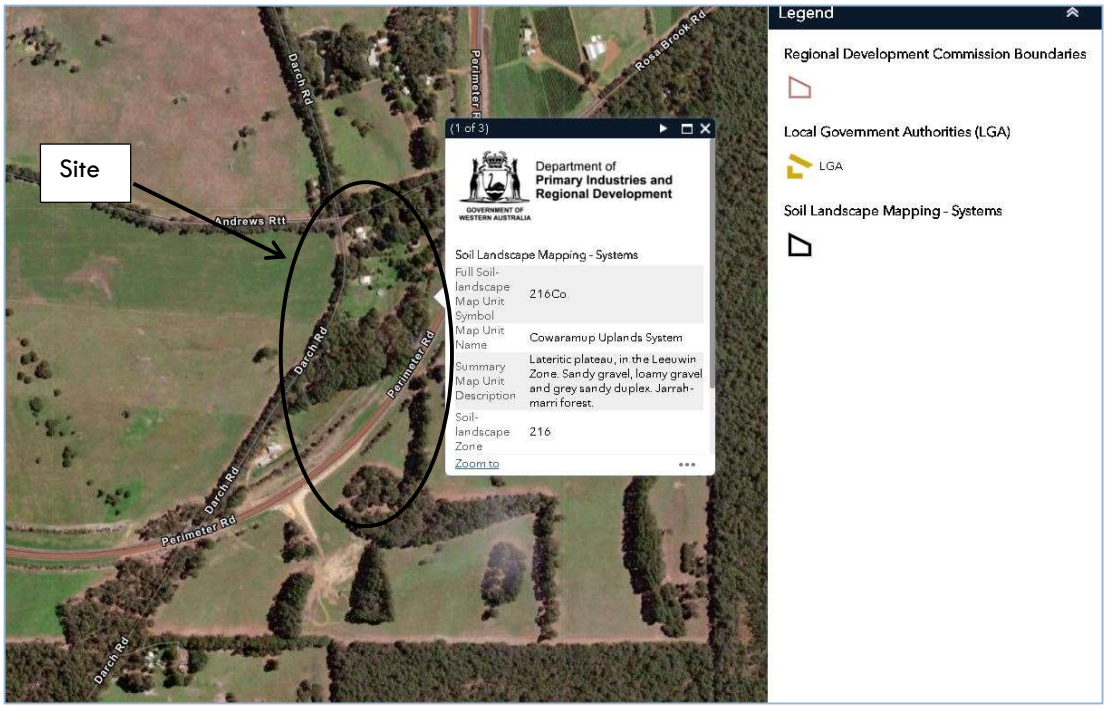


Figure 10: Geology of the area. Area marked. Source DPIRD.

The Leeuwin zone (Figure 11) consists of a moderately dissected lateritic plateau on granite, with colluvium in valleys and Tamala limestone over the granite on the western margin with sand dunes.

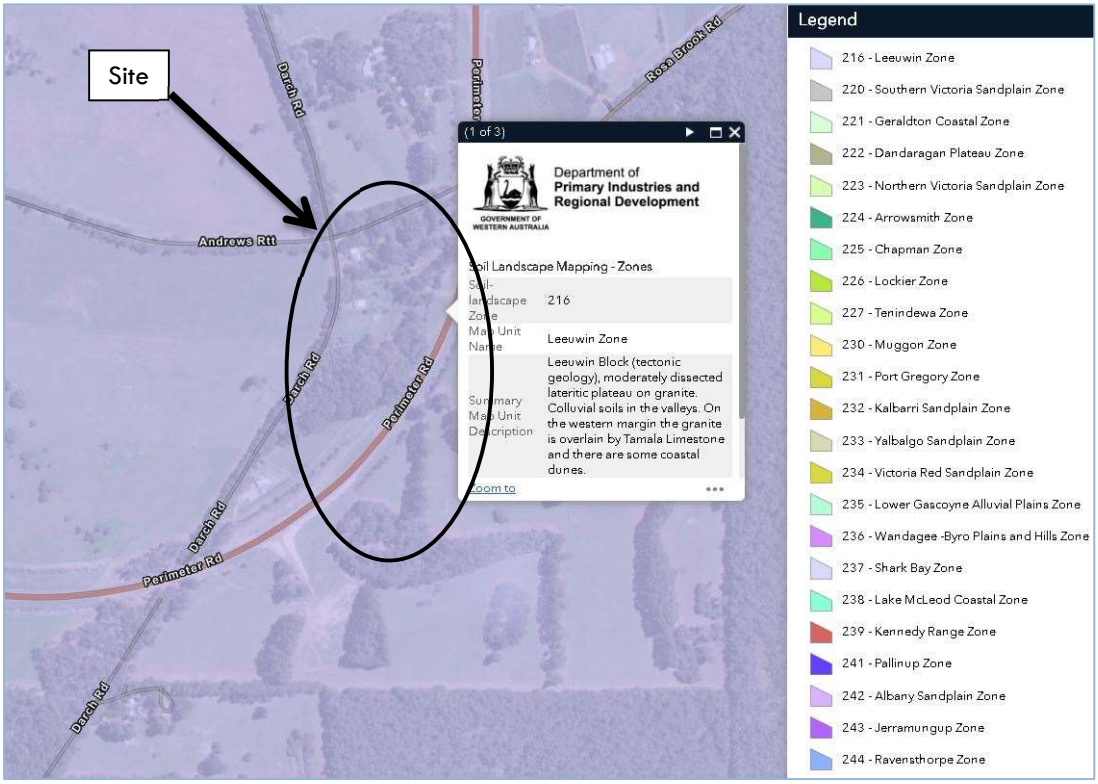


Figure 11: Soil landscape zones. Source: Natural Resource Information. DPIRD.

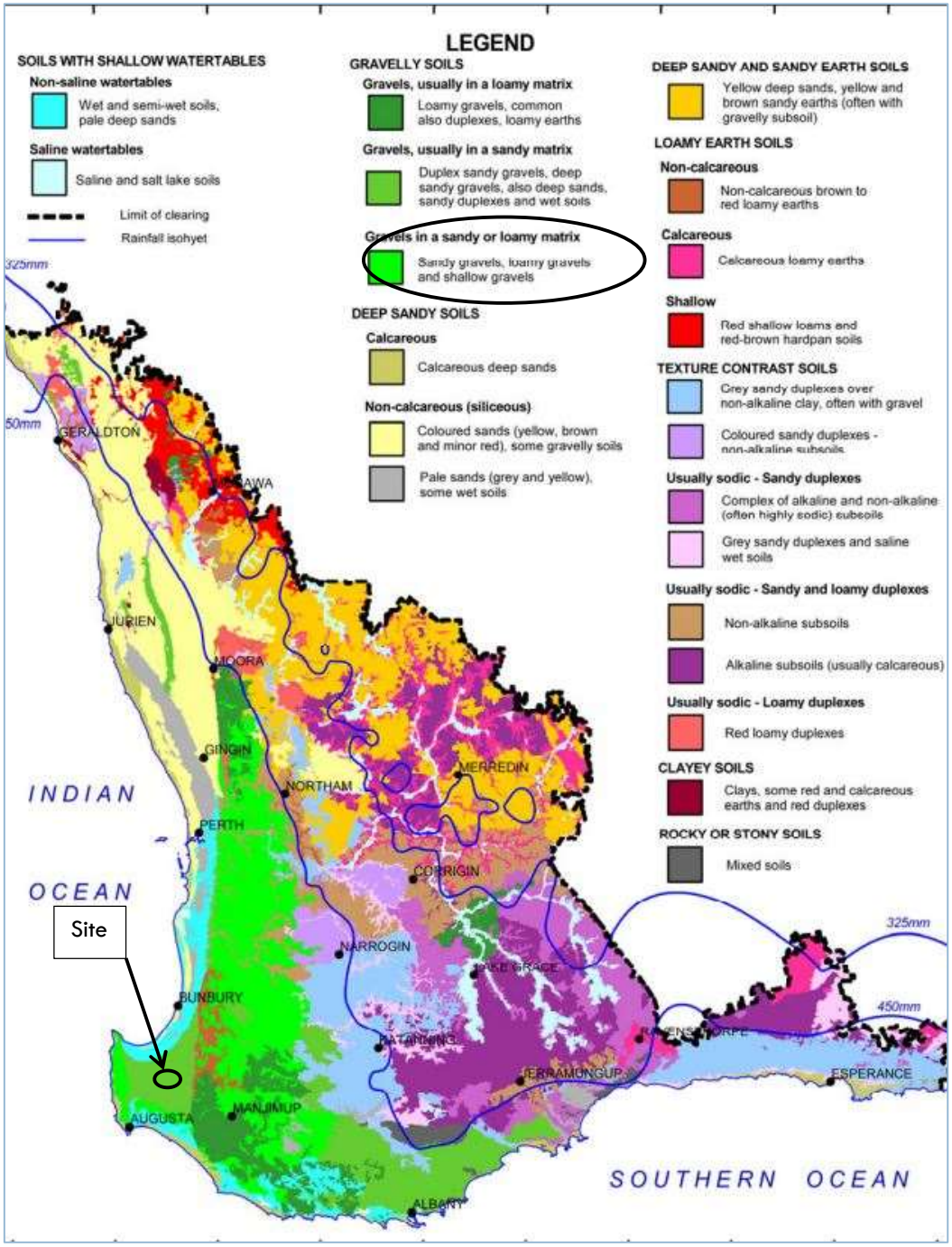
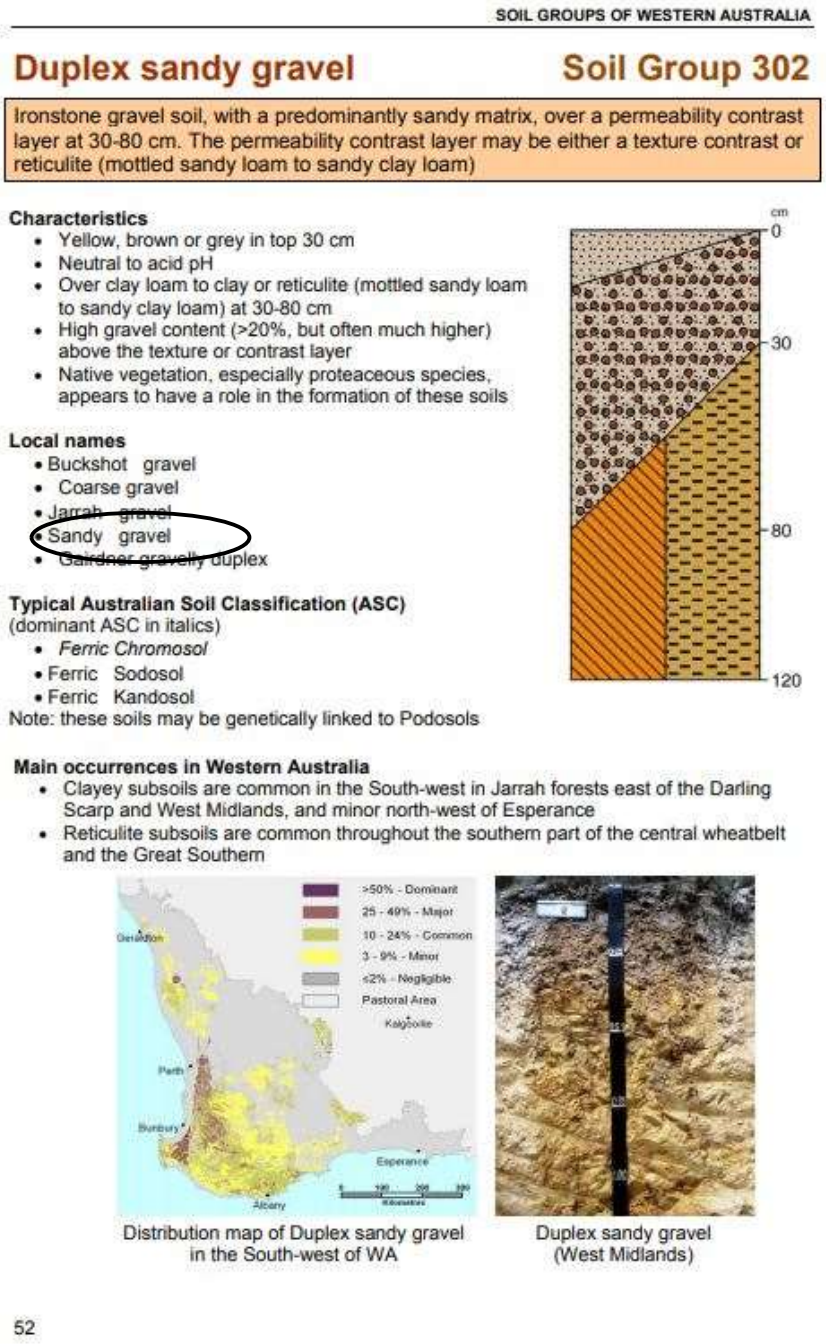


Figure 12: Soil groups in the south-west. Source: DPIRD.

The Cowaramup Uplands System consists of a lateritic plateau of the Leeuwin zone, with ironstone gravel soils with a predominantly loamy matrix.

Soils were also classified in accordance with the Dept. of Agriculture and Food publication "Soil Groups of Western Australia" as shown in Figure 12 – see references. Soil is determined as loamy gravel.



SOIL GROUPS OF WESTERN AUSTRALIA

Duplex sandy gravel — Soil Group 302

Ironstone gravel soil, with a predominantly sandy matrix, over a permeability contrast layer at 30-80 cm. The permeability contrast layer may be either a texture contrast or reticulite (mottled sandy loam to sandy clay loam)

Characteristics

- Yellow, brown or grey in top 30 cm
- Neutral to acid pH
- Over clay loam to clay or reticulite (mottled sandy loam to sandy clay loam) at 30-80 cm
- High gravel content (>20%, but often much higher) above the texture or contrast layer
- Native vegetation, especially proteaceous species, appears to have a role in the formation of these soils

cm 0 30 80 120

Local names

- Buckshot gravel
- Coarse gravel
- Jarrah gravel
- Sandy gravel
- Gairdner gravelly duplex

Typical Australian Soil Classification (ASC)
(dominant ASC in italics)

- *Ferric Chromosol*
- Ferric Sodosol
- Ferric Kandosol

Note: these soils may be genetically linked to Podosols

Main occurrences in Western Australia

- Clayey subsoils are common in the South-west in Jarrah forests east of the Darling Scarp and West Midlands, and minor north-west of Esperance
- Reticulite subsoils are common throughout the southern part of the central wheatbelt and the Great Southern

Distribution map of Duplex sandy gravel in the South-west of WA

Duplex sandy gravel (West Midlands)

52

Figure 13: Characteristics of pale sandy earths and wet soils.

SOIL SURVEY AND ANALYSIS

A soil survey was carried out at the site to determine capability for the application of treated effluent. Soil investigations were conducted at four locations, as shown in Figure 9, using excavator-dug test pits (TP1 to TP4) endeavouring to reach 2 m depth. The soils were similar in the test pits, so only minor variations would be expected throughout the area of interest. The same soil type was encountered in these investigations, with minor differences in their content. Soil descriptions are provided in the relevant sections that follow.

A soil permeameter test was undertaken at the same time and soil from this location was sent to the CSBP soil testing laboratory. The subsequent laboratory analysis included pH, electrical conductivity, nutrient content, Phosphorus Retention Index and Emerson Aggregate Class or similar dispersion test. Various tables in each section describe the soil constraints in detail for the soils encountered.

MUNSELL SOIL COLOUR

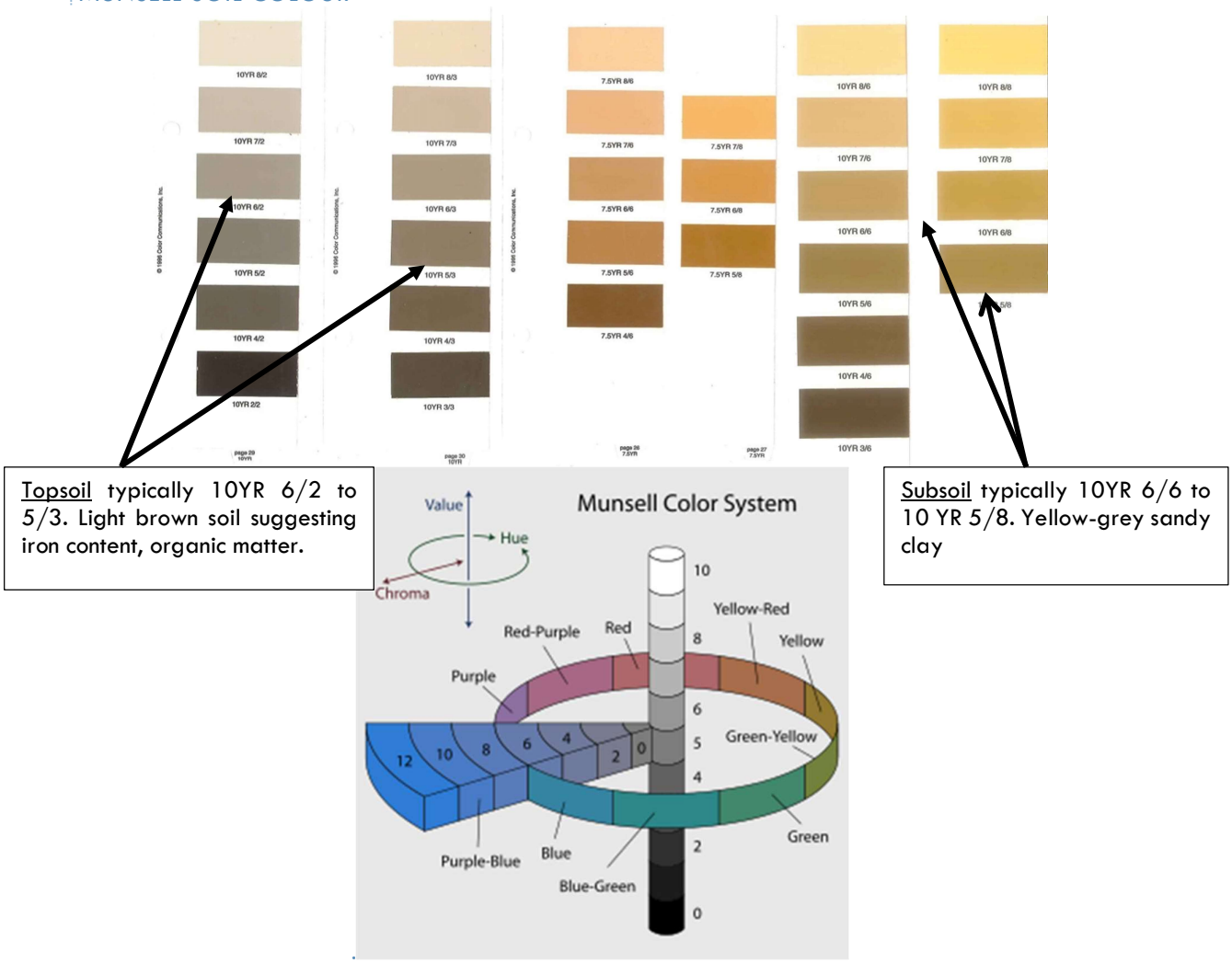


Figure 14: Typical colours of soils present on site

CLIMATE

The southwest region of Western Australia experiences a Mediterranean climate with warm dry summers and cool wet winters. The closest weather monitoring station is based at Witchcliffe. The average annual rainfall recorded at the station is 971.8 mm, with most of the rain falling between April and October (Bureau of Meteorology, 2023). The average daily temperature is between 10.7 and 21.3 degrees.

HYDROLOGY

A review of published literature was used to assess any possible constraints about the site, and then to make recommendations of appropriate wastewater treatment and land application areas.

In particular, the Government Sewerage Policy (GSP) requires that an onsite sewage system is not to be located within any area subject to inundation and/or flooding in a 10 percent Annual Exceedance Probability (AEP) rainfall event.

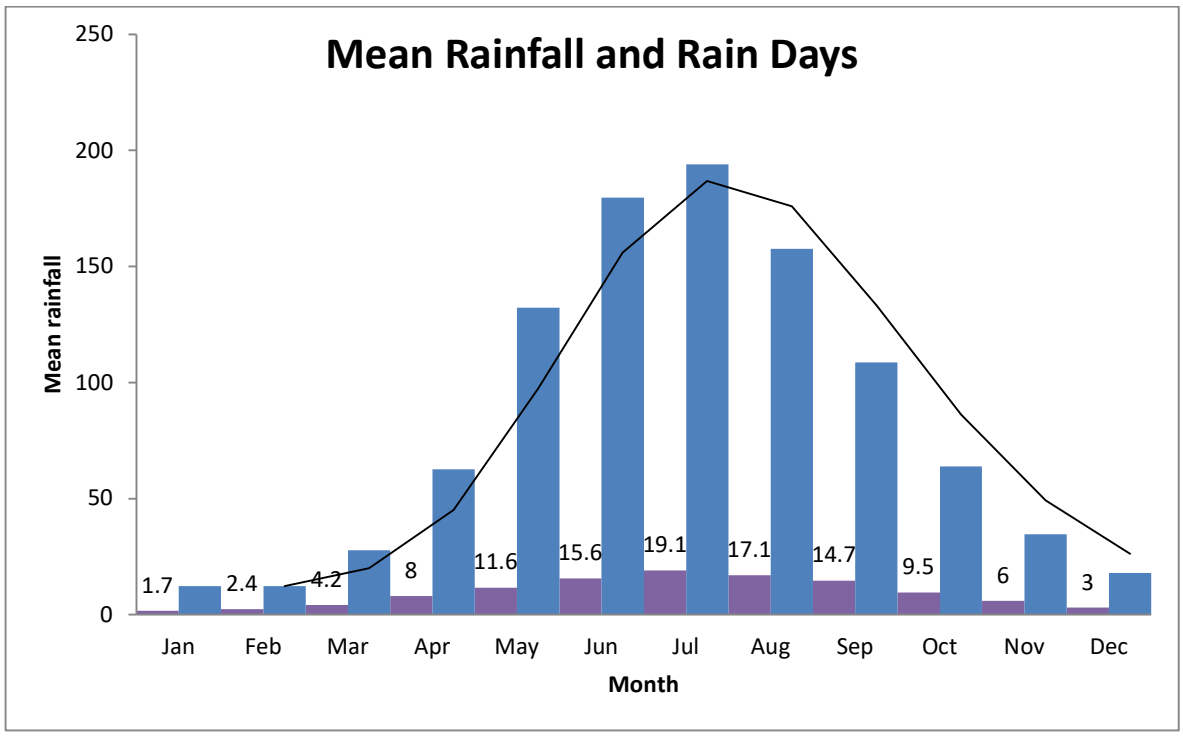


Figure 15: Average monthly rainfall for Witchcliffe

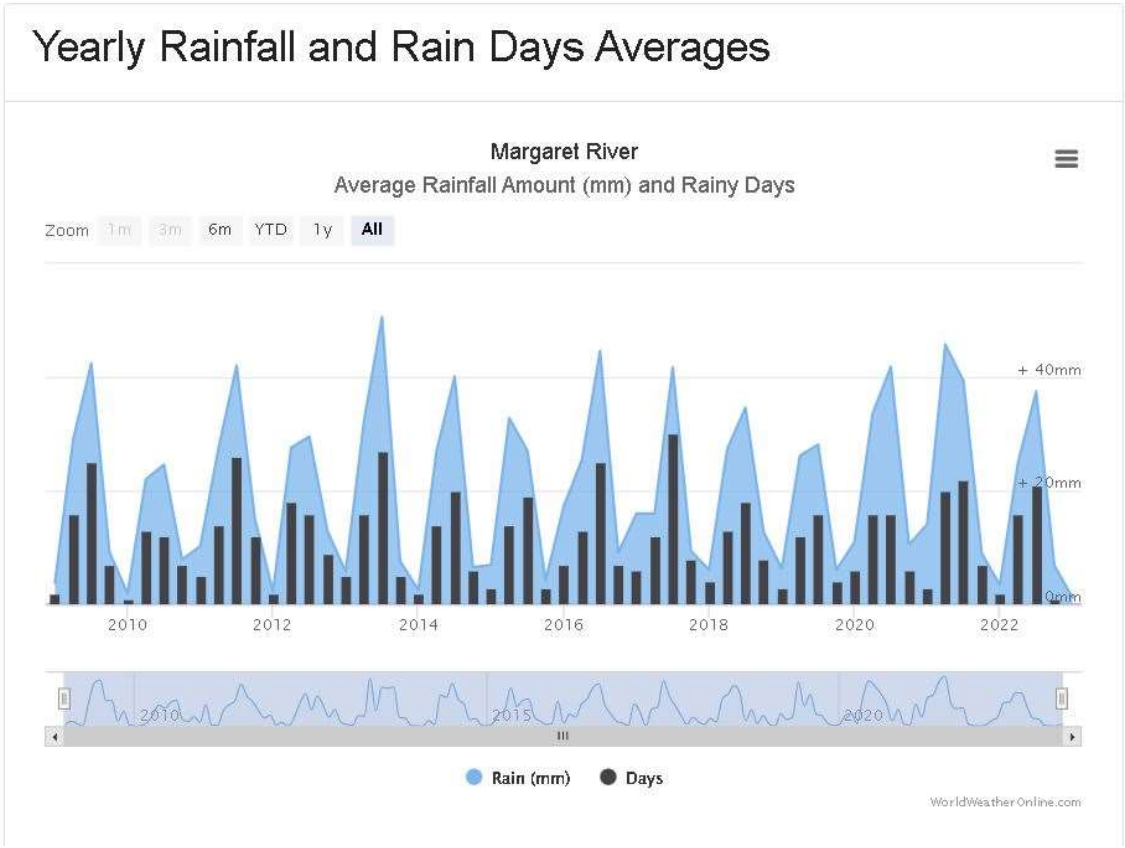


Figure 16: Typical rainfall amount and rainy days for Margaret River

From Figures 15, 16 and 17 it is clear that most rainfall falls in winter but rainfall does fall in every month, and this pattern is consistent from year to year. Furthermore, even in winter, the number of rainy days rarely exceeds 24 or about three-quarters of each month. Annual rainfall is 979.8 mm at Witchcliffe, and number of rainy days = 170.3.

Witchcliffe Long-term Averages

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Max (°C)	26.7	27.1	25.5	22.5	19.7	17.5	16.4	16.8	17.5	19.6	22.7	25.1	**21.3**
Mean Min (°C)	13.9	14.4	13.2	11.3	9.7	8.9	8.2	8.3	8.6	9.4	10.9	12.5	**10.7**
Mean Rain (mm)	11.4	11.8	28.1	64.0	135.6	181.9	198.4	162.9	113.3	63.8	34.8	15.9	**979.8**
Median Rain (mm)	5.4	6.7	26.4	57.0	118.6	148.6	197.8	149.8	103.6	56.9	31.4	8.2	**958.1**
Mean Rain Days	3.7	4.9	8.2	14.2	19.3	21.3	24.0	23.3	20.2	16.7	10.1	6.9	**170.3**

Figure 17: Witchcliffe long-term climate averages.

Information for flood hazard risk (Natural Resource Information) and Sewage sensitive areas (Dept Planning, Lands and Heritage) is shown later. There are no records of the site in the Perth groundwater map (Dept. Water website).

Peak flows for various ARI events and the Intensity Frequency Duration (IFD) data for Margaret River is shown in Figures 18 and 19. With a duration of 5 minutes, and the probability of a severe rainfall event as 10% (AEP 10), then the graph and table suggest a Design Rainfall Depth of about 11.5 mm. This is likely to be higher as storm events are considered, than the anticipated maximum rainfall intensity for Witchcliffe Maximum Rainfall of about 197.8 mm for July = 6.4 mm/day average or 8.3 mm/rainy day.

Location

Label: Darch Road, Margaret River

Latitude: 33.997 [Nearest grid cell: 33.9875 (S)]

Longitude: -115.099 [Nearest grid cell: 115.0875 (E)]



IFD Design Rainfall Depth (mm)

Issued: 19 April 2023

Rainfall depth for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP)

FAQ for New ARR probability terminology

Table | Chart

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	2.20	2.43	3.15	3.66	4.18	4.89	5.46
2 min	3.75	4.09	5.25	6.12	7.02	8.22	9.19
3 min	5.02	5.49	7.06	8.21	9.40	11.0	12.3
4 min	6.07	6.66	8.59	9.98	11.4	13.3	14.9
5 min	6.97	7.65	9.90	11.5	13.1	15.3	17.1
10 min	10.1	11.1	14.5	16.8	19.2	22.4	25.0
15 min	12.1	13.3	17.4	20.2	23.1	27.0	30.2
20 min	13.6	15.0	19.5	22.7	25.9	30.4	34.0
25 min	14.8	16.3	21.2	24.6	28.2	33.1	37.0
30 min	15.8	17.4	22.6	26.3	30.1	35.3	39.6
45 min	18.2	19.9	25.8	30.0	34.4	40.5	45.4
1 hour	20.0	21.9	28.3	32.9	37.7	44.4	49.8

Design rainfall depth at 10% AEP and storm duration 5 mins.

Figure 18: Rainfall depth for duration for Annual Exceedance Probabilities (AEP).

Given an AEP 10% and storm duration of 5 minutes then the anticipated rainfall intensity is 138 mm/hr as calculated below. Using this value and the runoff coefficient for a grassed area (Figure 20) then a runoff flow value can be calculated. The catchment area is deemed to be about the size of one zone of the LAA so that the impact of a severe rainfall event can be determined.

Rainfall intensity = Design rainfall depth (mm) Duration = 5 mins = 0.0833 hr
Duration (hrs)

Rainfall intensity = $\frac{11.5}{0.0833}$ = 138 mm/hr

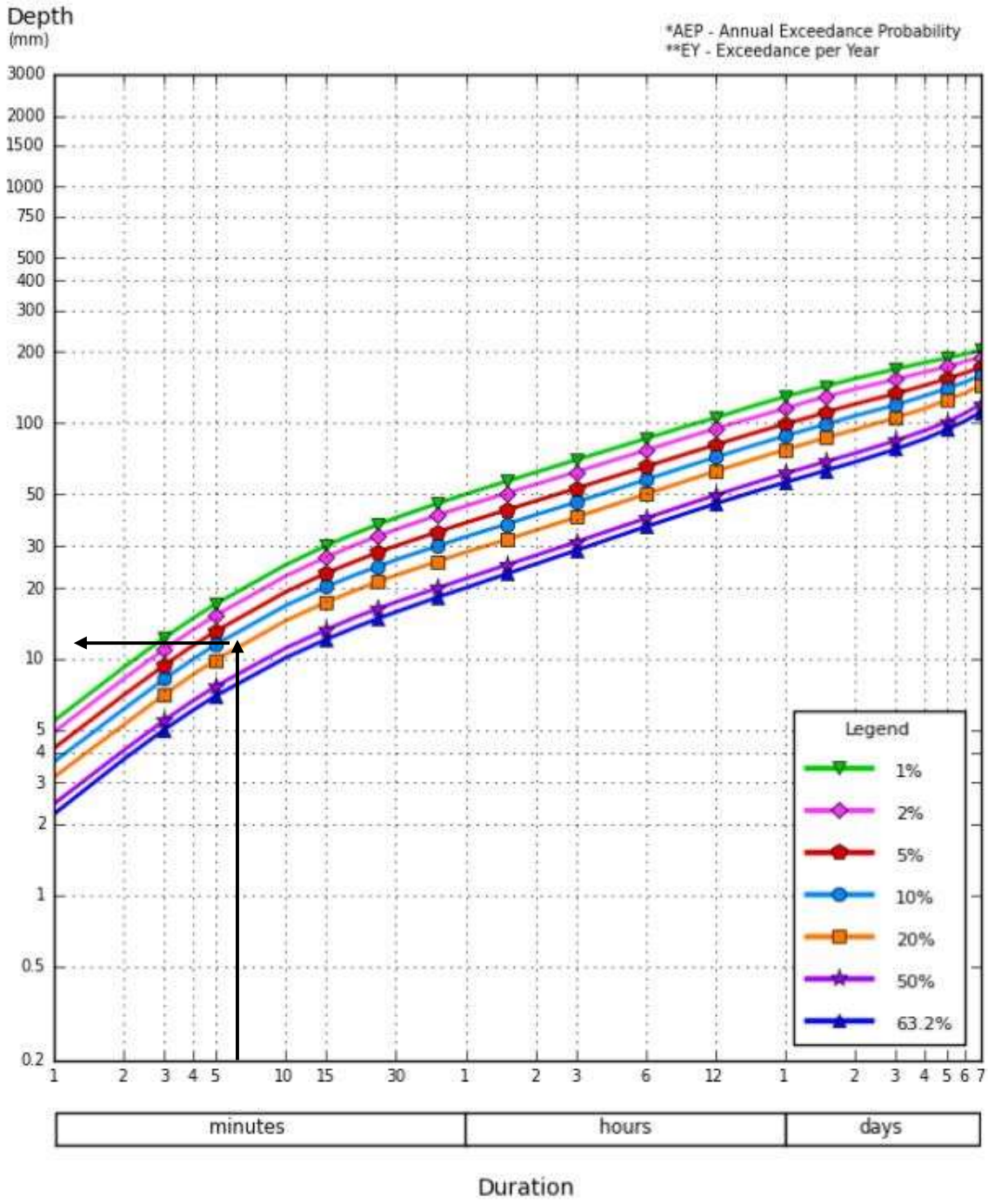


Figure 19: Graph of Design Rainfall Depth (mm) at various AEP levels.

COEFFICIENT OF RUNOFF : RUNOFF / RAINFALL

SOIL TEXTURE	COEFFICIENT OF RU
Concrete, Roof, or Asphalt	1.00
Clay – Bare	0.70
Clay – Light Vegetation	0.60
Clay – Dense Vegetation	0.50
Gravel – Bare	0.65
Gravel – Light Vegetation	0.50
Gravel – Dense Vegetation	0.40
Loam – Bare	0.60
Loam – Light Vegetation	0.45
Loam – Dense Vegetation	0.35
Sand – Bare	0.50
Sand – Light Vegetation	0.40
Sand – Dense Vegetation	0.30
Grass Areas	0.35

Runoff flow (L/s) = CIA/3600
Where:-
C = Coefficient of runoff, I = Rainfall Intensity (mm/hr), A = Catchment Area (m^2)
C = 0.35 (grass areas), I = 138 mm/hr and A = 225 m^2 (proposed LAA)

$$\text{Runoff Flow} = \frac{0.35 \times 138 \times 225}{3600} = 3.00 \text{ L/s}$$

With a slope of about 0.5-1º then the velocity of water movement across the sandy loam grassed-covered landscape would be less than 1 m/s (assuming width of irrigation area 10 m and 10 mm depth of water).
This poses no threat to the land application area, as water will be able to drain away through the natural ground.

Figure 20: Runoff coefficients for soils.

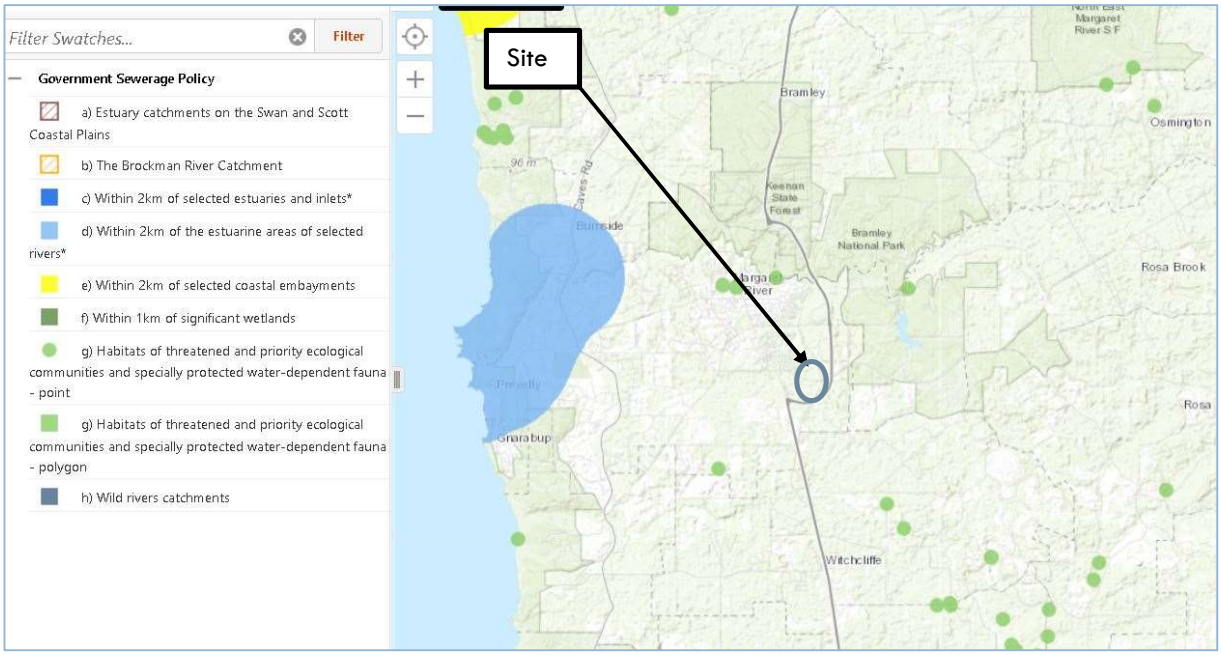


Figure 21: Sewage sensitive areas. Source: DPL&H.

COMMENT ON SSA

As indicated in Figure 21 the site is not within a sewage sensitive area.

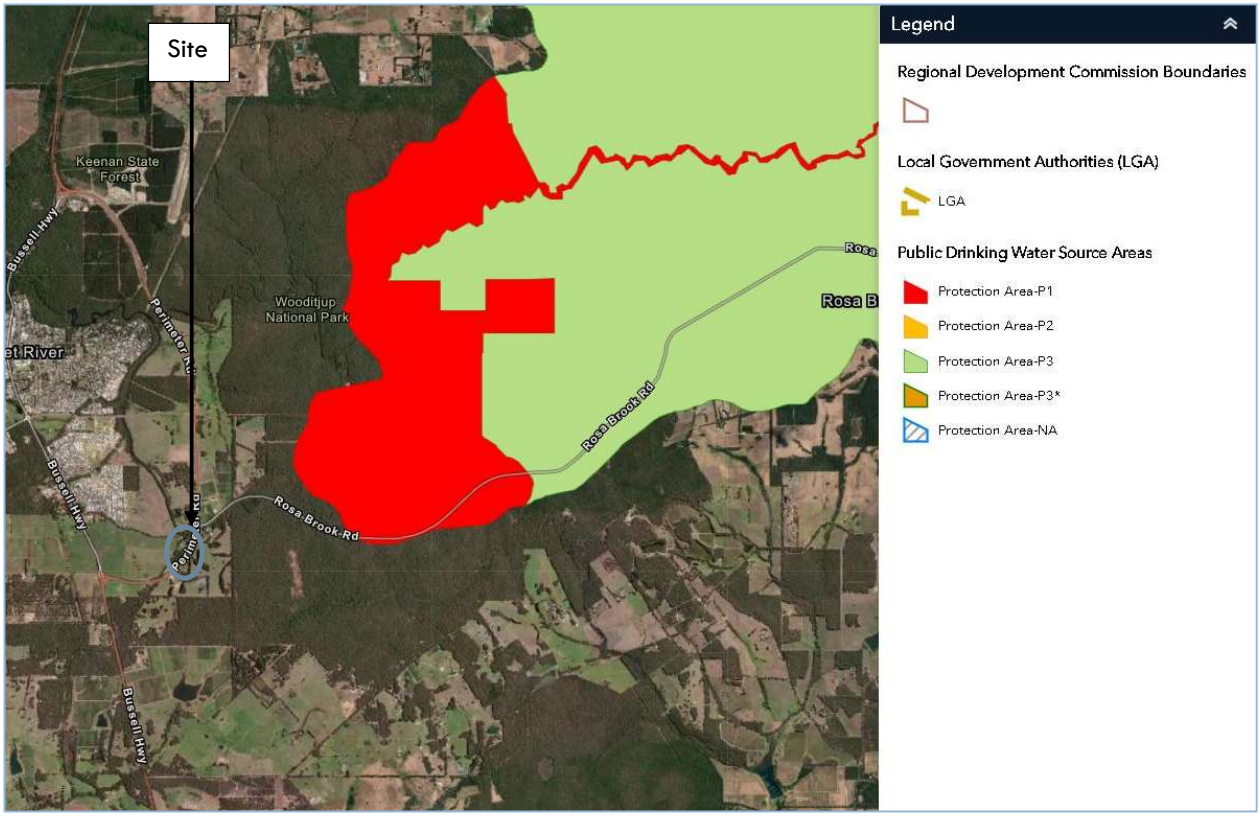


Figure 22: Public drinking water source areas. Source: DPIRD.

COMMENT ON PUBLIC DRINKING WATER SOURCE AREAS.

As indicated in Figure 22 the site is not within a public drinking water source area.

GROUNDWATER MONITORING

Groundwater monitoring was carried out during the initial assessment and groundwater was observed in each of the test pits at around 2 metres depth.

SOIL TESTING RESULTS

Table 2: Laboratory Test results. CSBP Bibra Lake.

	UNITS	RESULTS			
		TP 1	TP 2	TP 3	TP 4
Colour		YWGR	GR	GR	GR
Gravel	%	15-20	0	0	15-20
Texture		2.5	1	1	1.5
Ammonium nitrogen	mg/kg	< 1	< 1	< 1	1
Nitrate nitrogen	mg/kg	3	< 1	< 1	5
Phosphorous Colwell	mg/kg	6	46	4	7
Potassium Colwell	mg/kg	32	16	< 15	< 15
Sulfur	mg/kg	20	0.9	2.9	9.1
Organic Carbon	%	0.98	0.32	0.39	1.08
Conductivity	dS/m	0.04	0.015	0.014	0.034
pH level (CaCl2)		5	5.2	5	4.6
pH level (H2O)		5.7	6.4	5.8	5.3
DTPA Copper	mg/kg	0.33	0.25	0.2	0.69
DTPA Iron	mg/kg	12.8	23.8	6.1	84.6
DTPA Manganese	mg/kg	2.36	0.6	0.18	0.36
DTPA Zinc	mg/kg	0.21	0.24	0.12	0.23
Exc. Aluminium	meq/100g	0.223	0.115	0.227	1.033
Exc. Calcium	meq/100g	1.62	1.05	0.21	0.89
Exc. Magnesium	meq/100g	1	0.36	0.04	0.48
Exc. Potassium	meq/100g	0.12	0.05	0.01	0.04
Exc. Sodium	meq/100g	0.27	0.04	0.04	0.15
Boron Hot CaCl2	mg/kg	0.57	0.21	0.17	0.39
Phosphorous Retention Index		> 1000.0	6.9	20.2	168.8
Dispersion Index		0	10	11	10

GENERAL COMMENTS

Soils in general are slightly acidic, moderately high in iron, with mostly a very high phosphorus retention index. Dispersion index = 0 for the first soil test pit, with the remaining pits at around 10 (some dispersion possible). Nutrients are moderate or low, with moderate levels of phosphorous and potassium. Soil is typically sand or loam (CSBP = 1-2.5), gravel is 0 to 20 %. Results for cations calcium and magnesium were used to compare to sodium to enable Sodium Absorption Ratio (SAR) to be calculated. SAR is used to determine the sodicity of a soil and an assessment of any dispersion of clay aggregates. No dispersion is found in soils with a SAR value less than 3. The exchangeable sodium percentage (ESP) measures the proportion of cation exchange sites occupied by sodium. Soils are considered sodic when the ESP is greater than 6% and highly sodic when the ESP is greater than 15%. Calculations in Table 3 suggest sodicity is not likely to be an issue for any of the test pits. The jar tests as shown in the section that follows indicates that gypsum will be an effective treatment for dispersion.

$$SAR = \frac{[Na]}{\sqrt{\tfrac{1}{2}[Ca + Mg]}}$$

$$ESP = \frac{[Na] \times 100}{[Ca + Mg + K + Na]}$$

Table 3: Calculations of SAR and ESP values.

SAR/ESP						
Soil/site	Calcium meq/L	Magnesium meq/L	Potassium meq/L	Sodium meq/L	SAR	ESP
1. TP1	25.6	16.2	10	2.7	0.59	4.95%
1. TP2	9.6	10.5	3.6	0.4	0.13	1.66%
1. TP3	8.96	2.1	0.4	0.4	0.17	3.37%
1. TP4	21.76	8.9	4.8	1.5	0.38	4.06%

Table 4: Site Assessment

Feature	Description	Level of Constraint	Mitigation Measures
Climate	Average annual rainfall Witchcliffe is 979.8 mm. Average no. of rain days per year 170.3 days. Average annual pan evaporation is about 1400 mm.	Low	NN*
Vegetation	Mixture of grasses, understorey shrubs and trees, both exotic and native.	Nil	NN
Slope, Erosion and Landslip	Slope is low, with no evidence of sheet or rill erosion, and the erosion hazard is low. No evidence of landslip and landslip potential is low. Slope = 0.63° (1.1%)	Nil	NN
Landform	Typical soils of the Leeuwin Zone. In this case, loam or deep sand over loamy clay.	Low	NN
Rock Outcrops	No evidence of laterite, limestone or granite surface rocks and outcrops near land application areas.	Low	NN
Exposure and Aspect	Subject to good wind and sun exposure in cleared areas.	Low	NN
Drainage	No visible signs of surface dampness, spring activity or hydrophilic vegetation in the proposed effluent management area. Sandy loam soil, degrading into clay at depth, was observed in all test pits.	Low	Adopt DIR or DLR as per permeability studies.
Groundwater	Groundwater table encountered in all test pits. Generally fair drainage in first metre or so.	Medium	May be an issue for leach drains.
Imported Fill	No imported fill material was observed on the site.	Nil	NN
Land Available for LAA**	Considering all the constraints and buffers, the site has suitable land for the land application area for treated effluent.	Low	NN
Slope of LAA	The proposed effluent management areas are reasonably level.	Low	NN
Run-on and Runoff	Negligible stormwater run-on and minor run-off hazard.	Low	NN
Buffer Distances	All relevant buffer distances in the regulations are achievable from the proposed effluent management area.	Low	NN

*NN: not needed **LAA: Land Application Area

TEST PITS

TEST PIT 1 WP 520 S33 58.525 E115 06.058, 94 M, 5° SLOPE

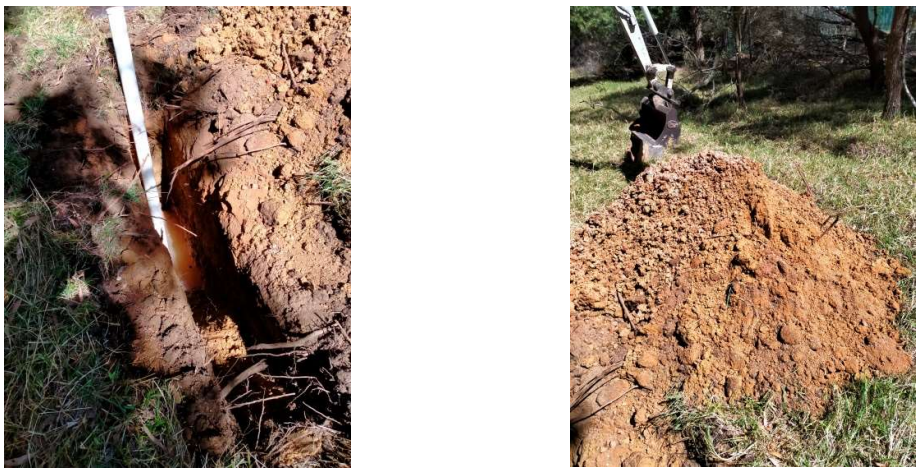


Figure 23: Soil profile (L) spoil (R)

COMMENTS ON TP 1

Dark brown sandy topsoil was found in the first 300 mm grading into brown gravel down to 800 mm. Yellow, red and white mottled clay before the excavation stopped at 2000 mm.

DISPERSION AND GYPSUM RESPONSIVENESS

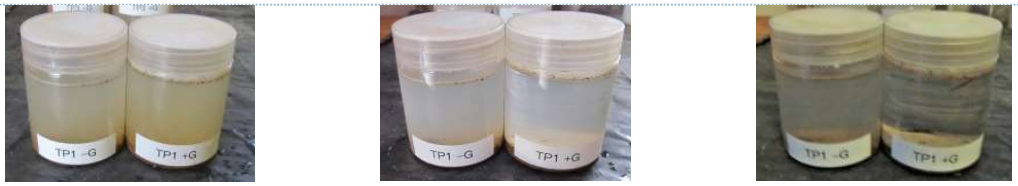


Figure 24: Dispersion and gypsum responsiveness TP1. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L) after 15 mins, (M) after 2 hrs, (R) after 20 hrs.

COMMENTS ON DISPERSION OF SOILS TP1

Some dispersion is evident as the water jar is generally murky over the course of the day, suggesting soil is slightly dispersive. The good response to gypsum suggests that this could be used to enable better water infiltration in the irrigation area, but probably unnecessary.

PERMEABILITY STUDIES

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 5. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 6.

SOIL CATEGORY BY RIBBON TEST

Estimated soil category by ribbon test found in Table 5.

Table 5: Results of ribbon test. TP1

Ribbon length (mm)	15-20
Feel of sample	Gritty
Soil category	2 – sandy loam/ loam



Figure 25: Ribbon test TP1

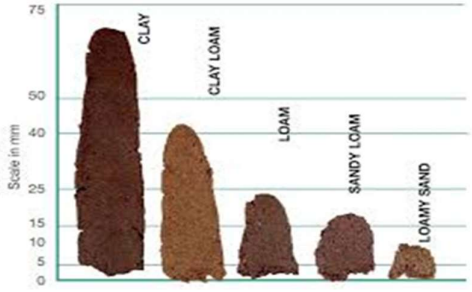


Figure 26: Ribbon test soil categories

SOIL CATEGORY BY PERMEABILITY

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.
Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm
Average radius of auger hole = 5 cm. Depth to any impermeable layer (if known) > 2000
Soil was: wet ☐ moist ☑ dry ☐ at time of investigation.

Table 6: Results of permeability studies TP1.

Time (mins)	Level in tube (mm reading)	Drop in level (mm)
Start 0	30	
0.5	90	60
1	130	40
1.5	180	50
2.0	220	40
	Average	95/min
K_{sat} (from AS1547)	0.63 m/day	



Figure 27:Permeability

Soil category from permeability readings: 3 (moderately structured loam).



Figure 28: Soil fractions for sample TP1.

COMMENTS OF SOIL FRACTIONS

Soil is mainly sandy, with much smaller amounts of silt and clay present. Soil category = 2 CSBP results: 15-20% gravel. Texture 2.5 – loam/clay. Colour yellow/grey.

Ksat VALUES

Instrument Data			
Reservoir internal Diameter (mm)	===>	45	4.5
Breather pipe Outer Diameter (mm)	===>	0	0
Test Hole radius (mm)	===>	50	5
Water Depth in Test Hole (mm)	===>	400	40

Test Results Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day
95	9.5	151.09	0.0434	0.63
96	9.6	152.68	0.0439	0.63
97	9.7	154.27	0.0444	0.64
98	9.8	155.86	0.0448	0.65
99	9.9	157.45	0.0453	0.65
100	10	159.04	0.0457	0.66
101	10.1	160.63	0.0462	0.67
102	10.2	162.22	0.0466	0.67
103	10.3	163.81	0.0471	0.68
104	10.4	165.40	0.0476	0.68
105	10.5	167.00	0.0480	0.69
106	10.6	168.59	0.0485	0.70
107	10.7	170.18	0.0489	0.70
108	10.8	171.77	0.0494	0.71

Figure 29: Ksat determination TP1.

Soil Profile Borehole Log | Date: November 23, 2022 | Test Pit number. TP1

Client, Address, Contact numbers. Stan Lawrence-Brown. Lots 4, 5 and 31 Darch Road, Margaret River.

Excavation type: Hand auger | Groundwater Depth: 1.8m

Depth (metres)	Ease of excavation	Graphic Log	Material description and field notes	Moisture
0	VE		Dark brown sandy topsoil with organic matter	M
0.5			Sandy light brown gravel	
1	F		Yellow, red and white mottled clay	
1.5				
2			End of excavation	

Soil Group Name: colour, grain size, other descriptors: Cowaramup Uplands System, Leeuwin Zone.

Rock Description: type, hardness, structure. Loamy gravel over clay/loam.

Key

Topsoil | Sandy loam | Clayey loam | Clay | Laterite | Parent rock | Gravel

Ease of excavation

VE very easy E easy F firm H hard VH very hard

Moisture content of soil

D = dry. M = moist soil. W = wet, saturated soil

Figure 30: Soil log TP1

Note: these comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 2.

Table 7: Soil Assessment – TP1

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low to moderate concentration (except iron as expected from yellow to brown soils), and the sodium level is low compared to calcium and magnesium.	Low	Soil amelioration with gypsum beneficial
Electrical Conductivity	EC and TDs moderate (25.6 mg/L). [0.04 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	No dispersion. EA Class 0. CSBP test result = 0 which suggests stable soil.	Low	Soil amelioration unnecessary
pH	5.0 (water = 5.7) which is very slightly acidic. Would expect soil conditions to have a minor effect on plant growth.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Occasional stone to 20 mm and larger rocks at depth. Approximately 15-20% gravel. Figure 28 shows a range of gravel stones in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is low – 2.7 ppm. Exchangeable Sodium Percentage (ESP) 4.95%, (non-sodic <6%).	Low	NN
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.59). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Medium	Sodicity and dispersion issues are not likely to pose a constraint.
Phosphorus Retention Index	>1000 Very High PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN*. Nutrient retention system is not required.
Soil Depth	Topsoil: 100-150 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: >600 mm. Sandy to loamy clay soil for most of pit. Loamy clay at end of excavation.	Medium	Shallow subsurface irrigation may be useful
Soil Permeability and Design Loading Rates	Measured at 0.63 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (weakly structured loam); Design Loading Rate (DLR) for primary system 15 mm/d and 30mm/d for STS. 4 mm/d for dripline irrigation system.	Low	Shallow subsurface irrigation can be used.
Soil Texture and Structure	Sandy loam (Category 2). Permeability soil category = 3 Gravel 15-20%. Texture 2.5 – loam (CSBP)	Low to Medium	Shallow subsurface irrigation can be used
Watertable Depth	Groundwater encountered at 1.8 m	Medium	Shallow irrigation or inverted leach drains can be used

*NN: not needed

TEST PIT 2 WP 521 S33 58.623 E115 05.965, 95 M, 5° SLOPE



Figure 31: (L) Soil profile. (R) Spoil.

COMMENTS ON TP 2

Dark grey sandy topsoil and visible organic matter was found in first 150 mm. Grey sand extended 450 mm then grey/brown sand to 1800mm and then white, red and yellow mottled clay before excavation stopped at 2000 mm.

DISPERSION AND GYPSUM RESPONSIVENESS

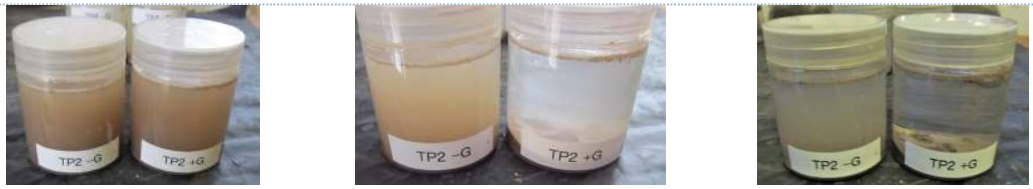


Figure 32: Dispersion and gypsum responsiveness TP2. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L) after 15 mins, (M) after 2 hrs, (R) after 20 hrs.

COMMENTS ON DISPERSION OF SOILS TP2

Some dispersion is evident as water jar generally murky over the course of the day, suggesting soil is slightly dispersive. The good response to gypsum suggests that this could be used to enable better water infiltration in the irrigation area, but probably unnecessary.

PERMEABILITY STUDIES

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 8. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 9.

SOIL CATEGORY BY RIBBON TEST

Estimated soil category by ribbon test found in Table 8.

Table 8: Results of ribbon test. TP2

Ribbon length (mm)	10-15
Feel of sample	Gritty loam
Soil category	2 – sandy loam/ loam



Figure 33: Ribbon test TP2

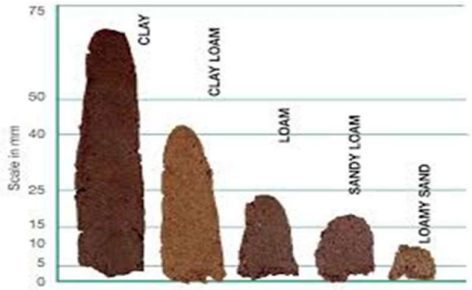


Figure 34: Ribbon test soil categories

SOIL CATEGORY BY PERMEABILITY

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.
Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm
Average radius of auger hole = 5 cm. Depth to any impermeable layer (if known) > 1800
Soil was: wet ☐ moist ☑ dry ☐ at time of investigation.

Table 9: Results of permeability studies TP2

Time (mins)	Level in tube (mm reading)	Drop in level (mm)
Start 0	30	
0.5	140	110
1	220	80
1.5	290	70
2	340	60
	Average	160/min
K_{sat} (from AS1547)	1.05 m/day	

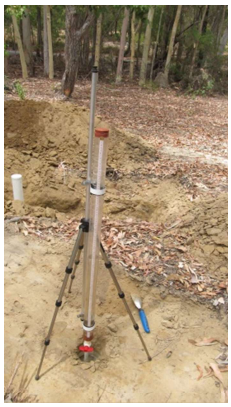


Figure 35:Permeability

Soil category from permeability readings: 3 (weakly structured loam).



Figure 36: Soil fractions for sample TP2

COMMENTS OF SOIL FRACTIONS

Soil is mainly sandy, with much smaller amounts of silt and clay present. Soil category = 2. CSBP results: 0% gravel. Texture 1– sand. Colour grey.

Ksat VALUES

Instrument Data			
Reservoir internal Diameter (mm)	===>	45	4.5
Breather pipe Outer Diameter (mm)	===>	0	0
Test Hole radius (mm)	===>	50	5
Water Depth in Test Hole (mm)	===>	400	40

Test Results				
Water Fall		Flow Rate	Ksat	Ksat
Rate (mm)/min		cm3/min	cm/min	m/day
160	16	254.47	0.0732	1.05
161	16.1	256.06	0.0736	1.06
162	16.2	257.65	0.0741	1.07
163	16.3	259.24	0.0745	1.07
164	16.4	260.83	0.0750	1.08
165	16.5	262.42	0.0755	1.09
166	16.6	264.01	0.0759	1.09
167	16.7	265.60	0.0764	1.10
168	16.8	267.19	0.0768	1.11
169	16.9	268.78	0.0773	1.11
170	17	270.37	0.0777	1.12
171	17.1	271.96	0.0782	1.13
172	17.2	273.55	0.0787	1.13
173	17.3	275.14	0.0791	1.14
174	17.4	276.74	0.0796	1.15
175	17.5	278.33	0.0800	1.15
176	17.6	279.92	0.0805	1.16
177	17.7	281.51	0.0809	1.17

Figure 37: Ksat determination TP2.

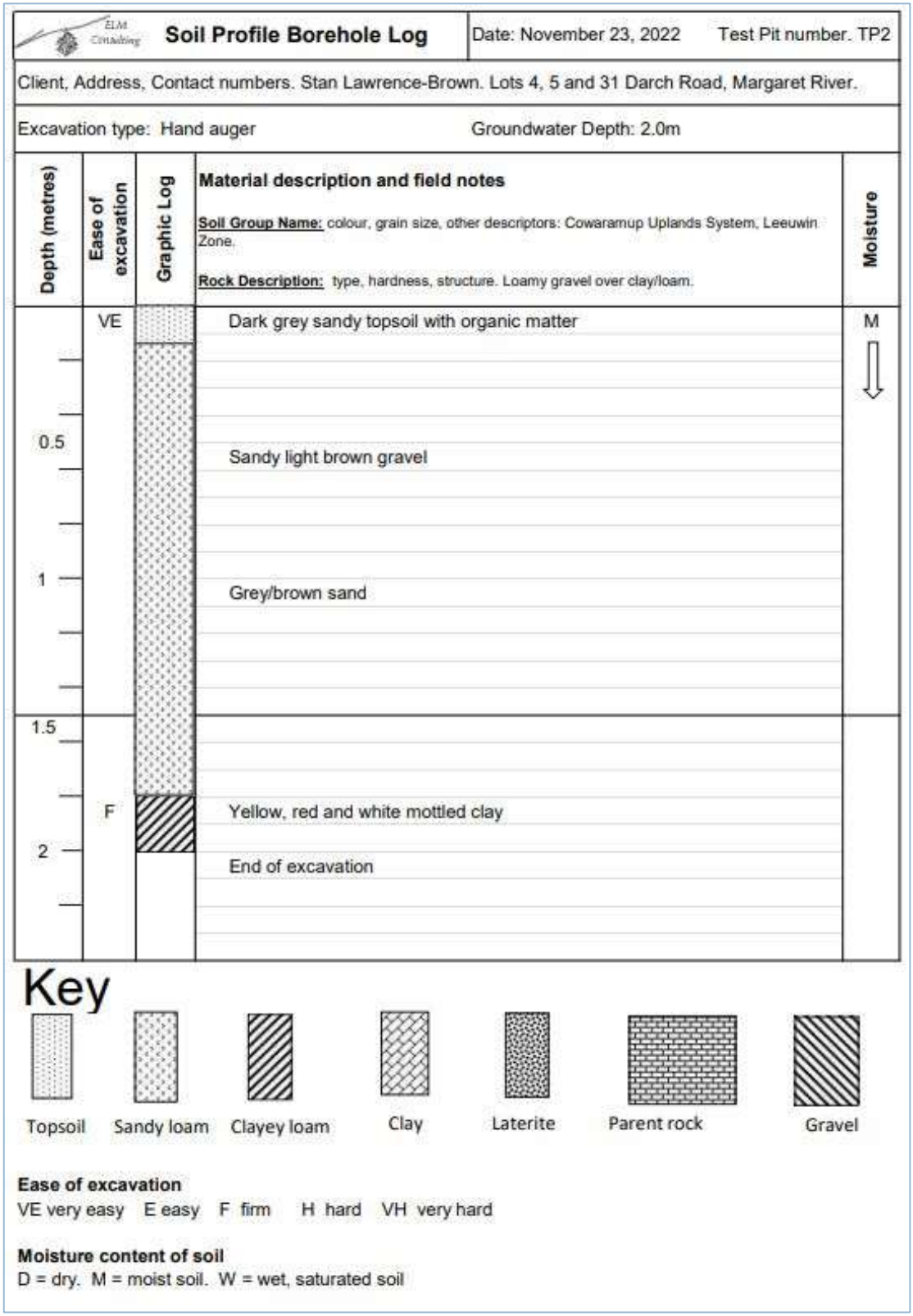


Figure 38: Soil log TP2

Note: these comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 2.

Table 10: Soil Assessment – TP2

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low to moderate concentration (except iron as expected from yellow to brown soils), and the sodium level is low compared to calcium and magnesium.	Low	Soil amelioration with gypsum may be beneficial
Electrical Conductivity	EC and TDs moderate (9.6 mg/L). [0.015 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Slight dispersion. EA Class 1. CSBP test result = 10 which suggests low rates of gypsum may be beneficial.	Low	Soil amelioration may be beneficial.
pH	5.2 (water = 6.4) which is very slightly acidic. Would expect soil conditions to have a minor effect on plant growth.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Occasional stone to 10 mm. Figure 36 shows some small stones in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is low – 9.6 ppm. Exchangeable Sodium Percentage (ESP) 1.66%, (non-sodic <6%).	Low	NN*
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.13). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Medium	Sodicity and dispersion issues are not likely to pose a constraint.
Phosphorus Retention Index	6.9 Moderate PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	Nutrient retentive soil can be added to the disposal field, but unnecessary.
Soil Depth	Topsoil: 150 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: >1600 mm. Sandy loam to loam soil for most of pit. Clayey loam to clay expected at depth	Medium	Shallow subsurface irrigation can be used
Soil Permeability and Design Loading Rates	Measured at 1.05 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (loam); Design Loading Rate (DLR) for primary system 15 mm/d and 30 mm/d for STS. 4 mm/d for dripline irrigation system.	Low	Shallow subsurface irrigation can be used
Soil Texture and Structure	Sandy loam (Category 2). Permeability soil category = 3 Gravel 0%. Texture 1 – sandy loam (CSBP)	Low to Medium	Shallow subsurface irrigation can be used
Watertable Depth	Groundwater encountered at 2m.	Medium	Shallow irrigation can be used Not in sewage sensitive area.

*NN: not needed

TEST PIT 3 GPS WP522 S33 58.744 E115 05.878, 91 M, 5° SLOPE



Figure 39: (L) Soil profile. (R) Spoil.

COMMENTS ON TP 3

Dark grey sandy topsoil and visible organic matter was found in first 100 mm. Grey/brown sand extended another 800 mm then start of light grey sand with mottled clay before excavation stopped at 2000 mm.

DISPERSION AND GYPSUM RESPONSIVENESS



Figure 40: Dispersion and gypsum responsiveness TP3. In each photo the RHS jar is soil in gypsum solution. LHS jar is soil in water. (L) after 15 mins, (M) after 2 hrs, (R) after 20 hrs.

COMMENTS ON DISPERSION OF SOILS TP3

Some dispersion is evident as water jar generally murky over the course of the day, suggesting soil is slightly dispersive. The good response to gypsum suggests that this could be used to enable better water infiltration in the irrigation area, but probably unnecessary.

PERMEABILITY STUDIES

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 11. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 12.

SOIL CATEGORY BY RIBBON TEST

Estimated soil category by ribbon test found in Table 11.

Table 11: Results of ribbon test. TP3

Ribbon length (mm)	15-20
Feel of sample	Gritty
Soil category	2 – sandy loam/ loam



Figure 41: Ribbon test TP3

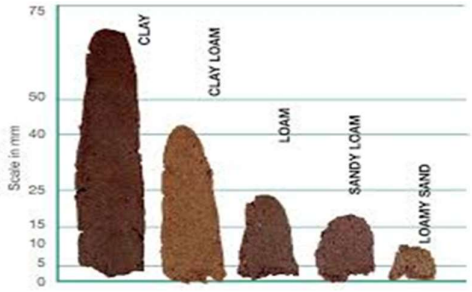


Figure 42: Ribbon test soil categories

SOIL CATEGORY BY PERMEABILITY

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.
Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm
Average radius of auger hole = 5 cm. Depth to any impermeable layer (if known) > 1800
Soil was: wet ☐ moist ☑ dry ☐ at time of investigation.

Table 12: Results of permeability studies TP3

Time (mins)	Level in tube (mm reading)	Drop in level (mm)
Start 0	20	
0.5	120	100
1	330	210
1.5	540	210
2	710	170
	Average	345/min
K_{sat} (from AS1547)	2.27 m/day	



Figure 43:Permeability

Soil category from permeability readings: 2 (weakly structured sandy loams)at best or 3 (moderately structured loam).



Figure 44: Soil fractions for sample TP3

COMMENTS OF SOIL FRACTIONS

Soil is mainly sandy, with much smaller amounts of silt and clay present. Soil category = 2 CSBP results: 0% gravel. Texture 1 – sandy loam. Colour grey.

Ksat VALUES

Instrument Data			
Reservoir internal Diameter (mm)	===>	45	4.5
Breather pipe Outer Diameter (mm)	===>	0	0
Test Hole radius (mm)	===>	50	5
Water Depth in Test Hole (mm)	===>	400	40

Test Results				
Water Fall Rate (mm)/min		Flow Rate cm3/min	Ksat cm/min	Ksat m/day
345	34.5	548.70	0.1578	2.27
346	34.6	550.29	0.1582	2.28
347	34.7	551.88	0.1587	2.29
348	34.8	553.47	0.1591	2.29
349	34.9	555.06	0.1596	2.30
350	35	556.65	0.1601	2.30
351	35.1	558.24	0.1605	2.31
352	35.2	559.83	0.1610	2.32
353	35.3	561.42	0.1614	2.32
354	35.4	563.01	0.1619	2.33
355	35.5	564.60	0.1623	2.34
356	35.6	566.19	0.1628	2.34
357	35.7	567.78	0.1633	2.35
358	35.8	569.37	0.1637	2.36

Figure 45: Ksat determination TP3

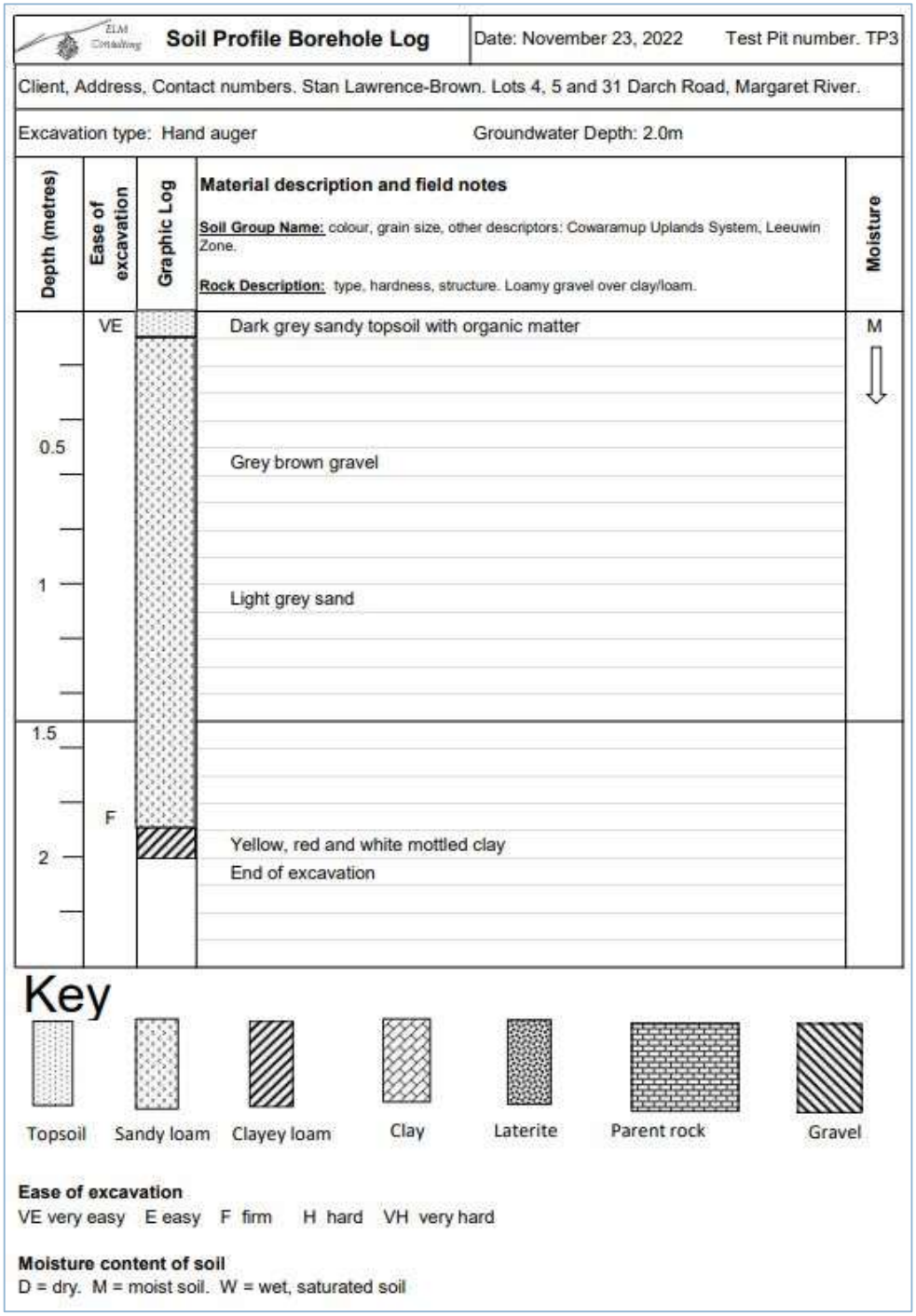


Figure 46: Soil log TP3

Note: these comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 2.

Table 13: Soil Assessment – TP3

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low to moderate concentration (except iron as expected from yellow to brown soils), and the sodium level is low compared to calcium and magnesium.	Low	Soil amelioration with gypsum beneficial
Electrical Conductivity	EC and TDs moderate (8.96mg/L). [0.014 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	No dispersion. EA Class 1. CSBP test result = 11 which suggests gypsum addition may be beneficial.	Low	Soil amelioration with gypsum may be beneficial
pH	5.0 (water = 5.8) which is very slightly acidic. Would expect soil conditions to have a minor effect on plant growth.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Occasional stone to 10 mm and a small amount of larger rocks at depth. Approximately 0% gravel. Figure 44 shows a range of gravel stones in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is low – 0.4 ppm. Exchangeable Sodium Percentage (ESP) 3.37%, (non-sodic <6%).	Moderate	Sodicity and SAR low.
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.17). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Medium	Sodicity and dispersion issues are not likely to pose a constraint.
Phosphorus Retention Index	20.2 Moderate PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN*. Nutrient retention system is not required.
Soil Depth	Topsoil: 100 mm	Low	Shallow subsurface irrigation may be used.
	Subsoil: >1700 mm. Sandy to sandy loam soil for most of pit. Loamy clay at end of excavation.	Medium	Shallow subsurface irrigation may be used.
Soil Permeability and Design Loading Rates	Measured at 2.27 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 2 (sandy loam); Design Loading Rate (DLR) for primary system 25 mm/d and 50 mm/d for STS. 5 mm/d for dripline irrigation system.	Low	Shallow subsurface irrigation may be used.
Soil Texture and Structure	Sandy loam (Category 2). Permeability soil category = 2 Gravel 0%. Texture 1– sandy loam (CSBP)	Low to Medium	Shallow subsurface irrigation may be used.
Watertable Depth	Groundwater encountered at base of test pit	Medium	Shallow irrigation or inverted leach drains may be used.

*NN: not needed

TEST PIT 4 GPS WP523, S33 58.723 E115 05.911, 94 M, 5° SLOPE



Figure 47: (L) Soil profile. (R) Spoil.

COMMENTS ON TP 4

Grey sandy topsoil and visible organic matter was found in first 100 mm. Grey/brown sand extended another 1100 mm then start of yellow, red and white sandy grit with clay before excavation stopped at 2000 mm.

DISPERSION AND GYPSUM RESPONSIVENESS



Figure 48: Dispersion and gypsum responsiveness TP4. In each photo the RHS jar is soil in water. LHS jar is soil in gypsum solution. (L) after 15 mins, (M) after 2 hrs, (R) after 20 hrs.

COMMENTS ON DISPERSION OF SOILS TP4

Some dispersion is evident as water jar generally murky over the course of the day, suggesting soil is slightly dispersive. The good response to gypsum suggests that this could be used to enable better water infiltration in the irrigation area, but probably unnecessary.

PERMEABILITY STUDIES

A sample of soil from the profile was taken and a simple ribbon test performed: the results of which are shown in Table 14. A constant head permeameter was employed to measure the infiltration rate into the soil, and the results are summarised in Table 15.

SOIL CATEGORY BY RIBBON TEST

Estimated soil category by ribbon test found in Table 14.

Table 14: Results of ribbon test. TP4

Ribbon length (mm)	10-15
Feel of sample	Gritty
Soil category	2 – clay loam/ loam



Figure 49: Ribbon test TP4

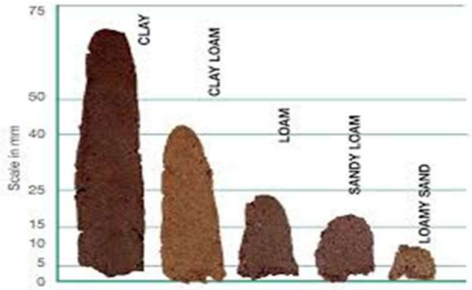


Figure 50: Ribbon test soil categories

SOIL CATEGORY BY PERMEABILITY

Use of permeameter to measure water movement into the soil as per ASNZS 1547:2012.
Depth of auger hole = 50 cm Depth of water in auger hole = 40 cm
Average radius of auger hole = 5 cm. Depth to any impermeable layer (if known) > 1800
Soil was: wet ☐ moist ☐ dry ✔ at time of investigation.

Table 15: Results of permeability studies TP4

Time (mins)	Level in tube (mm reading)	Drop in level (mm)
Start 0	40	
0.5	100	60
1	170	70
1.5	210	40
2	270	60
2.5	310	40
3	360	50
	Average	107/min
K_{sat} (from AS1547)	0.70m/day	



Figure 51:Permeability

Soil category from permeability readings: 3 (weakly structured loam).



Figure 52: Soil fractions for sample TP4.

COMMENTS OF SOIL FRACTIONS

Soil is mainly sandy, with much smaller amounts of silt and clay present. Soil category = 2 CSBP results: 15-20% gravel. Texture 1.5 – loam/clay. Colour grey.

Ksat VALUES

Instrument Data

Reservoir internal Diameter (mm)	===>	45	4.5
Breather pipe Outer Diameter (mm)	===>	0	0
Test Hole radius (mm)	===>	50	5
Water Depth in Test Hole (mm)	===>	400	40

Test Results				
Water Fall		Flow Rate	Ksat	Ksat
Rate (mm)/min		cm3/min	cm/min	m/day
107	10.7	170.18	0.0489	0.70
108	10.8	171.77	0.0494	0.71
109	10.9	173.36	0.0498	0.72
110	11	174.95	0.0503	0.72
111	11.1	176.54	0.0508	0.73
112	11.2	178.13	0.0512	0.74
113	11.3	179.72	0.0517	0.74
114	11.4	181.31	0.0521	0.75
115	11.5	182.90	0.0526	0.76
116	11.6	184.49	0.0530	0.76
117	11.7	186.08	0.0535	0.77
118	11.8	187.67	0.0540	0.78
119	11.9	189.26	0.0544	0.78
120	12	190.85	0.0549	0.79
121	12.1	192.44	0.0553	0.80
122	12.2	194.03	0.0558	0.80

Figure 53: Ksat determination TP4

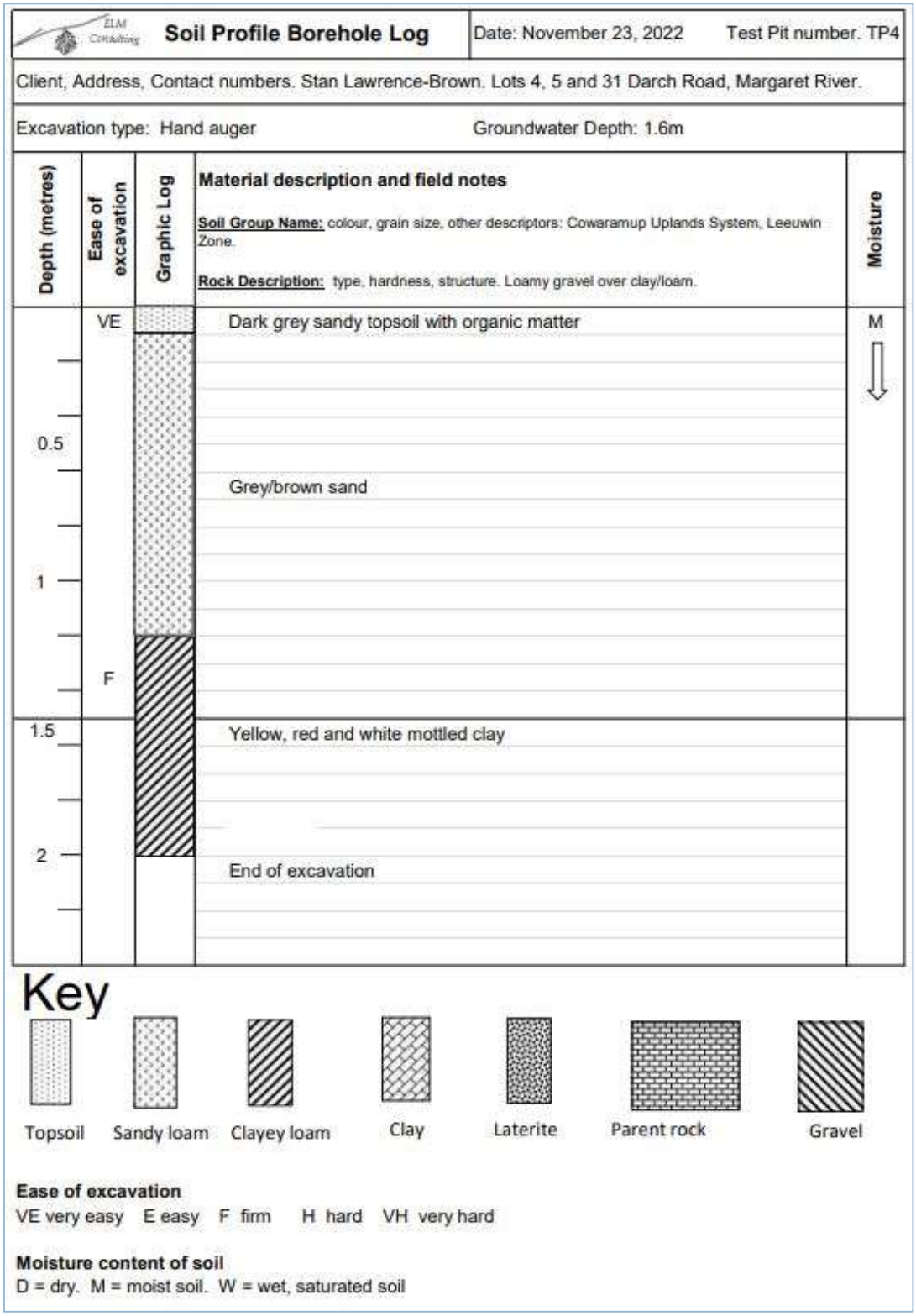


Figure 54: Soil log TP4

Note: these comments are a review of the generic soil fraction. This is both a summary and comments of the laboratory testing as shown in Table 2.

Table 16: Soil Assessment – TP4

Feature	Assessment	Level of Constraint	Mitigation Measures
Cation Exchange Capacity (CEC)	Main cations have low to moderate concentration (except iron as expected from yellow to brown soils), and the sodium level is low compared to calcium and magnesium.	Low	Soil amelioration with gypsum beneficial
Electrical Conductivity	EC and TDs moderate (21.76 mg/L). [0.034 dS/m]	Low	Monitoring of EC not necessary
Emerson Aggregate Test	Minor dispersion. EA Class 1. CSBP test result = 10 which suggests gypsum addition may be helpful.	Low	Soil amelioration may be helpful.
pH	4.6 (water = 5.3) which is very moderately acidic. Would expect soil conditions to have a minor effect on plant growth.	Low	Addition of alkaline wastewater may restore to optimum pH level
Rock Fragments	Occasional stone to 10 mm with some larger rocks at depth. Approximately 15 to 20% gravel. Figure 52 shows a range of gravel stones in the screen.	Low	No consideration required.
Sodicity (ESP)	Sodium concentration is low – 1.5 ppm. Exchangeable Sodium Percentage (ESP) 4.06%, (non-sodic <6%).	Low	NN
Sodium Absorption Ratio (SAR)	Sodium concentration is lower than Magnesium and Calcium concentrations in the tested samples; SAR is low (0.38). Dispersion tests confirm low sodicity. SAR is usually only a problem for dispersion and permeability if value >5.	Low	Sodicity and dispersion issues are not likely to pose a constraint.
Phosphorus Retention Index	168.8 High PRI, sufficient to remove phosphates. Soils above PRI 20 are accepted to remove phosphorus from wastewater.	Low	NN*. Nutrient retention system is not required.
Soil Depth	Topsoil: 100 mm	Low	Shallow subsurface irrigation in topsoil possible.
	Subsoil: 1000 mm. Sand to sandy loam soil for most of pit. Loamy clay at end of excavation.	Medium	Shallow subsurface irrigation may be useful.
Soil Permeability and Design Loading Rates	Measured at 0.7 m/day saturated conductivity (K_{sat}) (AS/NZS1547:2012). Category 3 (loam; Design Loading Rate (DLR) for primary system 15 mm/d and 30 mm/d for STS. 4 mm/d for dripline irrigation system.	Low	Shallow subsurface irrigation recommended.
Soil Texture and Structure	Loam (Category 3). Permeability soil category = 3. Gravel 15-20%. Texture 1.5 – sand/loam (CSBP)	Low to Medium	Shallow subsurface irrigation recommended.
Watertable Depth	Groundwater encountered at 1.6m.	Low	Use either dripline or inverted leach drains.

*NN: not needed

8. DISCUSSION

It is reasonable to suggest that soils over whole site are similar – sandy topsoil, sandy loams over loamy clay at depth. Permeability was generally high, and Category 2 and 3 soils are found on site (weakly structured sandy loam). Flatbed drains and conventional leach drains are possible depending on local siting of the system, which is determined upon excavation. There is also enough clear area for dripline.

GOVERNMENT SEWERAGE POLICY

Relevant sections (e.g., 5.2.1, 5.2.2, 5.2.3 and 5.2.5) that discuss setbacks and separation from the water table and in relation to lot size and soil types are briefly:

- An onsite sewage system is not permitted in any area subject to inundation and/or flooding in a 10% Annual Exceedance Probability (AEP) rainfall event. This is discussed in detail in Section 7 of this report.
- In loams and heavy soils, a vertical separation distance from the highest known groundwater table is to be a minimum of 1.5 m (for lots within sewage sensitive areas).
- Where slope exceeds one in five (1:5 or 20%) the land application area should be engineered to prevent run-off (including levelling, bunding of LAA and interceptor/cut-off drains to divert stormwater intrusion to LAA).
- Local government may approve the location of land application areas outside of building envelopes where the proposed location meets the requirements outlined above.
- Secondary treatment systems with nutrient removal will generally be required in public drinking water source areas and sewage sensitive areas.

All the relevant conditions can be met in the proposed development with the use of semi-inverted leach drains, flatbed drains or dripper irrigation.

Considering the whole site, calculations of loading rates based on soil assessments are as follows (based on worst-case scenario):

HYDRAULIC/DESIGN LOADING RATE

From AS/NZS 1547:2012, Tables L1 and M1, Soil Category 3 – weakly structured loam (Ksat approx 0.63m/d and above).

DLR Trenches and beds (Table L1) 15 mm/d for primary systems and 30 mm/d for Secondary Treatment Systems.
DIR Drip or spray irrigation (Table M1) = 4 mm/d.

Furthermore, the GSP provides information in Schedule 2, Table 3 with Soil category 3 loams the required LAA required is 429 m^2 for primary treatment and 225 m^2 for secondary treatment.

LAND APPLICATION AREA (LAA) CALCULATIONS

The following outlines options for the wastewater irrigation systems. These are provided as examples of appropriate system sizing.

The proposal is for single dwellings. Allowing for a larger household (5-bedroom, 6 persons. E.g., 2 adults and 4 children) with 150L of wastewater per day = 900L.

Based on the results of the site and soil assessment, Health Regulation 49 that describes the surface area of drains and the calculations listed above, the overall land capability of the proposed onsite sewage system is as follows:

Primary treatment:
Dripline irrigation cannot be used.
Leach drains 900 ÷ (1.5 x 15) = 40 m. Assume DLR = 15, SA drains 1.5 m^2. Proposal 2 drains of 20 m length.
Flatbeds 900 ÷ (2.4 x 15) = 25 m. Proposal 2 beds x 12.5 m long drain.

Secondary Treatment System:
Dripline irrigation 900 ÷ 4 = 225 m^2.
Leach drains 900 ÷ (1.5 x 30) = 20 m. Assume DLR = 30, SA drains 1.5 m^2. Proposal 2 drains of 10 m length.
Flatbeds 900 ÷ (2.4 x 30) = 12.5 m. Proposal 2 beds x 7 m long drain.

As conventional leach drains require greater depth of burial, and groundwater may be encountered in some areas of the site, then flatbed drains, or dripline irrigation is recommended. However, the developer has choice. All these systems can be accommodated on the available land application area.

Proposed location for a wastewater system and LAA is found in Figure 31.

SECONDARY TREATMENT SYSTEM (STS) RECOMMENDATIONS

Extra nutrient retention to increase PRI is required for the disposal field that corresponds with the second test pit. For dripline you will need to ensure disinfection as dispersal is typically substrata, and may be exposed at some times, but for flatbeds and leach drains this is not required as this is situated in subsoil.

Drains will require a diversion valve which can be changed at every service (3 months) by the service technician. Alternatively, a KRain or similar hydraulic valve, which automatically shifts water to a different bed each time the pump is employed, can be installed.

Figure 31 indicates that the Land Application Area could easily be placed on each of the new lots, with a preference for locations away from dams and low-lying areas. In addition, setbacks from boundaries and buildings need to be followed as per Council requirements.

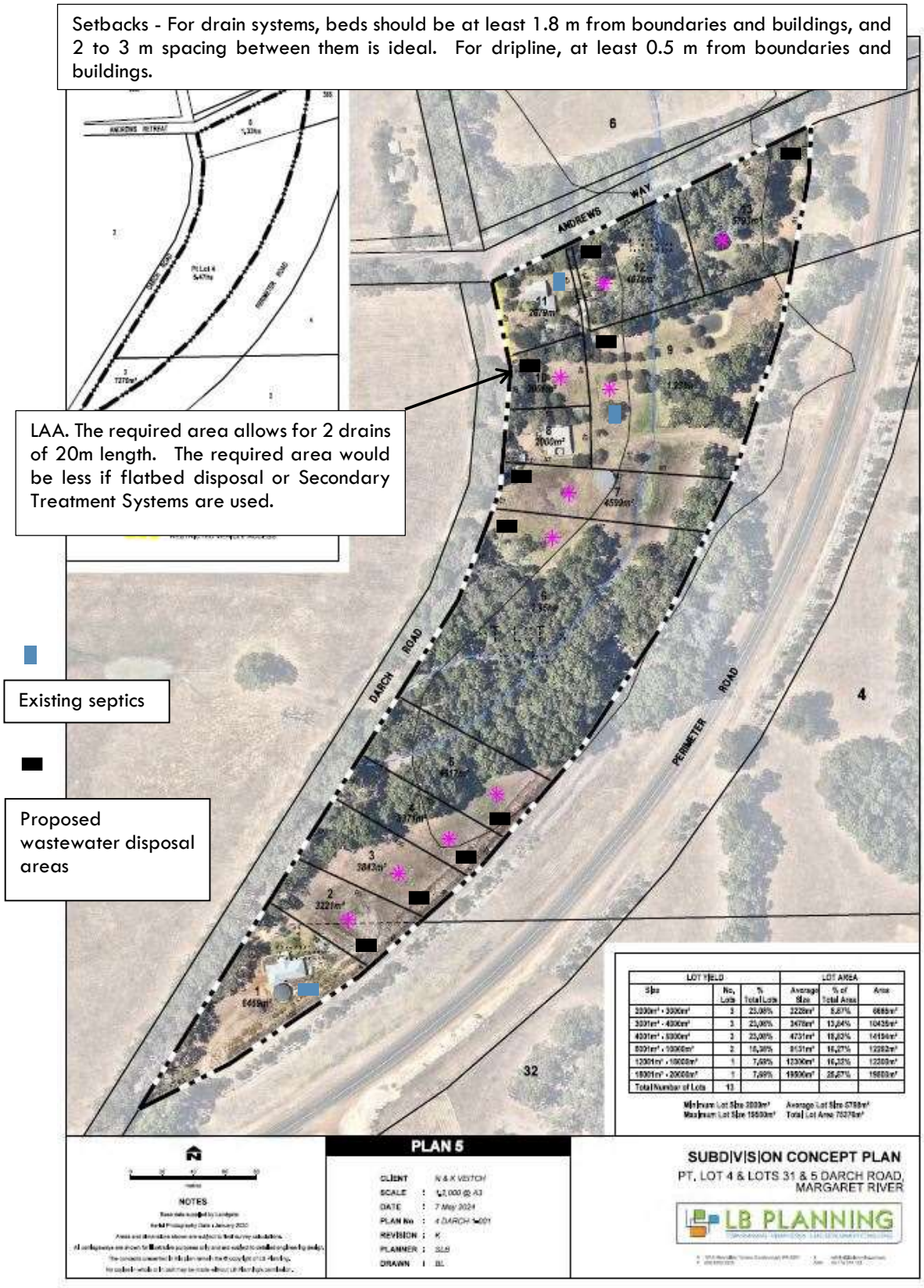


Figure 55: Indicative area for wastewater treatment system.

FINAL STATEMENT

There is enough land application area space available on the proposed new lots. Permeability is generally good so at most 225 m^2 of irrigated area for a secondary treatment system is required on the new lots. Depending on Council regulations, there could be more or less footprint for leach drains/flatbeds.

For secondary treatment systems the irrigation area can easily be located away from the dwellings. Effluent is typically pumped; hence drains can be a little longer than 20 m.

9. REFERENCES

ASRIS (2023), Australian Soil Resource Information System, http://www.asris.csiro.au/index_ie.html.

Australian/New Zealand Standard AS1547:2012, On-site domestic wastewater management.

Baxter, J. (1977) Heavy mineral sand deposits of Western Australia. Geological Survey Mineral Resources Bulletin 10.

Bureau of Meteorology (2023), Climate Averages for specific sites. Publicly available data prepared by the Bureau of Meteorology, Commonwealth of Australia. http://www.bom.gov.au/climate/averages/tables/ca_wa_names.shtml

Davidson, W. (1995). Hydrogeology and groundwater resources of the Perth region. Geological Survey of Western Australia, Department of Minerals and Energy.

DPIRD (2003), Land Profiler, Shires of Capel, Busselton and Augusta-Busselton, Perth, Western Australia.

DPIRD(2023), Natural Resources Info, http://www.agric.wa.gov.au/

Department of Health (2001), Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units (ATU's). November 2001. Department of Health, Perth.

Department of Health (2002), Movement of Nutrients from Onsite Wastewater Systems in Soils. Department of Health, Perth, Western Australia.

Department of Water (2005), Busselton Catchment Area (Including Ten Mile Brook Catchment) Drinking Water Source Protection Plan.

Department of Water (2010), WQPN 70, Water Quality Protection Note: Wastewater Treatment and Disposal – domestic systems (June 2010). Department of Water, Perth, Western Australia.

Departments of Health, Planning and Water (2019), Government Sewerage Policy

Earth Colors - a guide for soil and earthtone colors. (1996). Globe Program. Chicago, USA.

Government of Western Australia (2005), Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations 1974. October 2005.

Pen, L.J. (1997), A Systematic Overview of Environmental Values on the Wetlands, Rivers and Estuaries of the Busselton-Walpole Region, Water and Rivers Commission Report WRAP 7.

Schoknecht, N and Pathan, S (2013). Soil groups of Western Australia: a simple guide to the main soils of Western Australia (4th edition). DPIRD and Food. Perth. Report 380.

Tille, P, Stuart-Street, A. and Gardiner, P. Geology, soils and climate of the Margaret River wine region. DPIRD. 8-2020.

Tille, P. J. and Lantzke, N. C. (1990) Busselton – Busselton – Augusta: Land Capability Study. Land Resources Series No. 5. Western Australian DPIRD.

Wells, M. (2001), Assessment of Land Capability for On-Site Septic Tank Effluent Disposal. Agriculture WA, Perth, Western Australia.

10. INFORMATION ON SECONDARY TREATMENT SYSTEMS (STS)

This is a generic description of considerations for a STS. Further information about the operation and maintenance of these systems can be found from manufacturers and suppliers.

1. Consequences of overloading system.

Every Secondary Treatment System (STS) or septic or wastewater treatment system gradually accumulates sludge and scum. This is because the scum that floats on the surface is mainly oils, grease and fats, and these substances are not readily broken down by the bacteria. Sludge builds up on the bottom as this is foodstuffs and materials that aren't broken down, as well as a build-up of dead bacteria. Literally millions of bacteria die every day and this accumulates as sludge.

Should the system experience overloading from too many people using and contributing to the wastewater stream then there is simply not enough retention time for the microbes and processes that occur to satisfactorily break down the solids, so more sludge and scum occur and untreated sewage passes from one chamber to another, and may eventually be pumped out to irrigation.

In this scenario, eventually, your system will require a pump out – typically anywhere from two to five years.

2. Consequences of under-loading the system.

A Secondary Treatment System relies on a balance between food (household wastewater) and microbes. If not enough wastewater enters the treatment plant (due to homeowners away on holiday, few people staying in home) then microbes run out of food and die – more sludge accumulates. However, the most important effect is that should a large volume of wastewater suddenly enter the system then there is isn't enough microbes to break this down and so untreated sewage passes through the system.

3. Requirements for servicing and maintenance (by authorised Service Technician).

Service Personnel need clear access to your system so that they can carry the required testing and cleaning equipment from their vehicle to the tank/s, and so that they can easily remove hatches and undertake the range of tasks performed at each service. Please:

- Do not cover tanks and hatches with soil, cement, paving or any material.
- Do not prevent quick and easy access to any inspection openings.
- Do not allow roof or surface water to enter any part of the system.
- Allow free access to your property for the service person. Ensure that the gates are unlocked, your dogs are locked up and your children are supervised.
- Keep plants and grass monitored and maintained on land application areas (irrigation zone/s).

4. Homeowners responsibilities

Here are some suggestions that will help to ensure the optimum operation of your wastewater treatment system.

Washing Machines

Try to evenly spread your washing over a period of a week. Avoid where possible to wash everything in one day. It puts too much water and alkaline substances in the system in a short time and your treatment plant will struggle to cope. Liquid soaps breakdown easier than powder types, and they generally contain less salt and are at a lower pH – both of which will affect soils and plant growth. Try not to use too much soap of any type.

Things to Avoid

Chlorine, disinfectant, ammonia, acids, bleaches, caustics and heavy chemical products, nappy pre-soaker products, antibacterial products, fat, oil, grease, milk, toilet deodorizers and cleaners etc are some of the types of products that will cause the bacteria to die off in your STS. It will recover but may cause some odours in the short term.

Don't allow foreign objects, (eg. Nappy liners, disposable nappies, tampons, pads, condoms etc) to enter the system. They do not breakdown and can cause problems.

Avoid pouring large quantities (½ litre or more) of beer, flour, yeast, wine, milk, fruit juice or oils into the system. Products that are acidic may affect bacteria production. (Milk, beer and fruit juices, for example, often contain large amounts of sugar which is digested by some bacteria that rob the water of oxygen, and this, in turn, stops the growth and working of those bacteria that rely of oxygen to survive).

5. Types of products and materials that should not enter the STS plant.
You must try to use environmentally-friendly cleaning products as any product used that kills bacteria is harmful to your system. If you wish to use some of the harsher cleaning products, such as bleach, nappy cleaning products and any disinfectants, it is suggested that you use a bucket and discard the contents in a hole in a disused area of the garden.
Some other things that may cause problems are antibiotics or people who are on chemotherapy. Antibiotics are designed to kill bacteria in your body and they also wipe out these good bacteria working hard in the STS. We do not suggest that you stop your medication, just expect that the treatment system may not function well for a short time.
It is fair to suggest that all products should be used in moderation.

Surface cleaners - when using surface cleaners try to wipe excess cleaner with a disposable cloth and discard contents into the bin.

Toilet cleaners - cream cleaner or washing soda (Sodium carbonate).

General cleaners – bicarb soda (Sodium hydrogen carbonate), vinegar (not too much).

Floor cleaners - use hot water and detergent.

Laundry powders and liquids - use suitable products that contain low phosphorus and low salt (used as bulking/fill agents).

Do Not Allow These to Enter Your STS (not down the drain)

- oil, paint and chemicals
- drain cleaning or clearing products
    - methylated spirits, kerosene, acetone or any other solvents
    - flea or tick wash
- oven cleaners
- plastics of any type
- disposable nappies, sanitary napkins

Appendix B

Bushfire Management Plan

Prepared by Working on Fire Planning

WOFP JOB CARD

INVOICING DETAILS

NAME:	Neville and Kerrie Veitch	**PHONE:**	
ADDRESS:		**EMAIL:**	
CLIENT JOB #:	20190315	**CLIENT P/O #:**	

CLIENT DETAILS (where different to invoicing details)

NAME:		**PHONE:**	Click here to enter text.
COMPANY:		**EMAIL:**	Email.
ON BEHALF OF:	Click here to enter text.		
ADDRESS:	Click here to enter text.		

JOB DETAILS

SITE ADDRESS :	Pt Lot 4 & Lots 31 & 5 Darch Road, Margaret River		
SHIRE / CITY:	Shire of Augusta Margaret River	**FILE # :**	20190315

CONSULTANT DETAILS

CONSULTANT:	David Deeley	**DATE:**	6/09/2021

WORK DETAILS AND SUMMARY OF CHARGES

WORK TYPE	QUANTITY	TOTAL $ UNIT	$ WOFP	$ CLIENT	$ CONSULT.
BMP		Choose an item.	Choose an item.	$	$
				$	$
				$	$
MILEAGE	**kms**	**100c/km**		**$**	**$**
			Sub total	**$**	
			+ 10 % GST	**$**	
			Total	**$**	**$**

WORKING ON FIRE PLANNING



BUSHFIRE MANAGEMENT PLAN

CLIENT:	Neville and Kerrie Veitch
SITE LOCATION:	Pt Lot 4 & Lots 31 & 5 Darch Road, Margaret River
DATE:	6/09/2021
SHIRE/CITY:	Shire of Augusta Margaret River
FIRE CONSULTANT:	David Deeley
CLIENT CONTACT #	0439 914 896
WOFP FILE #:	20190315
VERSION #:	4.0

WORKING ON FIRE PLANNING
INTEGRATED FIRE MANAGEMENT
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WAPC cover sheet goes here

Document control

Client: Neville and Kerry Veitch

Report version	Purpose	Author/reviewer and accreditation details	Date submitted
Draft 1.0	BMP	Craig Hughes L1	25/09/2019
Submission 1.0	BMP – Review & sign off	David Deeley L2	25/10/2019
Submission 2.0	BMP revised and updated	David Deeley L2	05/03/2020
Submission 3.0	BMP address & site plan revised	David Deeley L2	03/08/2020
Submission 4.0	DFES/WAPC/Shire comments	David Deeley L2	04/09/2021

I hereby declare that I am a BPAD Accredited bushfire practitioner.
Accreditation No. 37575
Signature
Date 04/09/2021

Disclaimer

The recommendations and measures contained in this assessment report are based on the requirements of the Australian Standards 3959 – Building in Bushfire prone Areas, WAPC / DFES Guidelines for Building in Bushfire Prone areas (State Planning Policy 3.7) and CSIRO's research into Bushfire behaviour. These are considered the minimum standards required to balance the protection of the proposed dwelling and occupants with the aesthetic and environmental conditions required by local, state and federal government authorities. They DO NOT guarantee that a building will not be destroyed or damaged by a bushfire. All surveys and forecasts, projections and recommendations made in this assessment report and associated with this proposed dwelling are made in good faith on the basis of the information available to the fire protection consultant at the time of assessment. The achievement of the level of implementation of fire precautions will depend amongst other things on actions of the landowner or occupiers of the land, over which the fire protection consultant has no control. Notwithstanding anything contained within, the fire consultant/s or local government authority will not, except as the law may require, be liable for any loss or other consequences (whether or not due to negligence of the fire consultant/s and the local government authority, their servants or agents) arising out of the services rendered by the fire consultant/s or local government authority.

Section 1: Proposal details

The proposal is to subdivide Pt Lot 4, & Lots 31 & 5 Darch Road Margaret River (Figure 1), from 'General Agriculture' and 'Priority Agriculture' to 'Future Development' zoning. This will facilitate subdivision of the 6.81 ha combined parent Lots, to produce 15 Lots ranging from 2,026 m^2 to 16,000 m^2 (Figure 2). The original 3 parent Lots form a half crescent shape, which was created when the Perimeter Road was established through original farmland of the area. The 15 proposed Lots radiate around the half crescent to optimise Lot yield, egress and amenity.

There are two existing dwellings on the property, and these are to be retained within the proposed subdivision. The area is currently a mix of grazing pastures, planted exotic trees and shrubs and some stands of remnant vegetation (Figure 3). A detailed Environmental Assessment Report (EAR) prepared by SW Environmental, is to accompany this BMP as part of the DA documentation. This report defers to that document for a detailed environmental analysis of the site.

Surrounding land use is a mix of grazing pastures with rural and residential developments to the West and grazing pastures and uncleared remnant forests to the East.

This BMP document and the recommendations contained within it are aligned to the following:

- Consistency with SPP 3.7 and the planning requirements for local government;
- Identification of bushfire risks using vegetation types and slopes as in AS3959:2018;
- Identification of assets at risk- life, property, infrastructure and the environment;
- Identification of bushfire risk mitigation measures as acceptable solutions within the WAPC's guidelines[1];
- Allocation of responsibilities to persons / entities for the implementation of recommendations and management measures;
- Compliance with the Shire of Augusta Margaret River's Annual Firebreak & Fuel Hazard Reduction Notice.

[1] WAPC (2017) Guidelines for Planning in Bushfire Prone Areas v1.3, Dec 2017.

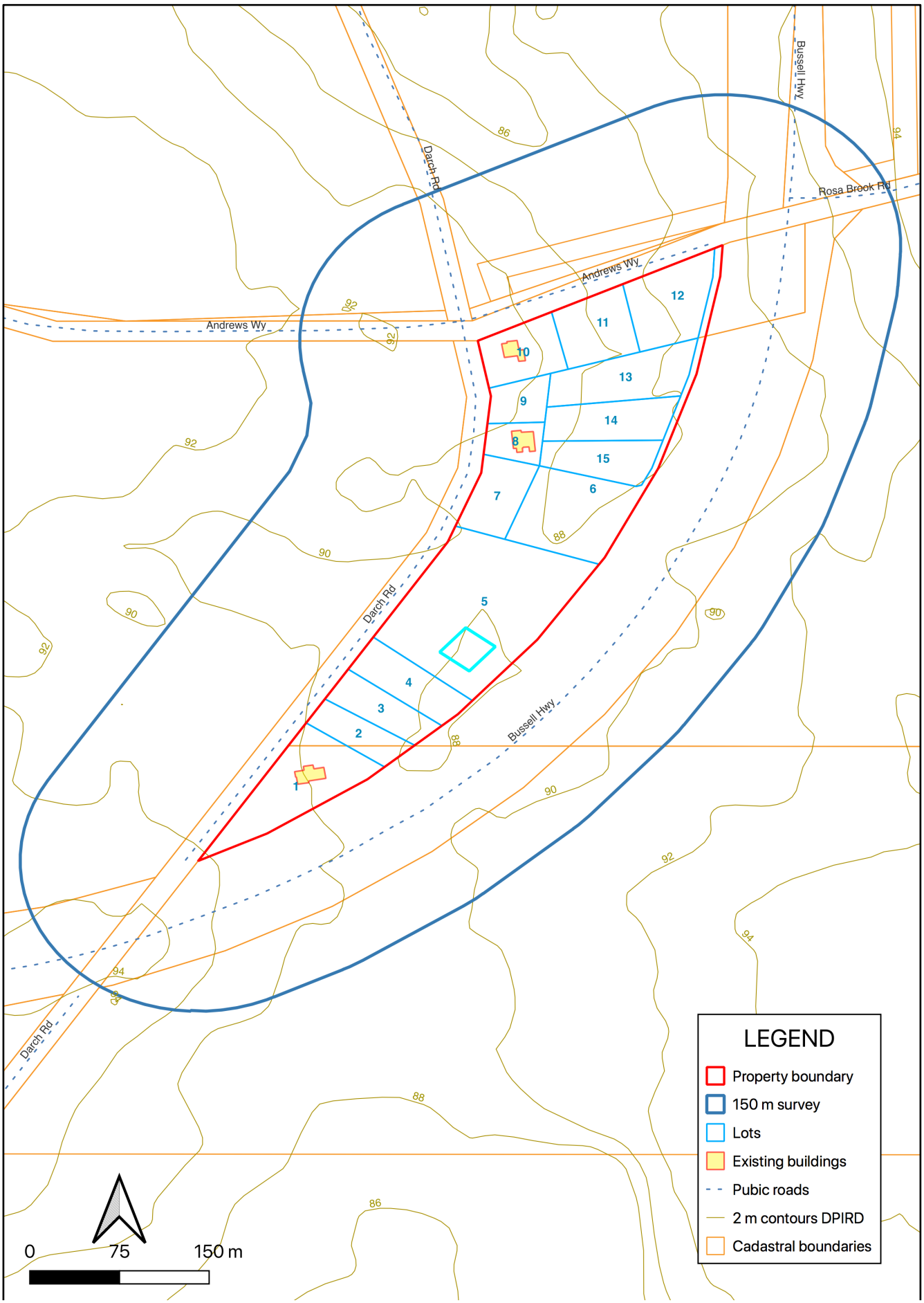


Figure 1 Location, property boundary, 150 m survey, lot layout, existing buildings, public roads and 2 m contours

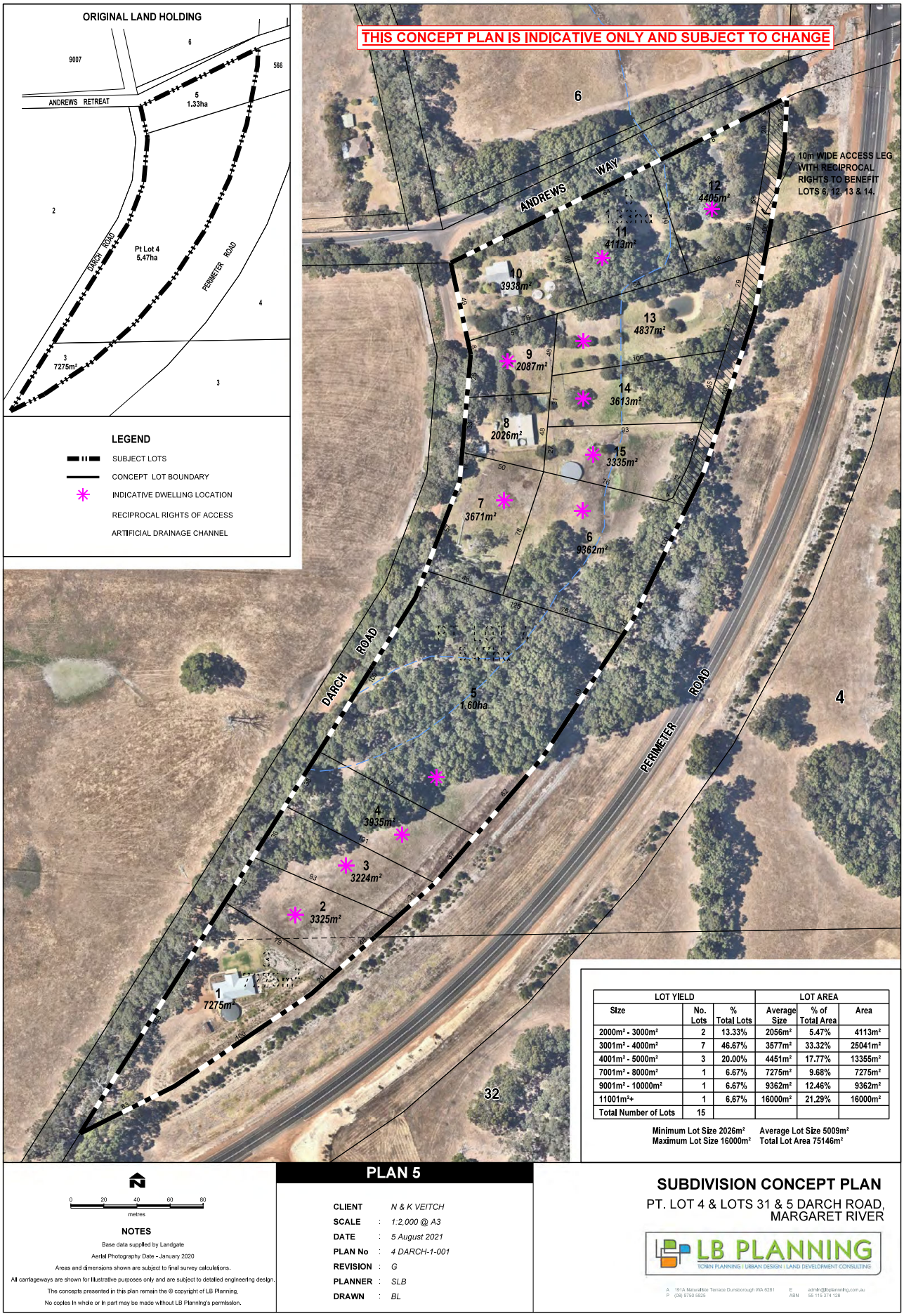


Figure 2 Proposed subdivision plan

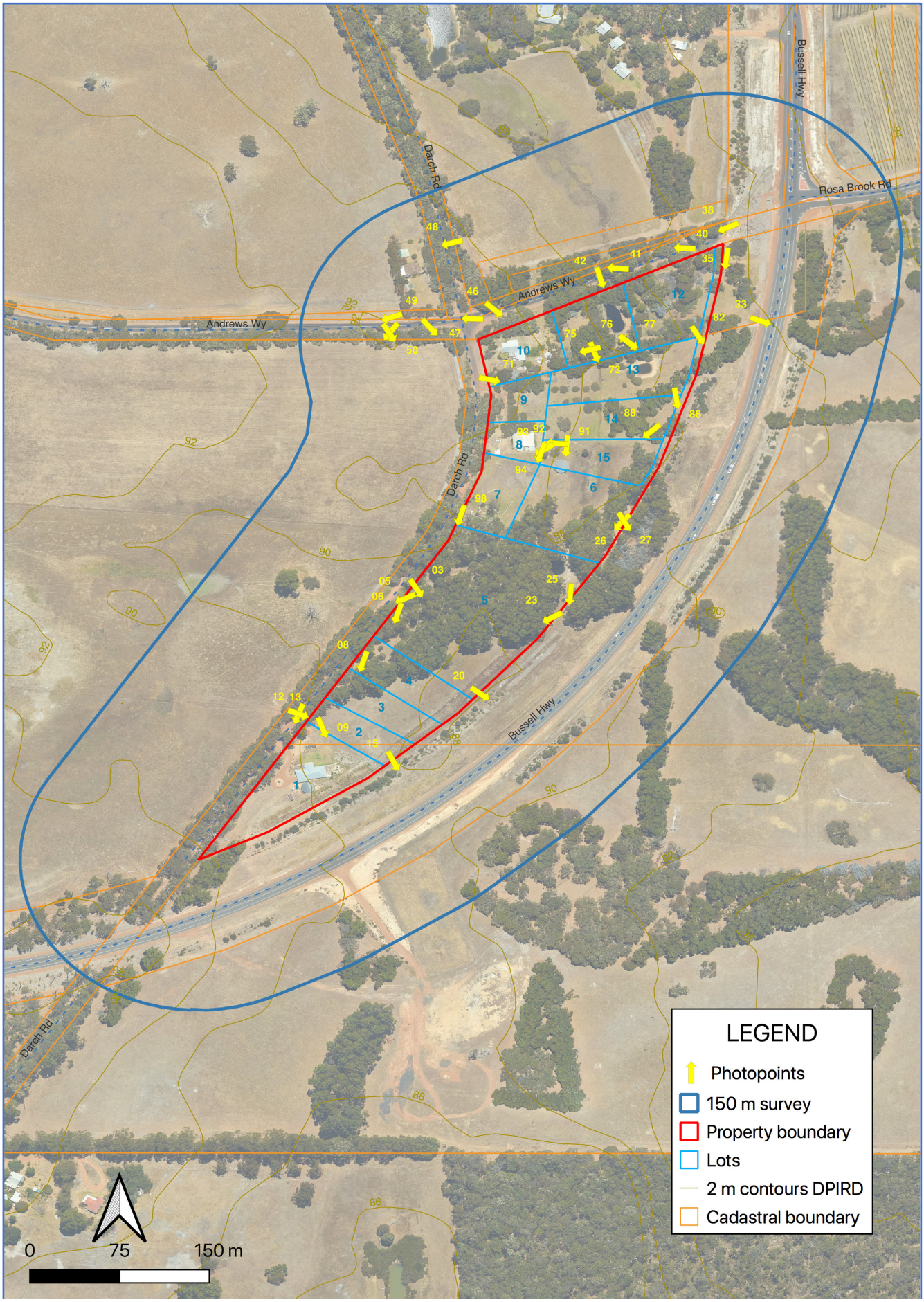


Figure 3 Air photo, Photopoints

Section 2: Environmental considerations

The vegetation and flora of Lots 4 and 5 Darch Road is highly disturbed and retains little value as representative native vegetation[2]. The study area has been historically cleared and grazed and as such there is virtually no native understorey retained within the property. The understorey is dominated by introduced grass and herb species. The overstorey is dominated by introduced Eucalypt species, and mostly planted Karri in Lot 4, and planted vegetation with some *Agonis flexuosa* regeneration in Lot 5.

Fauna diversity over the site is generally low, and fauna habitat quality generally poor over the study area. Evidence of two fauna of conservation significance was found at the site; Western Ringtail Possums in Lot 5 and to a lesser degree the northern paddock trees (Peppermint) of Lot 4, and forage evidence of Carnaby's Black Cockatoos. The retention of large Peppermint trees, native trees >50 cm-DBH and the five hollow trees in particular, will minimise impacts of the project on threatened fauna (reproduced from[1] as Figure 5).

The project also falls within the buffer zone of 'Rosa Brook Road (Margaret River Lore Ground) Other Heritage Place 4494' described as a *Ceremonial, Camp, Meeting Place, Battle ground*. It is listed as *Stored Data / Not a Site* under the AHA and therefore not a registered site. The closest registered site under the AHA is the Margaret River and its tributaries (ID 4495), a mythological site. The closest section of the registered site, as mapped, falls approximately 350 m north of the Project (PDLH, 2018). Given the degraded nature of the drainage features within the study area, they are not likely to be considered tributaries of the Margaret River nor would they be considered to form part of Site ID 4495.

There are no critical environmental constraints identified through the Environmental Assessment Report that would result in the Project not proceeding.

- Recommendations from the Environmental Assessment Report include:
- minimise of clearing of native vegetation where possible, particularly the trees over 50cm DBH and the vegetation complex Cowaramup (Cw1 – Valleys) along the Darch Road verge;
- retain the five hollow trees if possible (two of which are in the road verge);
- locate access tracks and crossovers to minimise impact on vegetation;
- carry out preliminary ASS investigations through geotechnical studies to determine the need for any on site ASS management;
- on-site stormwater management may be required to adequately address the wet areas and drainage; and,
- ensure a licensed fauna spotter is present on site for the clearing of any vegetation likely to support WRP (ie. vegetation in the northwest portions of Lots 3 and 4, southeast part of Lot 5 and southern parts of Lots 6 and 7).

[2] SW Environmental 2019. Environmental Assessment Report Lot 4 Darch Road, Margaret River.

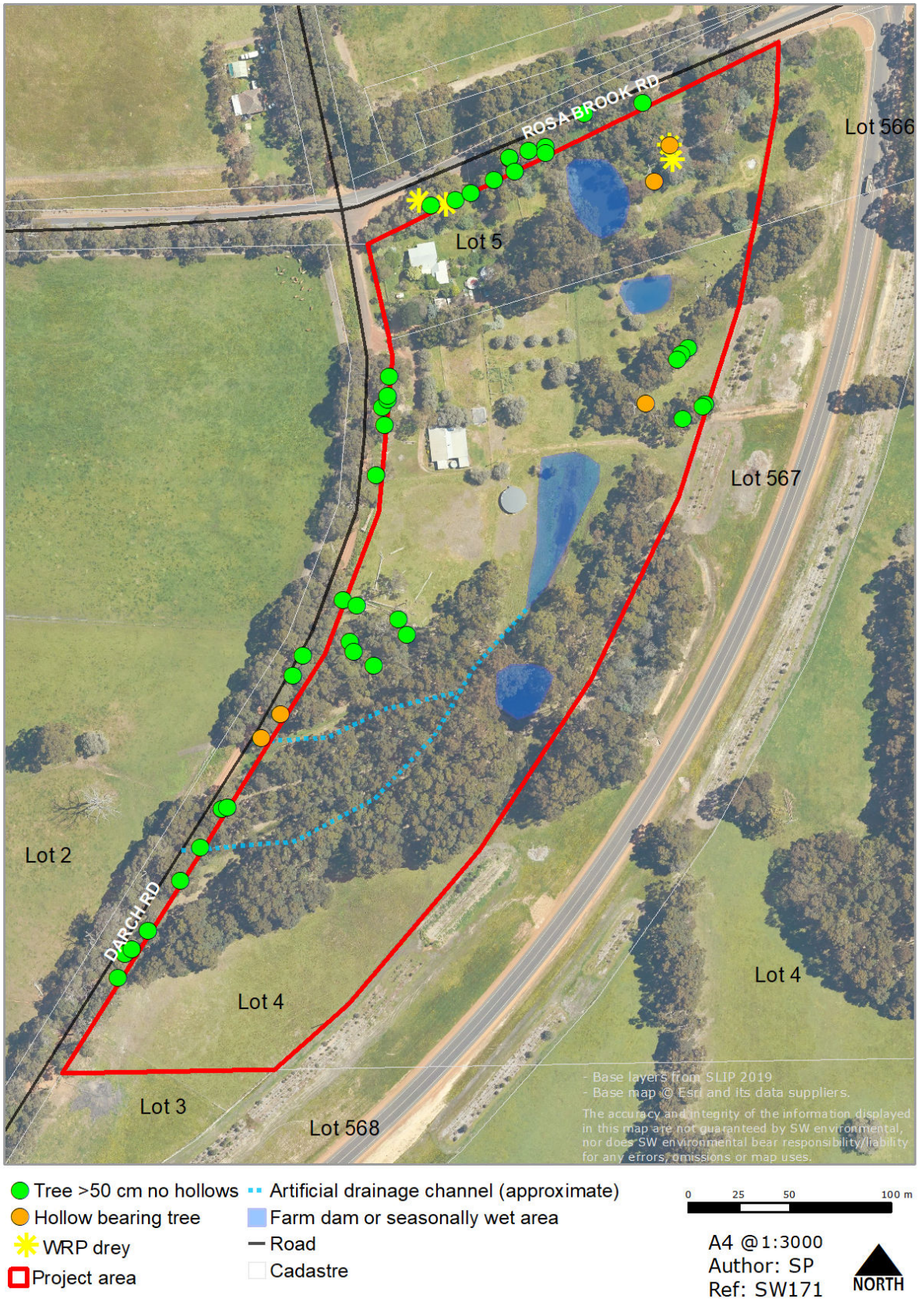


Figure 4 Environmental Issues

Section 3: Bushfire assessment results

Sub-section 3.1: Assessment inputs

All vegetation within 150 metres of the project site has been identified and classified or excluded in accordance with the provisions of AS3959:2018. Photo points were established across the site (Figure 3). All existing vegetation within 150 m of the Subject Site was classified (Figure 5) according to the Australian Standard.

Five (5) types of Classified vegetation were recorded across the site including:

1) Open Forest was recorded in the central parts of Lot 4 (Photos 03, 06, 23, 26);
2) Woodland was recorded to the north eastern parts of Lot 5 and south and east of the site (Photos 26, 27, 35, 75, 77);
3) Shrubland was recorded along the verge of Darch Rd and Perimeter Rd;
4) Grassland (Sown Pasture) was recorded on the northern and southern ends of the site as well as lots on all adjacent sides (Photos 09, 49, 50, 73, 91, 94); and,
5) Excluded Low-threat and non-vegetated areas were present surrounding the existing Dwellings and along road verges (Photos 13, 33, 46, 48, 91).

Sub-section 3.2: Assessment outputs

The site plan and lot layout (Figure 2), minimises the loss of original remnant vegetation, while retaining important WRP habitat on Lot 5 and adjoining road reserves. Conceptual conversion of unmanaged grasslands and replanted vegetation across the entirety of lots 1-4 and 6-15 to low-threat status as per the specifications of Schedule 1, is illustrated in Figure 6. BAL contours for this conceptual vegetation treatment after development (Figure 7), confirm that ratings of ≤BAL-29 under FDI 80 conditions are achievable, consistent with the requirements of SPP3.7. An area of replanted, eastern states Eucalypts (Photo 23), is required to be removed in the southeast portion of Lot 5 such that a building area (the cyan rectangle Figure 6) can achieve a rating of ≤BAL-29

While it is instructive for this preliminary structure plan stage of the proposed development, to demonstrate that ratings of ≤BAL-29 are possible with Low-threat vegetation being created within the boundaries of all proposed lots, at subsequent subdivisional stages of development, building envelopes and APZs are able to be nominated in the next stage BMP, to further minimise the removal of existing mature replanted trees on many lots.

Individual BAL assessments may also be required, after the sale of lots as part of building approvals, once final lot layouts, vegetation maintenance treatments, building envelope location and building geometry have been determined.

Management of the existing vegetation and any future landscaping within the nominated APZs, will need to be consistent with Schedule 1, to ensure subsequent dwelling remain at ≤BAL-29 in perpetuity.

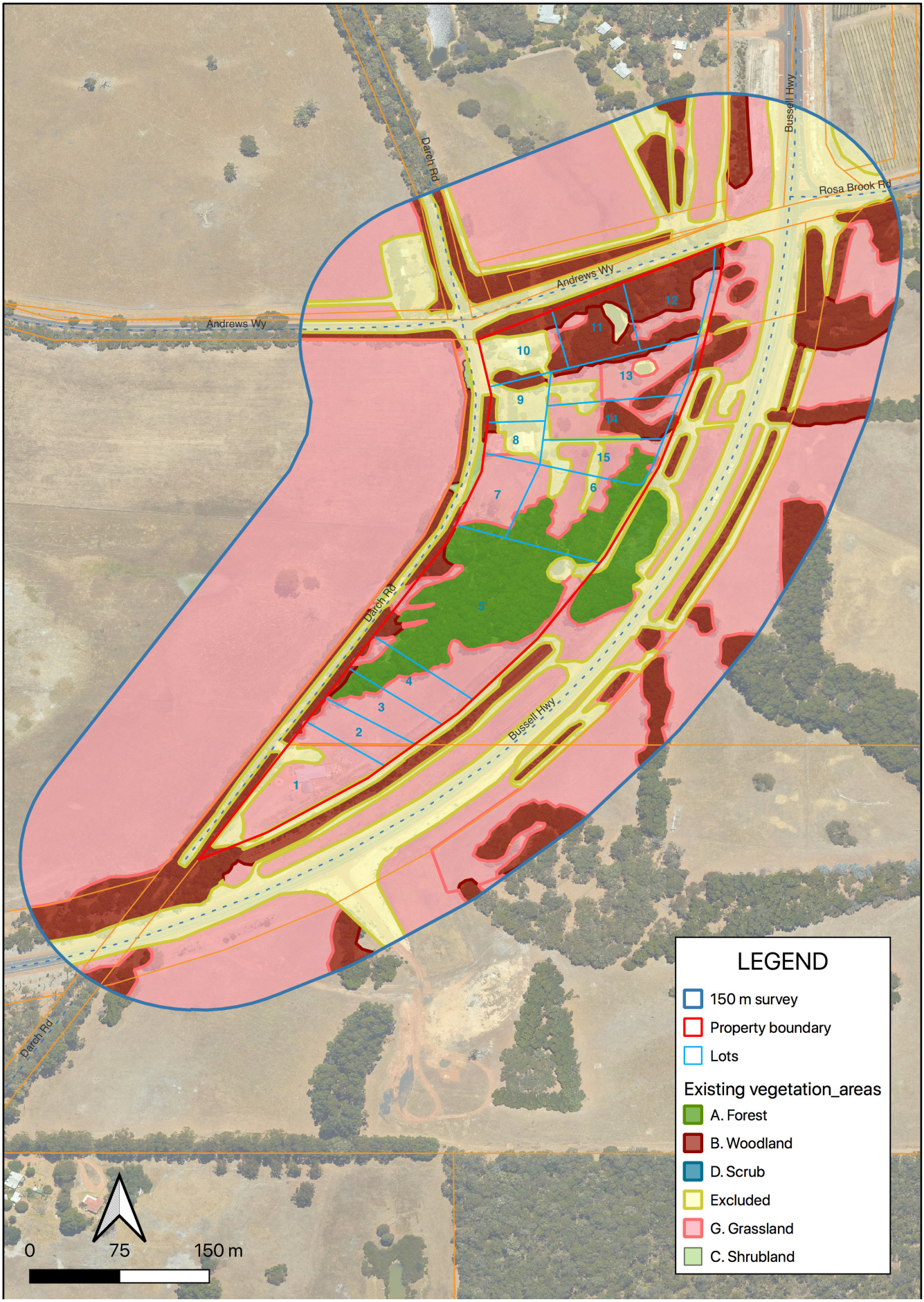


Figure 5 Vegetation classified existing for the site and its 150 m surrounds (as per AS3959)

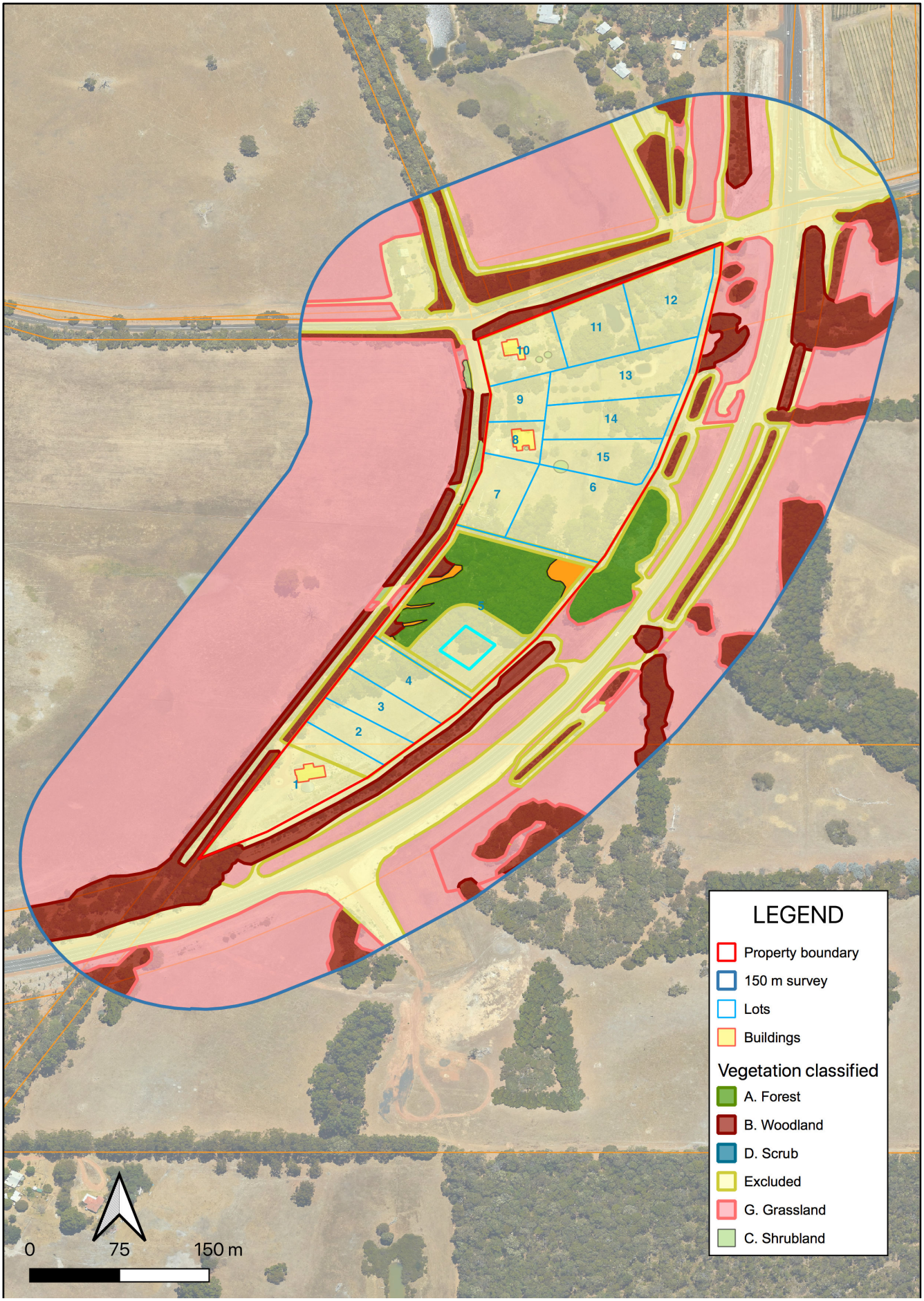


Figure 6 Conceptual conversion of vegetation on lots 1-4 and 6-15, to Low-threat status

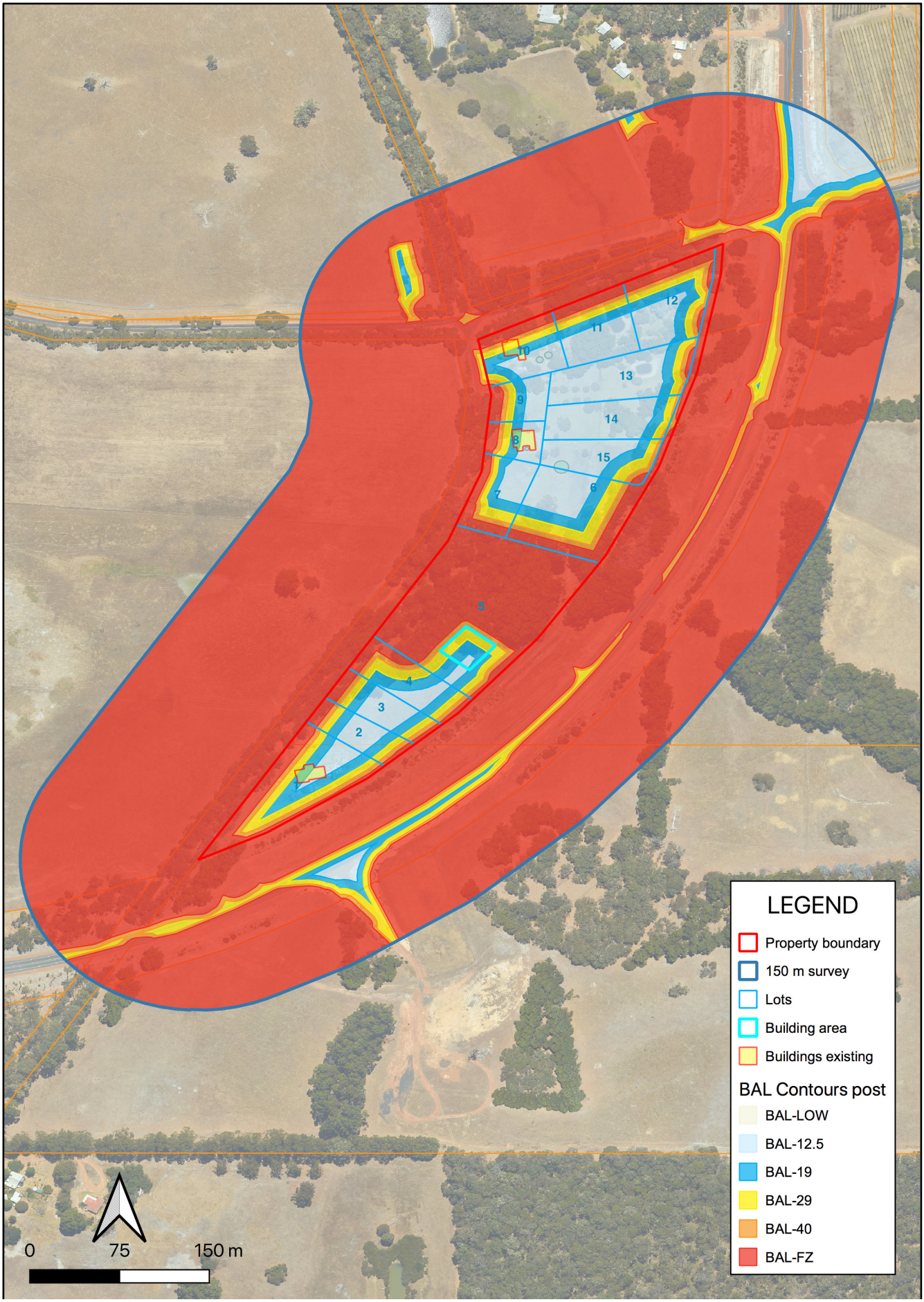


Figure 7 BAL contours after conceptual conversion of lots 1-4, 6-15 to low-threat and lot 5 to ≤BAL-29

Sub-section 3.3: Ground Photos

GROUND PHOTO 50

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 52

DIRECTION: **SE** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 53

DIRECTION: **SE** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 49

DIRECTION: **NW** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 47

DIRECTION: **N** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 48

DIRECTION: **N** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 46

DIRECTION: **NE** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 42

DIRECTION: **S** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 41

DIRECTION: **N** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 40

DIRECTION: **N** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 38

DIRECTION: **N** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 35

DIRECTION: **S** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 33

DIRECTION: **N** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 82

DIRECTION: **SE** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 77

DIRECTION: **E** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 76

DIRECTION: **N** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 73

DIRECTION: **SE** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 75

DIRECTION: **N** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 71

DIRECTION: **E** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 86

DIRECTION: **SE** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 88

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 26

DIRECTION: **W** SAMPLE POINT: **SITE**



Class A Forest

GROUND PHOTO 27

DIRECTION: **SE** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 25

DIRECTION: **S** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 23

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class A Forest

GROUND PHOTO 20

DIRECTION: **NE** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 15

DIRECTION: **SE** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 09

DIRECTION: **E** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 12

DIRECTION: **SW** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 13

DIRECTION: **NE** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(e)

GROUND PHOTO 08

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class A Forest

GROUND PHOTO 06

DIRECTION: **S** SAMPLE POINT: **SITE**



Class A Forest

GROUND PHOTO 05

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class B Woodland

GROUND PHOTO 03

DIRECTION: **SE** SAMPLE POINT: **SITE**



Class A Forest

GROUND PHOTO 98

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class A Forest

GROUND PHOTO 94

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 93

DIRECTION: **SW** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 92

DIRECTION: **N** SAMPLE POINT: **SITE**



Class G Grassland

GROUND PHOTO 91

DIRECTION: **S** SAMPLE POINT: **SITE**



Excluded 2.2.3.2(f)

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Section 4: Identification of bushfire hazard issues

The main bushfire threats to the development include extensive unmanaged Class G Grassland on all sides of the development together with Class A Forest along Darch Road and Andrews Way and running through Lot 5. With subdivision, perimeter firebreaks and establishment of Low-threat APZs within all lots, the risk can be significantly reduced. As the site is located in an agricultural area, the extensive Class G Grassland surrounding the development pose a threat but in their managed state as grazed land, the threat is reduced.

The Wooditjup National Park 550 m to the east of the site is could also pose a threat through ember attack with strong eastly winds.

Section 5: Assessment against the bushfire protection criteria

Sub-section 5.1: Compliance table

Table 1: Compliance table for bushfire protection criteria.

Bushfire protection criteria	**Method of compliance** **Acceptable solutions**	**Proposed bushfire management strategies**
Element 1: Location	A1.1 Development location The proposed development is inside the perimeter road boundary of Margaret River township and as such is a suitable area for increased population densities. The development is located in an area that on completion, will be subject to BAL–29 or below. **This meets the intent of Element A1.1.**	Much of the development and its immediate surrounds are Class G Grasslands. This is considered a Moderate Bushfire Hazard Level (BHL). Areas of Forest and Woodland surrounding and within the development pose an Extreme BHL but the risks posed by these areas can be managed through appropriate siting of building envelopes and APZs.
Element 2: Siting and design	A2.1 Asset Protection Zone Every habitable building will need to be surrounded by an APZ, such that ratings of BAL-29 are possible. **This meets the intent of Element A2.1.**	Building envelopes and APZs around all proposed habitable structures will be managed to the specifications of Schedule 1, and will comply with the annual Shire of Augusta-Margaret River Bushfire Management Notice.
Element 3: Vehicular access	A3.1 Two access routes. Access / egress is directly onto Andrews Retreat and Darch Road (Figure 8), which offer the option of two separate destinations. **This meets the intent of Element A3.1.**	The proposed development will have access to Andrews Way from lots 6, 11-15 and via Darch Road for lots 1-5 & 7-10. Andrews Way connects to Old Bussell Highway to the west. Egress from Darch Road and Andrews Retreat travelling North has connection to an existing Emergency Access Way (Darch Road North) that continues to John Archibald Drive.
	A3.2 Public road. N/A There are no public roads within the development	Andrews Way and Darch Road are Public Roads and meet the specifications of Table 6, Vehicle access technical requirements.

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
	A3.3 Cul-de-sac (including a dead-end-road) Construction by Main Roads of the Bussell Hwy ring road created a short 216 m Cul-de-sac from Darch Road to the east (Figure 8). This public road section was previously part of Rosa Brook Road a regional connector, is sealed, two-way, all-weather capable and conforms to the specifications of Table 6 column 2. There was/is no alternative. **This meets the intent of A3.3.**	This short section of public road was created by construction of the Bussell Hwy ring road. It conforms to Table 6 column 2.
	A3.4 Battle-axe An unavoidable 260 m Battle axe leg services through a 10 m wide reciprocal rights easement, Lots 6 & 13-15 (Figure 8), necessitated by the construction of the Bussell Highway ring road. There was/is no alternative. **This meets the intent of A3.4.**	The 260 m battle-axe leg and reciprocal rights easement will be built to the specifications of Table 6 column 1.
	A3.5 Private driveway longer than 50 metres. Private driveway on lot 5 is 74 m long with remaining lots <50 m from a public road (or reciprocal rights access as discussed in A3.4 above). **This meets the intent of Element A3.5.**	All driveways on proposed lots will be constructed to meet the specifications of Table 6 column 3, Vehicle access technical requirements including turn-around areas for a type 3.4 fire appliances.
	A3.6 Emergency access way Darch Road and Andrews Way connect to an existing Emergency Access Way (ie. Darch Road North) that in turn connects to John Archibald Drive. No additional EAW is required. **This meets the intent of Element A3.6.**	The existing Darch Road North EAW has been previously constructed to the specifications of Table 6 column 4.
	A3.7 Fire service access routes (perimeter roads) **N/A**	The existing public road network provides adequate emergency access.
	A3.8 Firebreak width Existing perimeter firebreaks will be upgraded and extended into all created Lots >4,000 m^2. **This meets the intent of Element A3.8.**	Perimeter firebreaks will be established on Lots 1, 5, 6, 11, 12 and 13 which are all >4,000 m^2, as directed in the current Shire of Augusta-Margaret River Bushfire Management Notice.
Element 4: Water	A4.1 Reticulated areas **N/A**	The proposed development is not serviced by reticulated systems.
	A4.2 Non-reticulated areas **This meets the intent of Element A4.2.**	The proposed development is 800 m to nearest residential zoned area where reticulated fire hydrants are available to the Water Corporation's No 63 Water Reticulation Standard. These hydrants will allow for a less than 20-minute turn-around time.
	A4.3 Individual lots **N/A**	

Sub-section 5.2: Additional management strategies

Bushfire management measures (Figure 10) include:

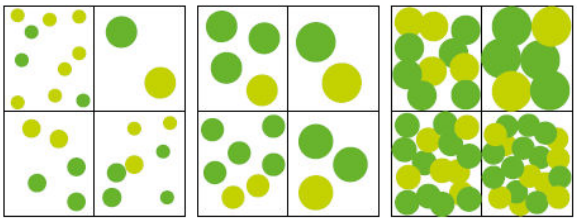
- **Fuel management:** Vegetation within created vacant lots will be maintained to Schedule 1 by the developer, until Lots are sold;
- **Compliance with annual firebreak notice:** Developers, land managers and prospective land purchasers are to comply with the Annual Shire of Augusta Margaret River Bushfire Management Notice (refer to Appendix 1);
- **Purchaser Advice:** All prospective purchasers will be made aware of the fire management issues, measures and responsibilities associated with the subdivision including BAL and AS3959:2018 – Construction of buildings in bushfire prone area requirements; and,
- **Egress:** All egress routes must be maintained in a trafficable condition (refer Table 6).

Schedule 1: Standards for Asset Protection Zones

SCHEDULE 1: STANDARDS FOR ASSET PROTECTION ZONES

- **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
- **Objects:** within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.
- **Fine Fuel load:** combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare.
- **Trees (> 5 metres in height):** trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.

Figure 18: Tree canopy cover – ranging from 15 to 70 per cent at maturity



- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m² in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

Table 6 Vehicular access technical requirements

TECHNICAL REQUIREMENTS	1 Public road	2 Cul-de-sac	3 Private driveway	4 Emergency access way	5 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					

Source: *Schedule 1 and Table 6 have been reproduced from WAPC bushfire guidelines V1.3 Appendices.*

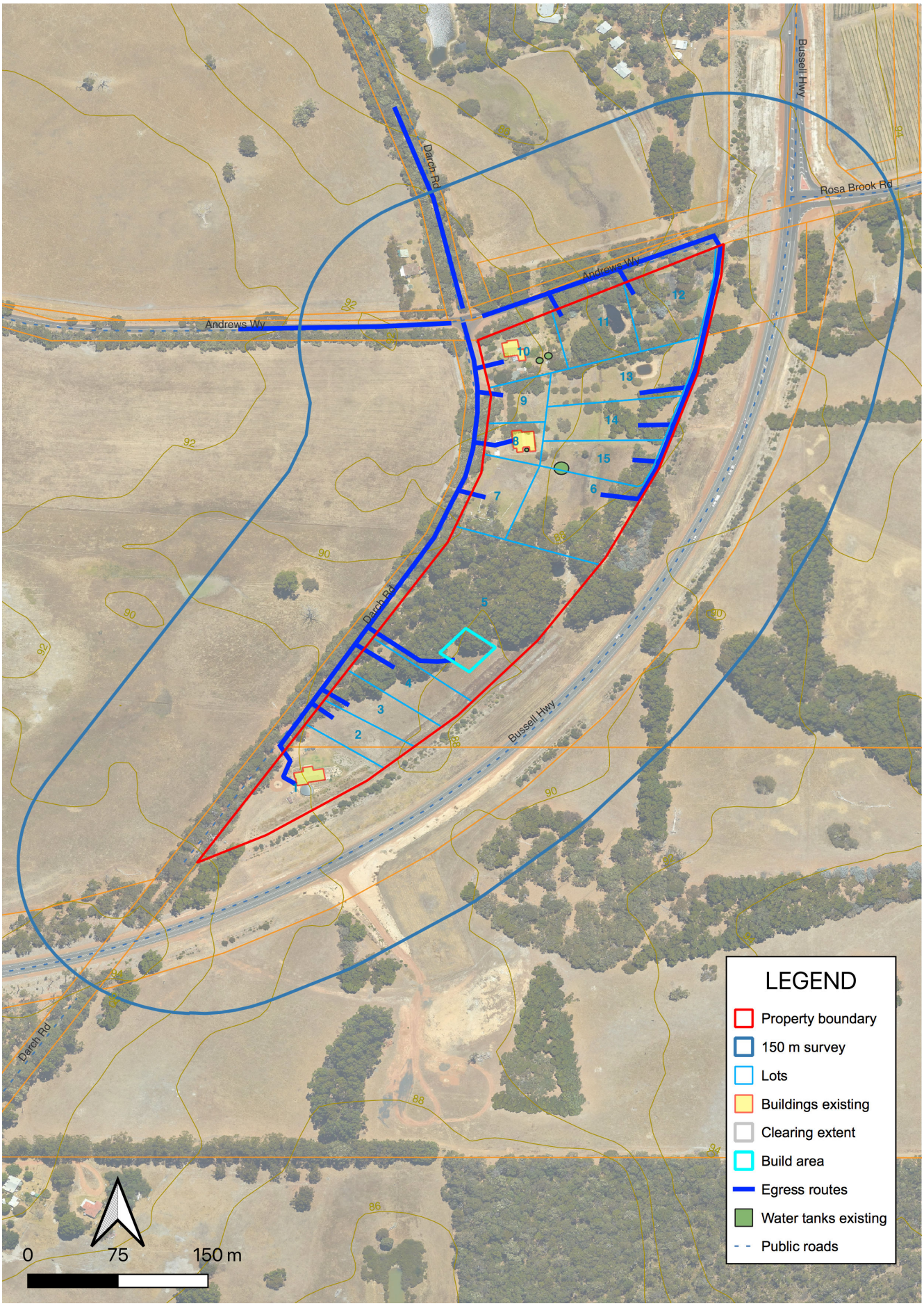


Figure 8 Bushfire management measures

Section 6: Responsibilities for implementation

DEVELOPER/LANDOWNER – PRIOR TO SALE OR OCCUPANCY	
No.	**Implementation action**
1	Install private driveway and reciprocal rights easement access to the standards stated in the BMP
2	Establish the Asset Protection Zones to the dimensions and standard stated in the BMP
3	Comply with the Shire of Augusta-Margaret River's annual fire management notice issued under S33 of the Bush Fires Act 1954.
4	Provide guidance for Lot purchasers to obtain individual BAL assessments to AS3959:2018 for their proposed building envelopes and dwellings.

LANDOWNER/OCCUPIER – ONGOING MANAGEMENT	
No.	**Management action**
1	Maintain the Asset Protection Zone to the dimensions and standard stated in the BMP
2	Comply with the Shire of Augusta-Margaret River's annual fire management notice issued under S33 of the Bush Fires Act 1954.
3	Maintain vehicular access routes within the lot to the required surface condition and clearances

LOCAL GOVERNMENT	
No.	**Management action**
1	Provide annual fire management notices.
2	Monitor land owner compliance with regulations.
3	Promote education and awareness of bushfire prevention and preparation measures.

Appendices

Appendix 1 Shire of Augusta Margaret River Bush Fire Management Information Booklet 2018-2019

(https://www.amrshire.wa.gov.au/services/community-safety/bush-fire-management-information-booklet-20182019)

Appendix C

Transportation Noise Assessment

Prepared by Lloyd George Acoustics

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Transportation Noise Assessment

Pt. Lot 4 and Lots 31 & 5 Darch Road, Margaret River

Reference: 20034534-01B

Prepared for:
N & K Veitch

Reference: 20034534-01B

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This report has been prepared in accordance with the scope of services described in the contract or agreement between Lloyd George Acoustics Pty Ltd and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client, and Lloyd George Acoustics Pty Ltd accepts no responsibility for its use by other parties.

Date	Rev	Description	Author	Verified
3-Aug-20	-	Issued to Client	Daniel Lloyd	Terry George
31-Aug-21	A	Layout Updated	Daniel Lloyd	Terry George
7-Aug-26	B	Layout Updated	Matt Moyle	Terry George

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1. INTRODUCTION

It is proposed to subdivide land at Pt. Lot 4 and Lots 31 & 5 Darch Road, Margaret River (refer *Figure 1-1*) with the proposed subdivision plan shown in *Figure 1-2*. The site adjoins Margaret River Perimeter Road, such that a noise assessment is required in accordance with *State Planning Policy No. 5.4 Road and Rail Noise*, being the subject of this report.

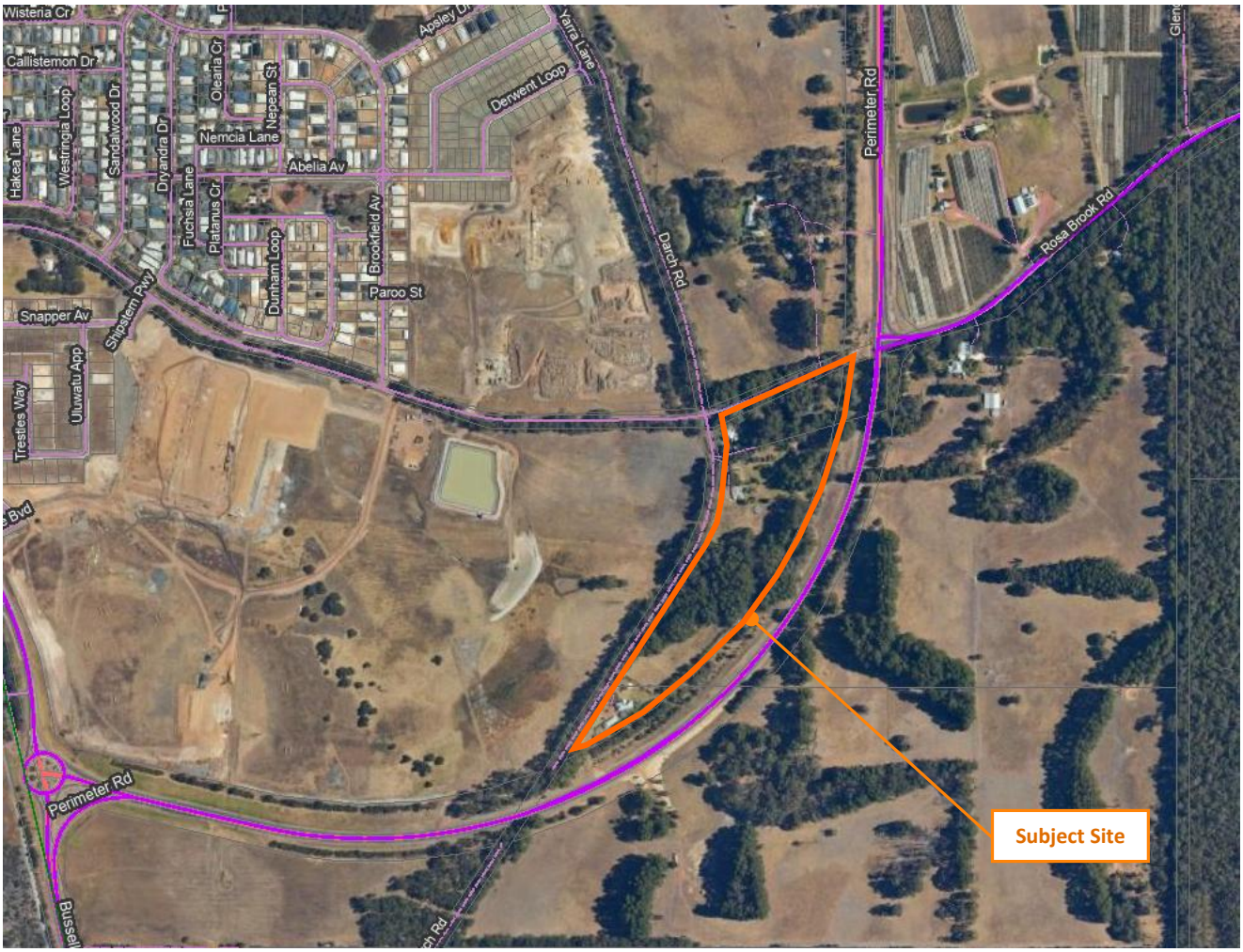


Figure 1-1: Subdivision Location (Source: DPLH PlanWA)

Appendix B contains a description of some of the terminology used throughout this report.

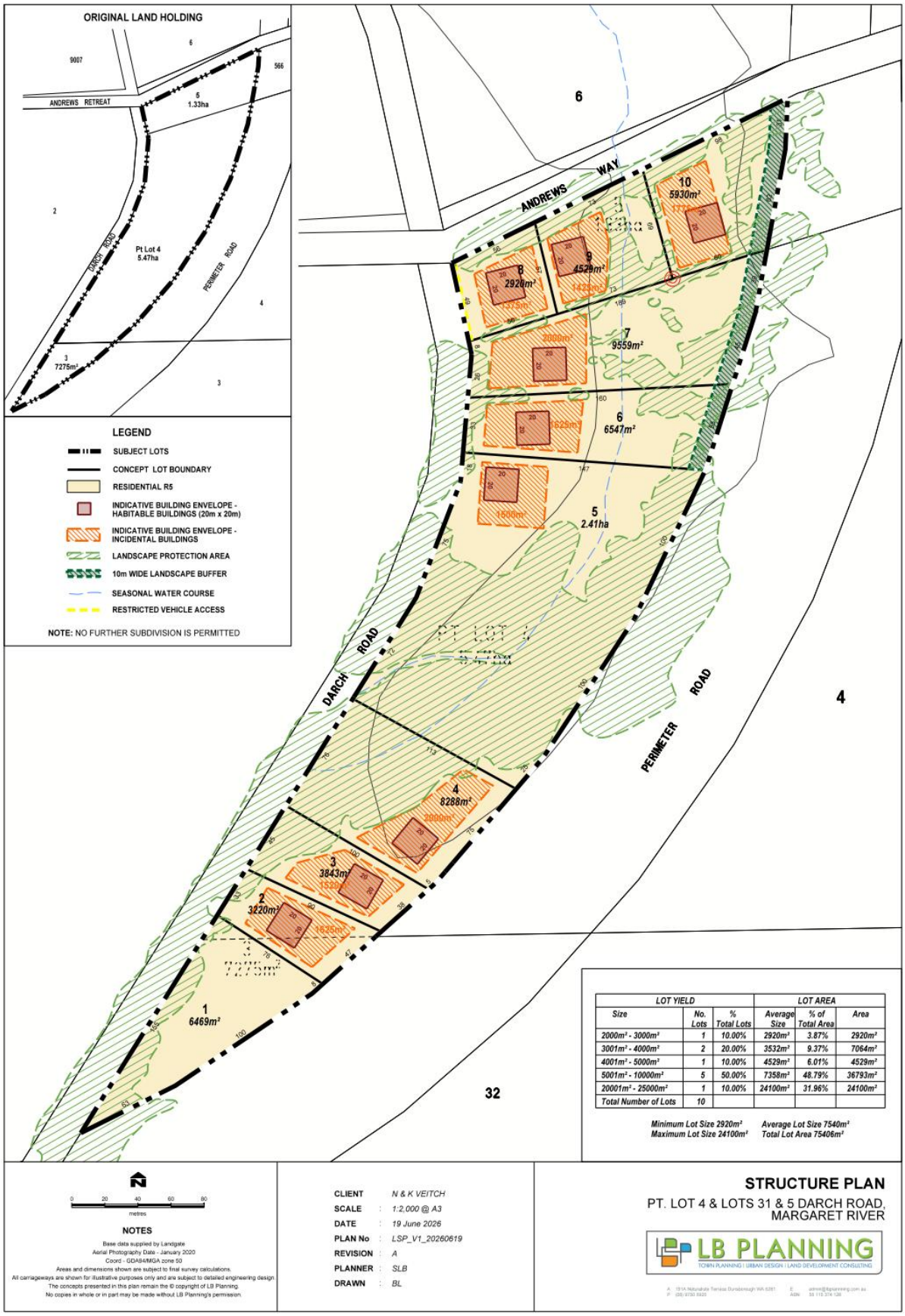


Figure 1-2: Subdivision Layout

2. CRITERIA

The criteria relevant to this project is provided in *State Planning Policy No. 5.4 Road and Rail Noise* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). SPP 5.4 is supported by the *Road and Rail Noise Guidelines* (the Guidelines) and the Department of Planning, Lands and Heritage mapping. The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards.

Table 2-1 sets out noise targets that are to be achieved by proposals under which SPP 5.4 applies. Where the targets are exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.

Table 2-1: Noise Targets for Noise Sensitive Land-Use

Scenario	Outdoor Noise Target		Indoor Noise Target	
Noise-sensitive land-use and/or development	55 dB $L_{Aeq(Day)}$	50 dB $L_{Aeq(Night)}$	40 dB $L_{Aeq(Day)}$ (Living and Work Areas)	35 dB $L_{Aeq(Night)}$ (Bedrooms)

Notes:

- Day period is from 6am to 10pm and night period from 10pm to 6am.
- The outdoor noise target is to be measured at 1-metre from the most exposed, habitable[1] facade of a noise sensitive building.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors* (as amended) for each relevant time period.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practicable to do so using the various noise mitigation measures outlined in the Guidelines.

The application of SPP 5.4 is to consider anticipated traffic volumes for the next 20 years from when the noise assessment has been undertaken.

[1] A habitable room is defined in State Planning Policy 3.1 as a room used for normal domestic activities that includes a bedroom, living room, lounge room, music room, sitting room, television room, kitchen, dining room, sewing room, study, playroom, sunroom, gymnasium, fully enclosed swimming pool or patio.

3. METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of SPP 5.4 and associated Guidelines, as described in *Section 3.1* and *Section 3.2*.

3.1. Site Measurements

Noise monitoring was undertaken at 192 Rosa Brook Road using a Ngara Noise Data Logger (S/N: 87803A) (refer *Figure 3-1*). The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. The logger complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within ± 1 dB. Lloyd George Acoustics holds current laboratory calibration certificate for the logger.

The microphone was approximately 1.4 metres above existing ground level and approximately 115 metres from the edge of Margaret River Perimeter Road main carriageway. The measurements were recorded between 9 March 2020 and 14 March 2020.



Figure 3-1: Noise Logger Location

3.2. Noise Modelling

The computer program *SoundPLAN 8.2* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Class 1 and 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two source heights at 1.5 metres and 3.6 metres above road level;
- A -0.8 dB correction has been applied to the lower level heavy vehicle noise source and -8.0 dB to the higher level noise source based on the *Transportation Noise Reference Book*; Paul Nelson (1987), so as to provide consistent results with the CoRTN algorithms;

- Adjustments of -0.8 dB and -1.7 dB have been applied to the predicted levels for the 'free-field' and 'at façade' cases respectively, based on the findings of *An Evaluation of the U.K. DoE Traffic Noise Prediction*; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group (March 1983).

Predictions are made at heights of 1.4 metres above ground floor level for single storey buildings and 4.2 metres above ground floor level for possible first floors of double storey buildings. The noise is predicted at 1-metre from an assumed building façade, resulting in a + 2.5 dB correction due to reflected noise.

Various input data are included in the modelling and these are discussed in *Section 3.2.1* to *Section 3.2.5*.

3.2.1. Ground Topography

Topographical and road design data for this project was taken from publicly available data e.g. Google Earth. At this stage information on subdivision levels are unknown and therefore the modelling uses the existing topography.

The design levels of the Perimeter Road were obtained from Main Roads WA.

3.2.2. Road Surface

The corrections applied for different road surface finishes are provided in *Table 3-1* (as provided in SPP 5.4 Guidelines).

Table 3-1: Noise Relationship Between Different Road Surfaces

Chip Seal				Asphalt			
14mm	10mm	5mm	Slurry	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	+1.0 dB	0.0 dB	-0.2 dB	-1.5 dB	-2.5 dB

The existing road surface is 10mm chip seal and assumed to remain unchanged into the future.

3.2.3. Vehicle Speed

The existing posted speed is 100 km/hr and assumed to remain unchanged into the future.

3.2.4. Traffic Volumes

Existing and forecast (2031) traffic volumes were obtained via the Main Roads WA website. The source was the publically available document detailing the results of the post-construction noise monitoring program (*Lloyd George Acoustics; Ref 19055010-01; dated 25/10/19*). *Table 3-2* provides the traffic volume input data in the model. While it is acknowledged that the 2031 traffic volumes are short of the 20 year horizon, these volumes are representative of worst-case future modelling.

Table 3-2: Traffic Information Used in Noise Modelling

Parameter	Scenario	
	Existing – 2019	Future – 2031
24-hour Volume	1,220	1,220
% Heavy	10	10

3.2.5. Ground Absorption

The ground absorption has been assumed to be 0.0 (0%) for the roads, 0.5 (50%) outside of the roads and 1.0 (100%) for public open spaces, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

4. RESULTS

4.1. Noise Monitoring

The results of the noise monitoring are summarised in *Table 4-1* and shown graphically in *Figure 4-1*.

Table 4-1: Measured Average Noise Levels at Logger

Date	Parameter			
	$L_{A10,18hour}$, dB	$L_{Aeq,24hour}$, dB	$L_{Aeq(Day)}$, dB	$L_{Aeq(Night)}$, dB
9/03/2020	49.9	47.7	48.9	43.1
10/03/2020	51.4	48.9	50.4	41.3
11/03/2020	52.0	48.7	50.2	42.2
12/03/2020	53.8	50.9	52.4	43.6
13/03/2020	52.0	49.1	50.2	45.5
9/03/2020	49.9	47.7	48.9	43.1
Average	**51**	**49**	**50**	**43**

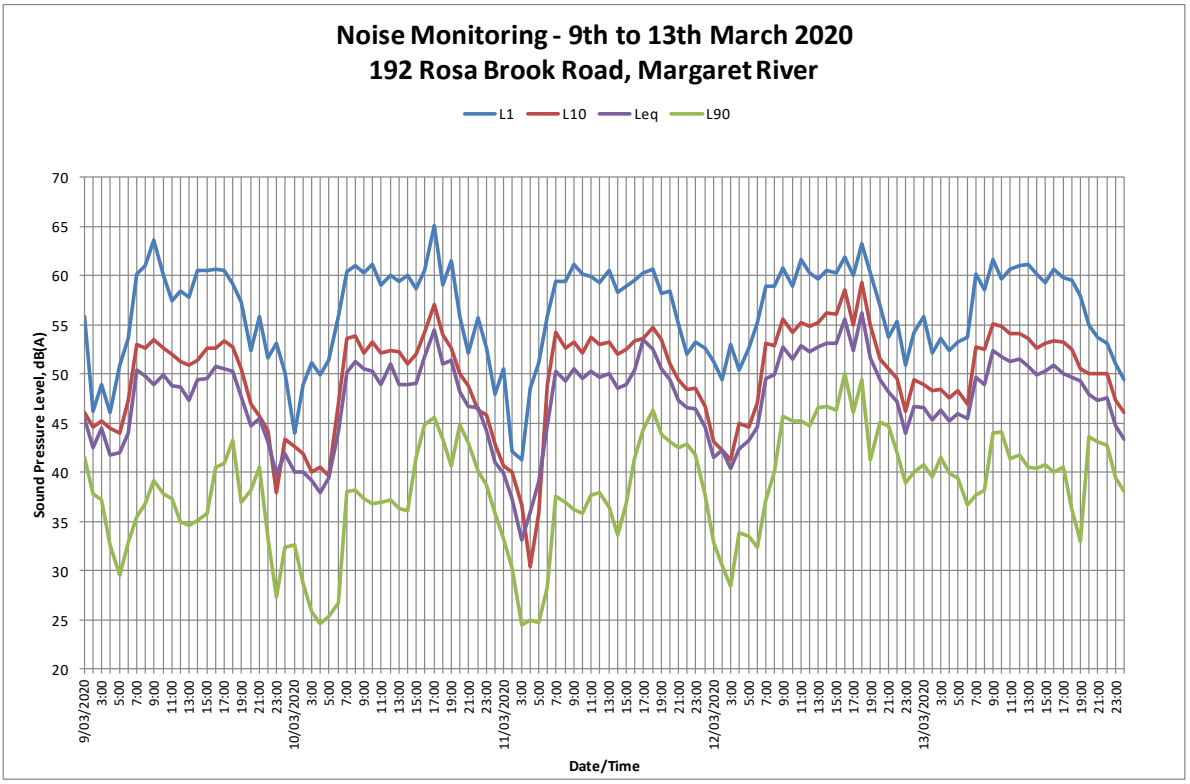
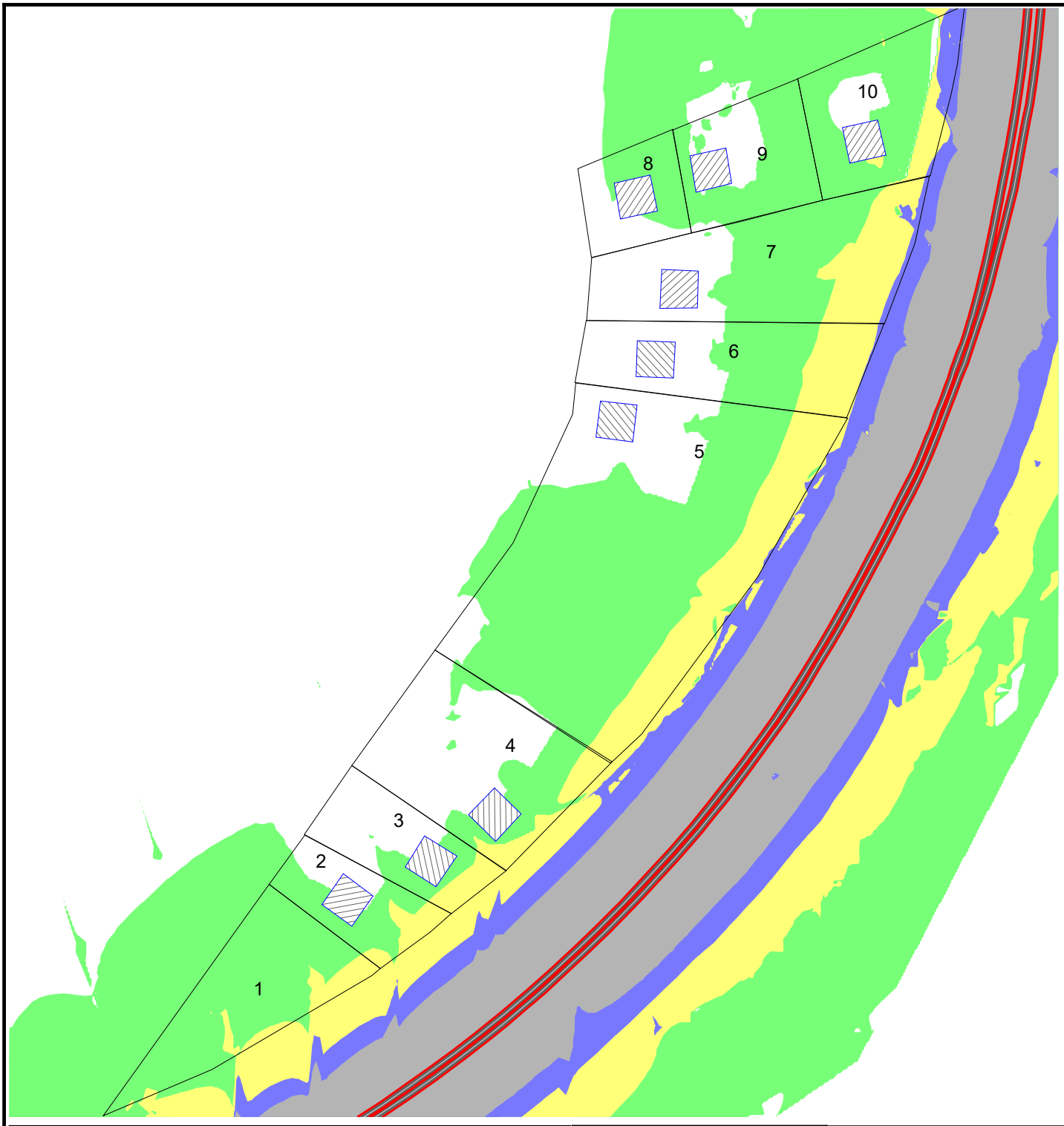


Figure 4-1: Hourly Noise Measurement Results at Noise Logger

The average difference between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 7 dB and this same difference has been assumed to exist in future years. As the difference between these two parameters is more than 5 dB, it is the daytime noise that will dictate compliance or otherwise.

4.2. Noise Modelling

The noise model was initially set-up for existing conditions and calibrated to the noise measurement location. The model is then updated to include the proposed subdivision, indicative buildings and future traffic volumes, maintaining the same model calibration. It should be noted that the location of the houses is in line with the Bushfire Management Plan (*Working on Fire Planning; Lot 4 & 5 Andrews Retreat, Margaret River; ref 20190315; date 6/03/2020*). The results of the noise modelling are provided as a noise contour plot in *Figure 4-2*.



Proposed Subdivision
Pt. Lot 4 and Lots 31 & 5 Darch Rd, Margaret River

Noise Level Contours

$L_{Aeq(Day)}$ Noise Level Contours Based on Future Conditions
Ground Floor Level

SoundPlan v8.2
CoRTN Algorithms

7 August 2026

Signs and symbols
- Road
- Indicative House

N

Noise levels
$L_{Aeq,Day}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

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Length Scale 1:10000
0 50 100 200 300 400 m

Figure 4-2

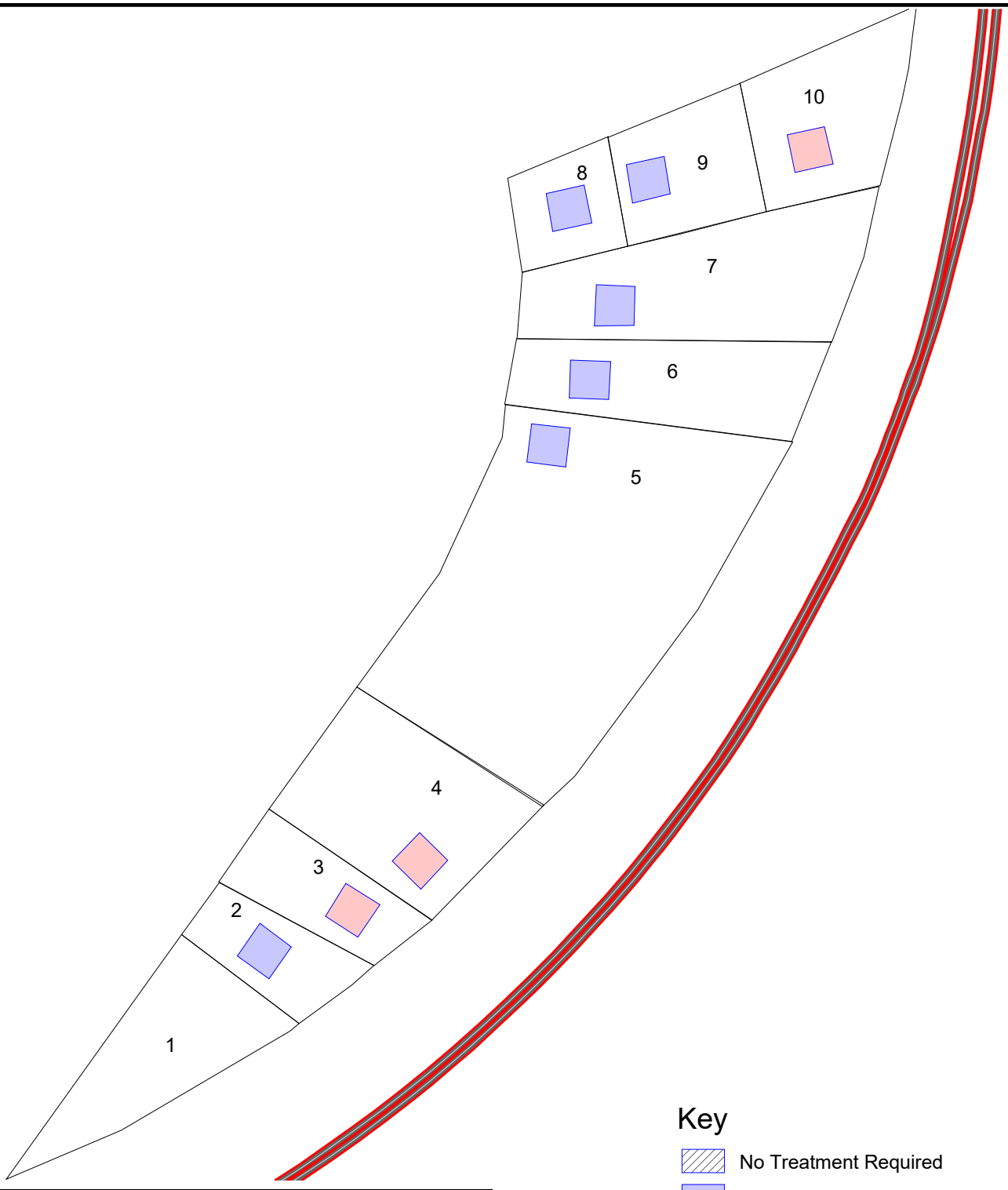
5. ASSESSMENT

The objectives of SPP 5.4 are to achieve:

- Indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- A reasonable degree of acoustic amenity for outdoor living areas on each residential lot.

Where the outdoor noise targets of *Table 2-1* are achieved, no further noise controls are necessary. With reference to *Section 4.2*, it is evident the outdoor noise target will be exceeded. It is not considered practicable to reduce the noise to below the target, as that would require a noise barrier along the entire property boundary in excess of 5.0m high.

Therefore, Quiet House Packages are required to dwellings on lots shown on *Figure 5-1* and *Figure 5-2*, being for ground floor and first floor levels respectively. *Appendix A* provides the Quiet House Packages, as taken from the SPP 5.4 Guidelines. Alternatives to the provided Packages can be accepted if supported by a report from a suitably qualified acoustical consultant (member firm of the Association of Australasian Acoustical Consultants (AAAC)) once the specific house plans for the lot are available. In addition, each of these lots will require a notification on title in accordance with SPP 5.4.



Key

- No Treatment Required
- "Package A" Treatment
- "Package B" Treatment
- "Package C" Treatment
- Road

Proposed Subdivision
Pt. Lot 4 and Lots 31 & 5 Darch Rd, Margaret River

Noise Mitigation Treatments - Upper Floor

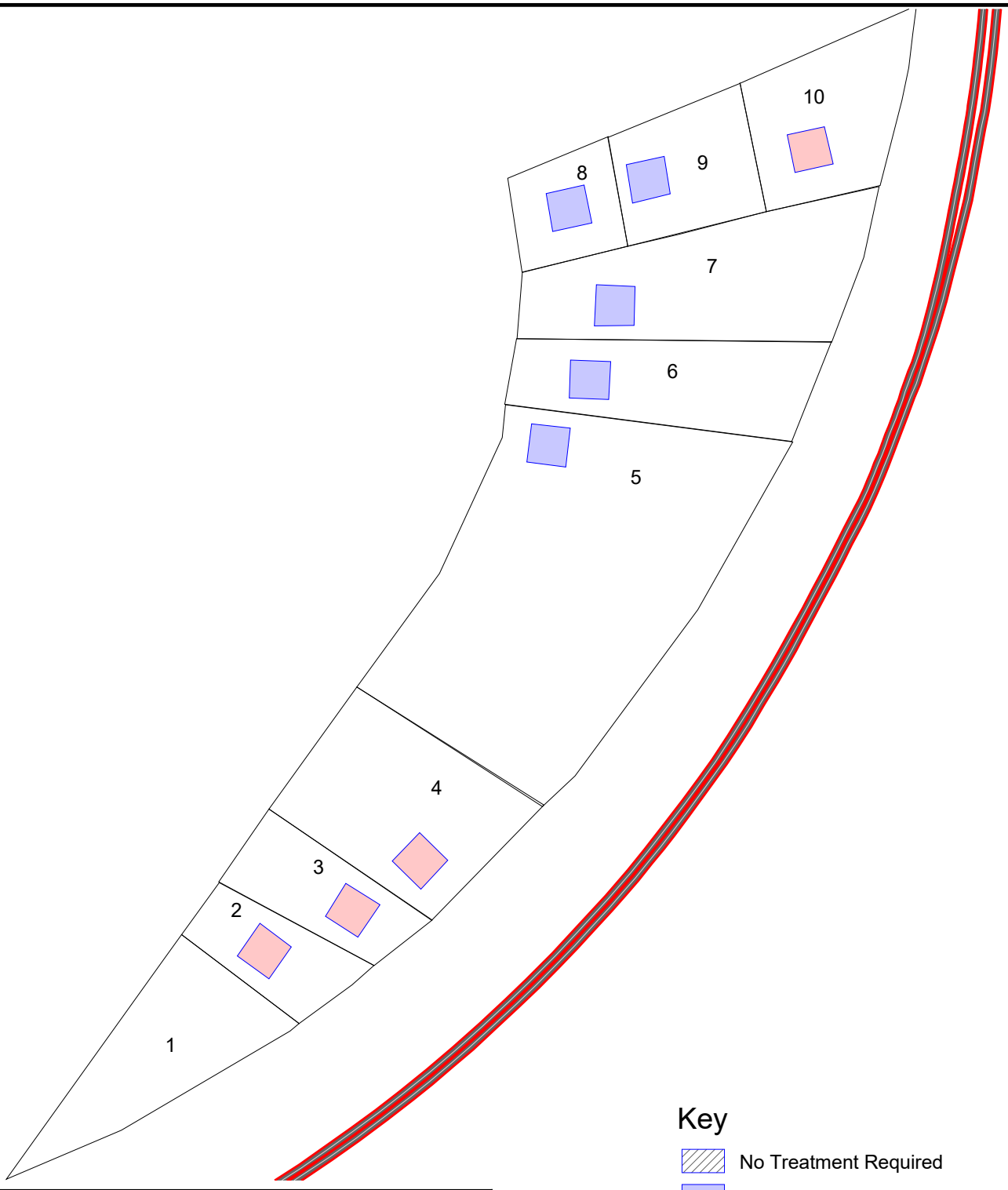
7 August 2026

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Length Scale 1:10000

0 50 100 200 300 400 m

Figure 5-1



Key

- No Treatment Required
- "Package A" Treatment
- "Package B" Treatment
- "Package C" Treatment
- Road

Proposed Subdivision
Pt. Lot 4 and Lots 31 & 5 Darch Rd, Margaret River

Noise Mitigation Treatments - Upper Floor

7 August 2026

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Length Scale 1:10000

0 50 100 200 300 400 m

Figure 5-2

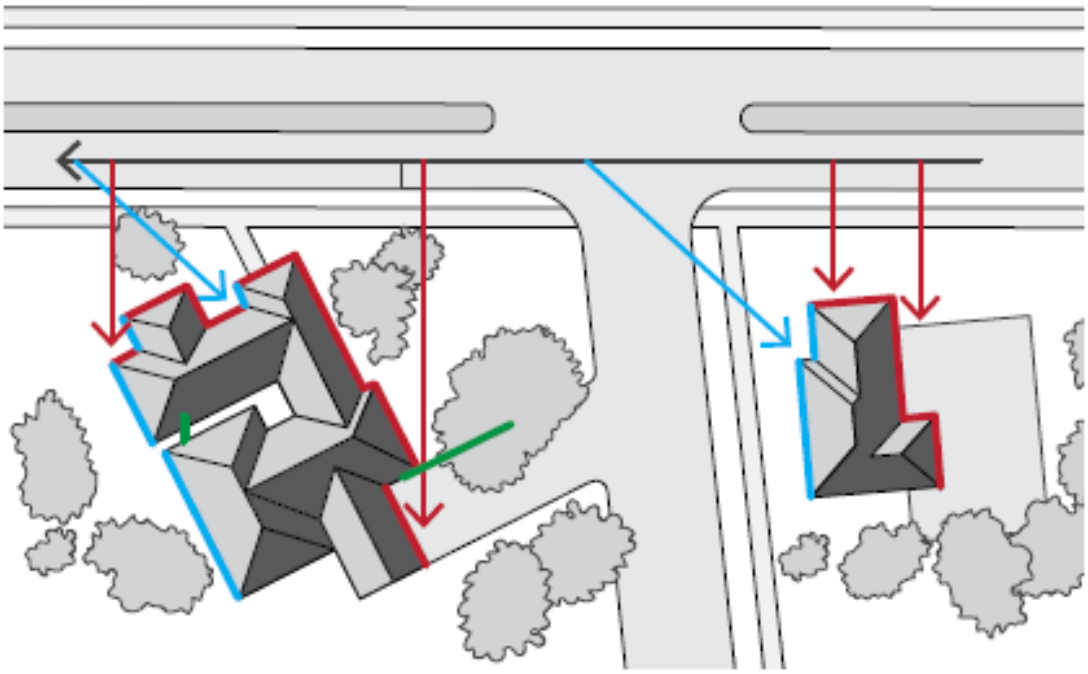
Appendix A – Quiet House Packages

The packages and information provided on the following pages are taken from *Road and Rail Noise Guidelines* (September 2019).

Where outdoor and indoor noise levels received by a noise-sensitive land-use and/or development exceed the policy's noise target, implementation of quiet house requirements is an acceptable solution.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor (red): Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular (at a 90 degree angle) to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor (blue): Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line, at any angle, can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor (green): Neither 'side on' nor 'facing', as defined above.



Quiet House Package A

56-58 dB $L_{Aeq(Day)}$ & 51-53 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Glazing	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): – Sliding or double hung with minimum 10mm single or 6mm-12mm-10mm double insulated glazing; – Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$): – Sealed awning or casement windows with minimum 6mm glass.	• Up to 40% floor area ($R_w + C_{tr} \geq 25$): – Sliding or double hung with minimum 6mm single or 6mm-12mm-6mm double insulated glazing; • Up to 60% floor area ($R_w + C_{tr} \geq 28$); • Up to 80% floor area ($R_w + C_{tr} \geq 31$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	No specific requirements	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.	• Doors to achieve $R_w + C_{tr} \geq 25$: – 35mm Solid timber core hinged door and frame system certified to R_w 28 including seals; – Glazed sliding door with 10mm glass and weather seals.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less.	
	Opposite	No specific requirements	
External Walls	All	• $R_w + C_{tr} \geq 45$: – Two leaves of 90mm thick clay brick masonry with minimum 20mm cavity; or – Single leaf of 150mm brick masonry with 13mm cement render on each face; or – One row of 92mm studs at 600mm centres with: ▪ Resilient steel channels fixed to the outside of the studs; and ▪ 9.5mm hardboard or fibre cement sheeting or 11mm fibre cement weatherboards fixed to the outside; ▪ 75mm thick mineral wool insulation with a density of at least 11kg/m^3; and ▪ 2 x 16mm fire-rated plasterboard to inside.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: • Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2 metres height above ground level.	

Quiet House Package B

59-62 dB $L_{Aeq(Day)}$ & 54-57 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Glazing	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): – Sliding or double hung with 6mm-12mm-10mm double insulated glazing; – Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$); • Up to 80% floor area ($R_w + C_{tr} \geq 34$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass.	• Doors to achieve $R_w + C_{tr} \geq 28$: – 40mm Solid timber core hinged door and frame system certified to R_w 32 including seals; – Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: – Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester (24kg/m³). Resilient ties used where required to connect leaves. – Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). – Single leaf of 220mm brick masonry with 13mm cement render on each face. – 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. – Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m³) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: – Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling with R3.0+ fibrous insulation.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Quiet House Package C

63-66 dB $L_{Aeq(Day)}$ & 58-61 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Glazing	Facing	• Up to 20% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 40% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Not recommended.	• Doors to achieve $R_w + C_{tr} \geq 30$: – Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass; – 40mm Solid timber core side hinged door, frame and seal system certified to R_w 32 including seals. Any glass inserts to be minimum 6mm.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: – Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). Resilient ties used where required to connect leaves. – Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m³). – Single leaf of 220mm brick masonry with 13mm cement render on each face. – 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. – Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m³) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 40$: – Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibrous insulation between steel sheeting and roof battens; – R3.0+ insulation batts above ceiling; – 2 x 10mm plasterboard ceiling or 1 x 13mm sound-rated plasterboard affixed using steel furring channel to ceiling rafters.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Mechanical Ventilation requirements

Where habitable room windows are openable to satisfy natural ventilation requirements of the NCC, means the occupant has the option to have windows open or closed to satisfy natural ventilation or acoustic requirements.

- Where ducted refrigerated air-conditioning is provided, incorporate fresh air duct intake;
- Evaporative systems require attenuated ceiling air vents to allow closed windows; and
- Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable.

Notification

Notifications on title advise prospective purchasers of the potential for noise impacts from major transport corridors and help with managing expectations.

The Notification is to state as follows:

This lot is in the vicinity of a transport corridor and is affected, or may in the future be affected, by road and rail transport noise. Road and rail transport noise levels may rise or fall over time depending on the type and volume of traffic.

Appendix B – Terminology

The following is an explanation of the terminology used throughout this report:

- **Decibel (dB)**

The decibel is the unit that describes the sound pressure levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

- **A-Weighting**

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A, dB.

- **L_{eq}**

The L_{eq} level represents the average noise energy during a measurement period.

- **L_1**

The L_1 level represents the noise level exceeded for 1 percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

- **L_{10}**

The L_{10} level represents the noise level exceeded for 10 percent of the measurement period and is considered to represent the “intrusive” noise level.

- **L_{90}**

The L_{90} level represents the noise level exceeded for 90 percent of the measurement period and is considered to represent the “background” noise level.

- **$L_{Aeq(Day)}$**

The $L_{Aeq(Day)}$ level is the logarithmic average of the L_{Aeq} levels from 6.00am to 10.00pm.

- **$L_{Aeq(Night)}$**

The $L_{Aeq(Night)}$ level is the logarithmic average of the L_{Aeq} levels from 10.00pm to 6.00am.

- **$L_{A10,18hour}$**

The $L_{A10,18hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00am and midnight.

- **$L_{Aeq,24hour}$**

The $L_{Aeq,24hour}$ level is the logarithmic average of the L_{Aeq} levels from over an entire day.

- **Noise-sensitive land use and/or development**

Land-uses or development occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan park, camping ground, educational establishment, child care premises, hospital, nursing home, corrective institution or place of worship.

- **R_w**

This is the weighted sound reduction index. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

- **C_{tr}**

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of – 4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -12 dB.

- **About the Term 'Reasonable'**

An assessment of reasonableness should demonstrate that efforts have been made to resolve conflicts without comprising on the need to protect noise-sensitive land-use activities. For example, have reasonable efforts been made to design, relocate or vegetate a proposed noise barrier to address community concerns about the noise barrier height? Whether a noise mitigation measure is reasonable might include consideration of:

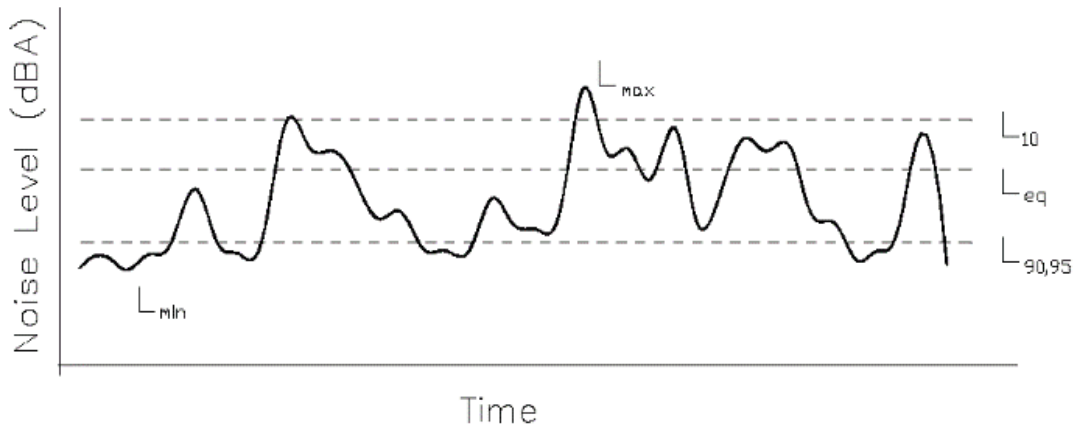
  - The noise reduction benefit provided;
  - The number of people protected;
  - The relative cost vs benefit of mitigation;
  - Road conditions (speed and road surface) significantly differ from noise forecast table assumptions;
  - Existing and future noise levels, including changes in noise levels;
  - Aesthetic amenity and visual impacts;
  - Compatibility with other planning policies;
  - Differences between metropolitan and regional situations and whether noise modelling requirements reflect the true nature of transport movements;
  - Ability and cost for mobilisation and retrieval of noise monitoring equipment in regional areas;
  - Differences between Greenfield and infill development;
  - Differences between freight routes and public transport routes and urban corridors;
  - The impact on the operational capacity of freight routes;
  - The benefits arising from the proposed development;
  - Existing or planned strategies to mitigate the noise at source.

- **About the Term 'Practicable'**

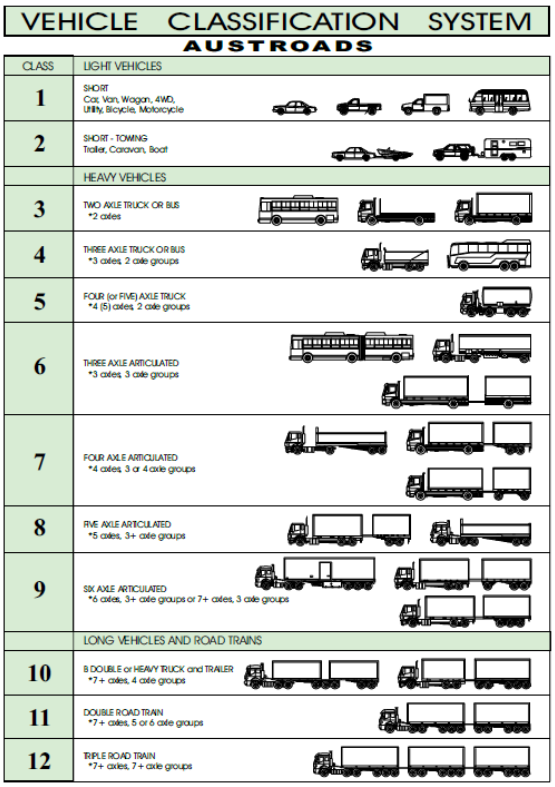
'Practicable' considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. It is defined as "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge" (*Environmental Protection Act 1986*). These may include:

- Limitations of the different mitigation measures to reduce transport noise;
- Competing planning policies and strategies;
- Safety issues (such as impact on crash zones or restrictions on road vision);
- Topography and site constraints (such as space limitations);
- Engineering and drainage requirements;
- Access requirements (for driveways, pedestrian access and the like);
- Maintenance requirements;
- Bushfire resistance or BAL ratings;
- Suitability of the building for acoustic treatments.

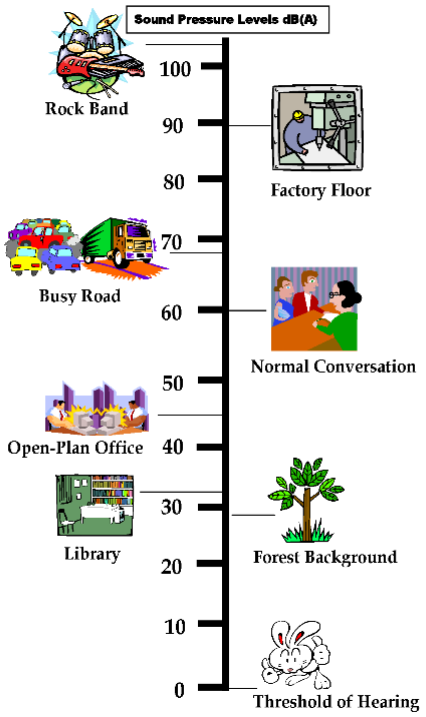
- **Chart of Noise Level Descriptors**



- **Austroads Vehicle Class**



- **Typical Noise Levels**



Appendix D

Environmental Assessment Report

Prepared by SW Environmental

Environmental Assessment Report

Lots 4 and 5 Darch Road, Margaret River

AUGUST 2024

Version control

Project number:	SW533			
Project file path:	SW355 Lot 4 5 Darch Road EAR			
Client:	N and K Veitch			
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Statement of limitations

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Common terms/acronyms

BC Act	WA *Biodiversity Conservation Act 2016*
DCCEEW	Federal Department of Climate Change, Energy, the Environment and Water
DBCA	WA Department of Biodiversity, Conservation and Attractions
DBH	Diameter at Breast Height in centimetres
DWER	WA Department of Water and Environmental Regulation
EP Act	WA *Environmental Protection Act 1986*
EPBC Act	Federal *Environment Protection and Biodiversity Conservation Act 1999*
FRTBC	Forest Red-tailed Black Cockatoo
Study area	A 10 km buffer around the Study area
NP	National Park
Study area	Lots 4 and 5 Darch Road
Suitable DBH tree	Tree of a size to develop large hollows (>50cm DBH most trees in the Southwest or >75cm for Karri).
WA	Western Australia

Executive summary

N. and K. Veitch, the owners of Lot 4 (Plan 403365) and 5 (Plan 03365) Darch Road, Margaret River, propose to subdivide (part of) Lot 4 and Lot 5 into multiple lots as per the current Concept Plan. Lots 4 and 5 Darch Road are located off Rosa Brook Road, approximately 3.5 km southeast of the Margaret River township, within the Shire of Augusta-Margaret River.

The study area comprises of 6.81 ha of rural land zoned *General agriculture* (Lot 4) and *Priority agriculture* (*A55*) (Lot 5) under the *Shire of Augusta-Margaret River Local Planning Scheme No. 1 (2010, updated Oct 2018*). It includes Lot 4 (5.47 ha western portion of the total 37.29 ha lot 4 boundary total, split by the Margaret River Perimeter Road), and Lot 5 (1.34 ha). The northern adjoining boundary of Lot 3 (0.73 ha existing) will also be adjusted.

A structure plan and rezoning application is required through the Western Australian planning process. To support the planning submission, an Environmental Assessment Report (EAR) was required. This EAR provides a review of the environmental aspects relevant to the site through a review of existing information, desktop assessment and the results of biological surveys. It also outlines critical environmental constraints, along with recommendations to minimise, mitigate and manage environmental impacts.

There are no critical environmental constraints identified through this Environmental Assessment Report that would result in the Project not proceeding. Direct impacts are generally assessed as being low, and indirect impacts of the Project are assessed as negligible. The following environmental factors had the potential to require further management or consideration, mostly at the subdivision stage:

- Acid sulfate soils (ASS)
- Hydrology - Surface water
- Hydrology - Wetlands
- Hydrology - Groundwater
- Biological - Vegetation
- Biological -Flora
- Biological -Weeds
- Biological – Fauna
- Bushfire management
- Noise and vibration

Based on the review of environmental factors in Section 3, the following factors are not likely to be impacted by the proposed subdivision enough to warrant further investigation or specific management:

- Existing land uses
- Geology (landform and soils)
- Contaminated sites
- Dieback
- Nearby reserves / conservation areas
- Habitat connectivity, linkage, corridor values
- Heritage (Aboriginal and other)

There are no critical environmental constraints identified through this Environmental Assessment Report that would result in the Project not proceeding. The following values are noted:

- Impacts to native vegetation within Lots 4 and 5 will be low, due to the Completely Degraded to Degraded condition of vegetation, including areas of planted exotic and non-endemic species.

- No conservation significant flora or communities occur in the study area (Steam EW 2018).
- Fauna habitat quality is Poor to Moderate over the site, with the majority of the lot areas providing Poor habitat quality.
- The site contains Marri trees which are suitable black cockatoo foraging habitat. Foraging habitat within the lot boundaries was restricted to only six Marri DBH trees with less than 0.2 ha of canopy area.
- No evidence of black cockatoo breeding or roosting was recorded within the study area.
- There is a limited potential for WRP to utilise individual tree hollows in *1. Cleared or parkland cleared with plantings / Poor fauna habitat quality*. The species is unlikely to occur within *2. Mixed Eucalypt Forest (planted) / Poor fauna* habitat quality due to the lack of refuge and midstorey.

Further considerations are provided below:

- Activation of ASS is considered unlikely however the Completion of an ASS self-assessment form will be required and if necessary, the preparation and implementation of an ASSDMP at the subdivision stage.
- Preparation of a LWMS and an UWMP is not recommended due to the small nature of the development and no change in stormwater behaviour associated with the site (Stantec 2021). The proposed development however should ensure that existing stormwater flow patterns are not disrupted or cut off.
- Onsite effluent disposal systems should a have setback of more than 30 m from any well, bore, stream, river or water course intended for consumption by humans (including non-perennial streams).
- Extraction of surface water will require a license from DWER to ensure environmental requirements are met.
- Drainage should be designed in line with the recommendations of the Site and Soil Evaluation report (E&LM 2023).
- A Site Revegetation Plan should be considered to reduce residual impact on WRP, with appropriate native species to the specifications of the Local Government.
- Minimise clearing of native vegetation where possible, particularly the trees over 50 cm DBH and the vegetation complex Cowaramup (Cw1 – Valleys) along Darch Road.
- Where clearing of potential black cockatoo and WRP habitat is proposed, impacts should be assessed against the EPBC Act at the subdivision stage.
- Fauna management protocols and actions will need to be implemented prior to and during clearing activities, potentially through implementation of a Fauna Management Plan. An authorised fauna spotter should be present to manage the clearing of any potential WRP habitat.
- Any Bushfire Management Plans prepared for this project should be read in conjunction with this EAR, with house locations sited to minimise clearing of vegetation.
- Retain the five hollow trees if possible (two of which are in the road verge).

1 Introduction

1.1 Background

N. and K. Veitch, the owners of Lot 4 (Plan 403365) and 5 (Plan 03365) Darch Road, Margaret River, propose to subdivide (part of) Lot 4 and Lot 5 into multiple lots as per the current Concept Plan (Figure A-1, Appendix A). Lots 4 and 5 Darch Road, herein referred to as the 'study area', are located off Rosa Brook Road, approximately 3.5 km southeast of the Margaret River township, within the Shire of Augusta Margaret River (see Figure A-2, Appendix A).

The study area comprises of 7.54 ha of rural land zoned *General agriculture* (Lot 4) and *Priority agriculture* (*A55*) (Lot 5) under the *Shire of Augusta-Margaret River Local Planning Scheme No. 1 (2010, updated Oct 2018*). It includes

- Lot 4 (5.47 ha western portion of the total 37.29 ha lot 4 boundary total, split by the Margaret River Perimeter Road), and
- Lot 5 (1.34 ha).
- The northern adjoining boundary of Lot 3 (0.73 ha existing) will be adjusted (Figure A-1).

A structure plan and rezoning application is required through the Western Australian (WA) planning process. To support the planning submission, an Environmental Assessment Report (EAR) was required.

1.2 Supporting documentation

A Preliminary Environmental Assessment Report was prepared by SW Environmental (2019) which included fauna, flora and vegetation surveys. The following reports have also been prepared, draft and subject to change:

- Bushfire Management Plan (Working on Fire Planning, 2021),
- Transportation Noise Assessment (Lloyd George Acoustics, 2021),
- Site and Soil Evaluation report (E&LM, 2023), and
- Civil and Electrical Servicing Report (Stantec 2021).

1.3 Scope of the report

This EAR provides a review of the environmental aspects relevant to the site through review of existing information, desktop assessment and the results of the biological surveys. It also outlines critical environmental constraints, along with recommendations to minimise, mitigate and manage environmental impacts.

Fauna, flora and vegetation surveys were carried out through site reconnaissance and targeted surveys (equivalent to Level 1 Basic and Targeted) by SW Environmental (2019). A recheck of hollows (targeted

black cockatoo[1] survey) was undertaken by SW Environmental in 2024. The study area included the eastern verge of Darch Road to ensure that any access improvements were considered.

Environmental factors that may affect the Project, include:

- Existing land uses
- Geology (landform and soils)
- Acid Sulphate Soils (ASS)
- Contaminated sites
- Hydrology (surface water, wetlands, groundwater)
- Biological diversity (flora, vegetation, fauna and habitats)
- Dieback
- Nearby reserves / conservation areas
- Habitat connectivity, linkage, and corridor values
- Heritage (Aboriginal and other)
- Bushfire management
- Noise and vibration

These factors are considered further in Section 3 and with potential impacts and recommendations made in Section 4.

2 Regulatory context

2.1 Key legislation and policies

2.1.1 Commonwealth legislation

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), administered by the federal Department of Climate Change, Energy, the Environment and Water (DCCEEW) addresses impacts to Matters of National Environmental Significance (MNES). These may include:

- World Heritage Properties,
- National Heritage Places,
- Wetlands of international importance (listed under the Ramsar Convention),
- Listed threatened species and ecological communities,
- Migratory species protected under international agreements,
- Commonwealth Marine Areas,

[1] Environmental Protection Authority 2020, Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment, EPA, Western Australia.

- The Great Barrier Reef Marine Park, and
- Nuclear actions (including uranium mines).

The decision whether to refer any proposed action under the EPBC Act to the DCCEEW is based upon whether the proposed action is likely to have a significant impact on MNES, in accordance with the Significance Impact Guidelines 1.1 Matters of National Significance (Department of the Environment, 2013).

Based on information in Section 3, the MNES applicable for the site are listed threatened species, i.e. black cockatoos and Western Ringtail Possum (*Pseudocheirus occidentalis*) (WRP). Federal policies and guidelines relevant to the Project include:

- Commonwealth Matters of National Environmental Significance – *Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999*, Department of the Environment, Water, Heritage and the Arts (DEWHA), (2009).
- Commonwealth *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered), Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable), Calyptorhynchus baudinii, and Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso* (SEWPaC 2012).
- Commonwealth *Referral guideline for 3 WA threatened black cockatoo species Carnaby's Cockatoo (Zanda latirostris), Baudin's Cockatoo (Zanda baudinii) and the Forest Red-tailed Black-cockatoo (Calyptorhynchus banksii naso)* Department of Agriculture, Water and the Environment (2022).

2.1.2 State (Western Australian) legislation

The *Environmental Protection Act 1986* (EP Act) is the key legislative tool for environmental protection in WA, administered by the Environmental Protection Authority (EPA) and the Minister for Environment.

Under Section 48A of the EP Act, when a scheme amendment is referred to the EPA, the EPA must decide whether or not to assess the scheme or determine that it is incapable of being made environmentally acceptable. The EPA considers Amendment 71 (the subject of this proposal) is unlikely to have a significant effect on the environment and does not warrant formal assessment under Part IV of the EP Act.

Key WA environmental legislation that may be relevant to the Project area is outlined in Table 1.

Table 1 Key State environmental legislation that may be relevant to the Project

Legislation	Responsible Government Department	Aspect
Aboriginal Heritage Act 1972 (AHA) and Regulations	Department of Planning, Lands and Heritage (DPLH)	Items and places of Aboriginal heritage significance
Agriculture and Related Resources Protection Act 1976	Department of Primary Industries and Regional Development (DPIRD)	Weeds, feral animals and other pests

Legislation	Responsible Government Department	Aspect
Biodiversity Conservation Act 2016 (BC Act) and Regulations	Department of Biodiversity, Conservation and Attractions (DBCA)	Threatened ecological communities, species and habitats, threatening processes, pests and weeds. Refer to Appendix B for conservation codes.
Biosecurity and Agricultural Management Act 2007 (BAM Act)	DPIRD	Weeds, feral animals and other pests
Bush Fires Act 1954	Department of Fires and Emergency Services (DFES)	Bushfire control and management
Contaminated Sites Act 2003	Department of Water and Environmental Regulation (DWER)	Contaminated sites and spills
Country Areas Water Supply Act 1947 (CAWS Act)	DWER	Public Drinking Water Source Areas (PDWSAs) and clearing approvals
Environmental Protection Act 1986 (EP Act) and Regulations (below)	Environmental Protection Authority or DWER	Part IV Environmental Impact Assessment Part V Works Approvals and Licences
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	DWER	Clearing of native vegetation
Environmental Protection (Noise) Regulations 1995	DWER	Noise and vibration
Planning and Development Act 2005	DPLH	Structure planning and subdivision approval
Heritage of Western Australia Act 1990 (Heritage Act)	DPLH	Items and places of non-aboriginal heritage significance
Rights in Water and Irrigation Act 1914 (RIWI Act)	DWER	Management of the use, service and health of water and watercourses (including beds and banks). Water licensing is required in all proclaimed areas and for all artesian groundwater wells in WA.
Waterway Conservation Act 1976 (Waterway Cons Act)	DWER	Waterway Management Areas

2.1.3 Guidelines and policies

The following guidelines are relevant to the EAR in relation to fauna, flora and vegetation management:

- Environmental Protection Authority (2020) Technical Guidance – *Terrestrial Guidance for Fauna Surveys for Environmental Impact Assessment*. Perth, Western Australia

- Environmental Protection Authority and Department of Environment and Conservation (2016) *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment.* Perth, Western Australia.
- Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3, EPA (2002).
- Department of Parks and Wildlife (2017). Western Ringtail Possum (*Pseudocheirus occidentalis*) Recovery Plan. Wildlife Management Program No. 58. Department of Parks and Wildlife, Perth, WA.
- Department of Parks and Wildlife (2013). Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan. Department of Parks and Wildlife, Perth, Western Australia.
- Department of Environment and Conservation (2008) Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan

3 Existing environment

3.1 Existing land use

The Project is located on the outskirts of Margaret River township, in a region known for viticulture, wineries and dairy farming. The Margaret River Perimeter Road is located adjacent to the Project, on the eastern side.

Lot 3 is currently comprised of an existing house and cleared land. Only the boundary would be altered. Lot 4 has been cleared and grazed, with a house and ancillary structures evident in the northwestern corner of the lot. There are two livestock dams. Small patches of mostly planted vegetation remain in a parkland cleared condition. Remnant vegetation is restricted to a few individual Karri trees. Several naturally regenerating Karris and Peppermints are in the centre north of the lot. The band of forest through the centre of the property was planted for small-scale silviculture by the owner approximately 30 years ago.

Lot 5 has a house and a dam. Apart from regenerating Peppermints along the drainage line, Lot 5 is also parkland cleared, with a variety of planted non-native trees and shrubs over a Kikuyu understorey. Rosa Brook Road contains native trees- Marri, Karri and Peppermint.

3.2 Interim Biogeographic Regionalisation of Australia (IBRA) values

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. IBRA also provides for the national and regional planning framework for the systematic development of a comprehensive, adequate and representative (CAR) National Reserve System, endorsed by all levels of government as a key tool for identifying land for conservation under Australia's Strategy for the National Reserve System 2009-2030 (DE, 2017). Vegetation representation is addressed in Section 3.8.1.

The Project is located within the Warren (W01) bioregion. It is described as dissected undulating country of the Leeuwin Complex, Southern Perth Basin (Blackwood Plateau), South-West intrusions of the Yilgarn Craton and western parts of the Albany Orogen with loamy soils supporting Karri Forest, laterites supporting Jarrah-Marri forest, leached sandy soils in depressions and plains supporting low Jarrah woodlands and paperbark/sedge swamps, and Holocene marine dunes with *Agonis flexuosa* and Banksia woodlands and heaths (Hearn et al 2002).

3.3 Climate

The Southwest of WA has a moderate, Mediterranean climate with mild wet winters and hot dry summers (Hearn et al 2002). Temperatures range from an average maximum of 28°C in February to a minimum of 8°C in August with an average annual rainfall of 1100 mm, with most of the rain falling between June and August (Margaret River data station Weatherzone, 2024).

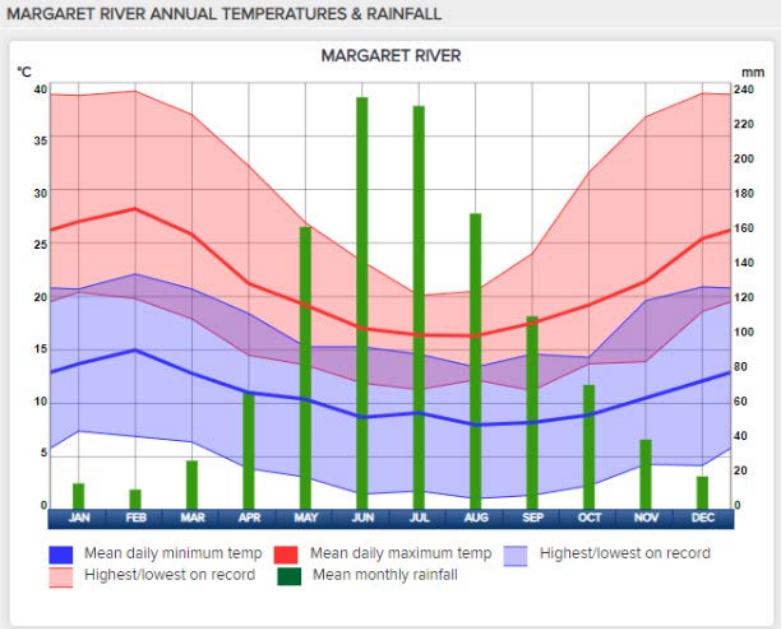


Figure 3-1 Annual temperatures and rainfall near the study area (Weatherzone 2024)

3.4 Geology, landform and soils

Topography at the site is relatively flat, apart from the altered drain and farm dams. The elevation across the site ranges from approximately 88 m Australian Height Datum (AHD) to 94 m AHD (Figure A-3, Appendix A). The study area occurs on the Margaret River Plateau. Soil mapping by Tille and Lantzke (1990) identifies three soil units within the study area (Figure A-4):

- Cowaramup wet vales phase - Small, broad U-shaped drainage depressions with swampy floors. Gravelly duplex (Forest Grove) soils on sideslopes and poorly drained alluvial soils on valley floor.
- Cowaramup wet flats phase – Poorly drained flats and slight depressions with pale grey mottled (Mungite).
- Cowaramup, undifferentiated upland phase – Flats and gentles slopes with gravelly duplex (Forest Grove) and pale grey mottled (Mungite) soils.).

Sandy loam soil, degrading into clay at depth, was observed in all test pits in the Site and Soil Evaluation Report prepared by E&LM (2023). The existing topography is suitable for large lots, with minor filling potentially required for house pads if required. No further actions are required in relation to this aspect.

3.5 Acid Sulfate Soils

Acid Sulfate Soils (ASS) occur in low-lying coastal areas and are common in water-logged, groundwater-dependant and high-groundwater-table environments. The former Department of Environment Regulation (DER) published ASS risk maps. Where a development cannot be redesigned to avoid disturbing ASS, the risk maps are used to trigger site-specific investigations and management strategies for ASS soil disturbance and/or lowering of the groundwater table.

The study area is mapped as Class 2 (2g, p4) risk of ASS (DER, 2010). Class 2 includes moderate to low risk of ASS occurring within 3 m of the natural surface but a high to moderate risk of ASS occurring beyond 3 m.

3.6 Contaminated sites

There are no land uses associated with the site that are likely to cause contamination or are mapped contaminated sites within 2.5 km of the project (SLIP 2024). No further actions are required in relation to this aspect.

3.7 Hydrology

3.7.1 Surface water

The study area has a slope of approximately 1.1 % (E&LM, 2023). A tributary of the Darch Brook starts on the northern boundary of the property. Site investigations identified four farm dams (with low water levels) and a network of artificial drainage channels. These were dry at the time of the site inspection in early winter 2024 (Figure A-3 and Photos below). The hydrology of the study area has been recently altered due to the onsite capture and management of in situ stormwater upstream in the adjacent, recently developed subdivision west of Darch Road. This has significantly reduced the catchment and run on entering the study area.

There is minimal risk of flooding across the site, although there is a moderate to high hazard of some flooding for 30% of Cowaramup wet vales phase soil unit (CoCOvw) (Figure A-4). The site does not appear to be within a mapped 100 Year ARI Floodplain Area (SLIP 2024).

The study area falls within a Margaret Town subarea of the Busselton Coast Surface Water Management Area (Surface Water Area) under the RIWI Act. This aspect deals with licensing for water extraction and is addressed further in Section 4. No impacts are proposed to the other aspects relating to water, listed in Table 2. No further actions are required.

Table 1: Acts relating to water resources in the context of the Project

Legislation	Aspect	Result and action
Country Areas Water Supply Act 1947 (CAWS Act)	Public Drinking Water Source Areas (PDWSAs), and clearing approvals	Project is not located within a PDWAs, no further action required.
Rights in Water and Irrigation Act 1914 (RIWI Act)	Irrigation Districts, Proclaimed Rivers	Project is not located within these areas, no further action required.
	Surface Water Areas	Margaret Town subarea of the Busselton Coast Surface Water Management Area. License required to extract water – refer to Section 4.
Waterway Conservation Act 1976 (Waterway Cons Act)	Waterway Management Areas (WMA)	Project is not located within a WMA, no further action required.



Photo 3-1 Historic artificial channel, no longer flowing.



Photo 3-2 Existing farm dam with low water levels.

3.7.2 Wetlands

The term 'wetlands' refers to damplands, estuary-peripheral and water body, floodplains, palusplain and sumplands. The wetland categories are recognised by the Environmental Protection Authority (EPA), the Department of Biodiversity, Conservation and Attractions (DBCA), the Western Australian Planning Commission (WAPC) and other authorities.

There are no mapped Ramsar wetlands within 10 km of the Project. The Spearwood Creek system, about 8 km south of the Project, has been proposed as a Ramsar addition. It will not be impacted by the Project.

The Project is mapped as palusvale and floodplain in the DBCA Geomorphic Wetlands dataset (SLIP 2024) (Figure 3-2). The dataset for the Margaret River area has not been reviewed and is yet to be assigned a conservation category. The mapped areas are highly degraded and may no longer be representative of the mapped wetland, given the hydrological changes within the study area.

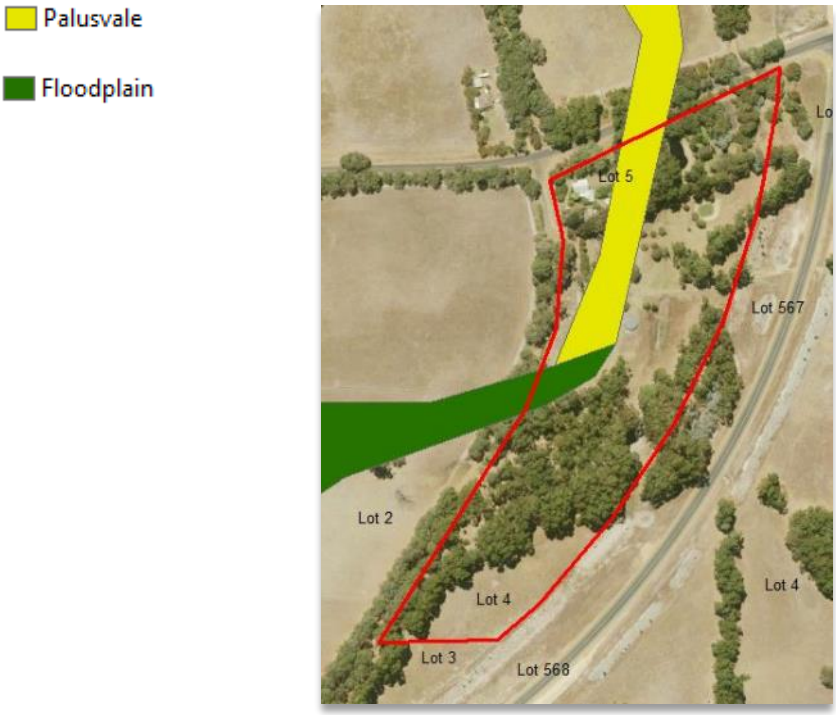


Figure 3-2 Wetland mapping (unreviewed) (SLIP 2024)

3.7.3 Groundwater

The study area falls within a RIWI Act Proclaimed Groundwater Area under Section 26B (1) the Blackwood Groundwater Area.

The Geotechnical Report (in Stantec 2021) did not observed groundwater in the test pit locations. It was noted that sub-surface clay has a low permeability and the groundwater table may increase (perched in the more permeable layers above the clay) during and after rainfall events, however, groundwater impact (i.e. dewatering highly unlikely) on shallow trenching is not anticipated and the "sandy/clays" are likely to become impermeable after the initial rain events. Due to the lack of significant excavation, ground water is not considered to have a significant impact on the proposed development or future residential properties, if built in accordance with relevant Australian Standards (Stantec 2021).

3.8 Flora and vegetation

3.8.1 Vegetation mapping

Vegetation complexes within the Project area are mapped by Mattiske and Havel (1998), described in Table 3. The national objectives and targets for biodiversity conservation in Australia have a target to prevent clearance of ecological communities with an extent below 30% of those present at pre-European levels (Commonwealth of Australia, 2001). This target is also set in the EPA's *Position Statement on the Environmental protection of native vegetation in Western Australia* (EPA, 2000). The Cowaramup (Cw1) vegetation complex, which covers most of the study area, has less than 30% of the pre-clearing extent intact. Apart from the road verge adjacent to Lot 4, areas of Cw1 in the study area are Completely Degraded or Degraded and are unlikely to be considered representative of this vegetation complex (EPA 2016).

Table 2: Vegetation complexes mapped for the study area (Mattiske and Havel 1998)

Vegetation complex	Description	% pre-European extent remaining
Cowaramup (C1 – Uplands)	Open to tall open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia grandis* on lateritic uplands in the hyperhumid zone.	34.36
Cowaramup (Cw1 - Valleys)	Mixture of open forest to woodland of *Eucalyptus diversicolor-Corymbia calophylla* and woodland of *Eucalyptus marginata* subsp. *marginata -Corymbia calophylla* on slopes and low woodland of *Melaleuca preissiana-Banksia littoralis* on depressions in the hyperhumid zone.	28.09

A field survey incorporating reconnaissance and targeted flora searches was completed by Stream Environment and Water in Spring 2018 for Lot 4 and the adjacent road verges. Four vegetation units were identified, including three forest/woodland communities and one which is predominantly cleared or consists of planted exotics and non-endemic species (Figure A-5). Descriptions for the three woodland communities were based on the results of relèves surveyed in each[2], supplemented by opportunistic recording of additional species during targeted searches (Table 4). Lot 5 was not surveyed as it was in a Completely Degraded condition (EPA 2016).

Aside from the roadside remnant vegetation along Darch Road (adjacent to Lot 4), the site was assessed as highly modified in 2018 and has been disturbed further through ongoing property management. In Lot 4, the mixed Eucalypt woodland is dominated by an overstorey of planted and self-seeded trees. *Eucalyptus diversicolor* (Karri) is native to the local area but most trees at this site were planted by the landowner. The other tree species in this community are eastern states species (*Corymbia maculata*,

[2] Releves were carried out in Lot 4; Lot 5 was subject to structural vegetation assessment only.

Eucalyptus grandis, *and Eucalyptus microcorys*) that are fast growing and prolific seed producers. There are several age groups of these species present, indicating ongoing recruitment.

Lot 5 is also highly modified, with planted exotic and non-endemic trees and shrubs over a dense ground cover of *Pennisetum clandestinum** (Kikuyu). *Agonis flexuosa* (Peppermint) is naturally regenerating in some areas, particularly along the dam edges and low areas. Mature remnant *Agonis flexuosa* occurs along the Rosa Brook Road verge, along with *Corymbia calophylla*, and *Eucalyptus diversicolor*. The understorey is Completely Degraded, with few native species (e.g. *Pteridium esculentum*), and extensive areas of *Pennisetum clandestinus** and others (Iridaceae, potentially *Watsonia meriana var. bulbillifera, Chasmanthe floribunda* (African cornflag), *Sparaxis bulbifera* or *Gladiolus sp*.). The road verge vegetation along Darch Road was assessed as being in a Good condition (EPA 2016).

Table 3: Vegetation communities described for the study area.

Community description	Code	Condition (Keighery 1994)	Area (ha)
1. Cleared or Parkland Cleared with Plantings Cleared or parkland cleared, with areas of planted mostly exotic/non-endemic trees/shrubs over a *Pennisetum clandestinus** (Kikuyu) understorey. Plantings include (not limited) *Acacia spp, Melaleuca spp*, *Pinus pinaster* and others, with occasional regenerating *Agonis flexuosa*.	Cl	Completely Degraded	4.28
			
2. Mixed Eucalypt Forest (planted) Forest (planted) of *Corymbia maculata, Eucalyptus diversicolor, Eucalyptus grandis and Eucalyptus microcorys* over isolated shrubs of *Leucopogon verticillatus* and *Juncus pallidus* over mixed herb and grass layer.	CmEdEg	Completely Degraded	2.10
			

Community description	Code	Condition (Keighery 1994)	Area (ha)
3. Marri Woodland over pasture Open forest of *Corymbia calophylla*, *Eucalyptus diversicolor* (planted) and *Corymbia maculata* (planted) over open woodland of *Agonis flexuosa* over mixed herb and grass layer. The Rosa Brook Road verge contains *Pteridium esculentum, Pennisetum clandestinus* * and other weeds in the understorey.	CcEdAf	Degraded	0.60



4. Marri Woodland (roadside remnant) Darch Road verge: Open forest of *Corymbia calophylla* over shrubland of *Pteridium esculentum*, *Styphelia propinqua, Leucopogon verticillatus* over sedgeland of *Lepidosperma squamatum, Lomandra micrantha* and *Cyathochaeta avenacea* and mixed herb and grass layer. NB *Taxandria linearifolia* and *Lepidosperma tetraquetrum* present in drainage line.	Cc	Good	0.34



3.8.2 Flora

The flora survey completed by Stream Environment and Water (2018), recorded 53 taxa of vascular plants from 24 families (Appendix C). Twenty nine of the 53 taxa are introduced. The number of introduced taxa is an underestimate, as the Spring survey only focussed on Lot 4. Given that Lot 5 has additional planted species and weeds, the total number of introduced taxa may be higher.

No threatened, Priority or other conservation significant flora, e.g. range extensions, were recorded in the study area. Given that the vegetation condition was mapped as Completely Degraded to Degraded, it is highly unlikely that any threatened flora would occur within Lots 4 or 5.

3.8.3 Weeds

Three of the 29 introduced flora species observed within the study area are listed as declared pest plants under the BAM Act, *Asparagus asparagoides* (Bridal Creeper) *Rubus ulmifolius* (Blackberry) and *Zantedeschia aethiopica* (Arum lily). The weed from the Iridaceae family along the Rosa Brook Road verge could also be listed.

3.9 Fauna and habitats

3.9.1 Fauna habitats and quality

Fauna habitats are generally associated with soils, vegetation type and condition, and other microhabitat features. Over the site, they vary for different fauna groups, however for the purpose of this assessment, they have been grouped into structural vegetation types that align with the vegetation types identified in Table 5, summarised below (mapped in Figure A-7):

1. Cleared or parkland cleared with plantings / Poor fauna habitat quality
2. Mixed Eucalypt Forest (planted) / Poor fauna habitat quality
3. Marri Woodland over pasture / Poor fauna habitat quality
4. Marri Woodland (roadside remnant) / Poor to Moderate fauna habitat quality

Farm dams are also present. Note, the artificial drainage channel and wet flats from the 2019 assessment are no longer present due to hydrological changes. Fauna habitat quality was based on Table 3.

Table 4: Fauna habitat quality categories and descriptions

Quality	Description
Good	• Native vegetation with intact and diverse habitat structure. Different vegetation age classes present at most stratum levels (ground, understorey, midstorey, canopy). • Forest/woodland: abundant hollow-bearing trees, including those with or likely to develop large hollows. Mature trees offer more foraging resources (nectar/seed). • Presence of shelter/refuges at ground level (dense understorey plants, tussock, rocky outcrop, hollow logs). • High habitat complexity (ecotones between vegetation types or habitat mosaic). This increases the range of foraging and shelter opportunities within a habitat. • Presence of key foraging and microhabitat components for target species. • Little to no obvious weed invasion or evidence of grazing.

Quality	Description
	• May be large patch and/or connected to other areas of native vegetation.
Moderate	• Native flora species dominant with moderate habitat structure complexity appropriate to vegetation type. Ground litter intact or slightly disturbed. More than one age class present. • Forest/woodland: low to moderate abundance of hollow-bearing trees or trees likely to develop hollows. • Some shelter and refuge present for ground dwelling fauna. • Some habitat complexity (ecotones between vegetation types or areas forming a habitat mosaic). • Marginal presence of key microhabitat components for target species. • May be small or large in scale, and isolated or well connected.
Poor	• Habitat highly disturbed and simplified with low structural complexity. Ground litter layer absent or highly modified. Complexity reduced by the presence of only one age class . • Little or no shelter and refuge for ground dwelling fauna. • Forest/woodland: not likely to support hollow-bearing trees. • Lack of key foraging and microhabitat components for target species. • May have evidence of weed invasion or grazing. • May be narrow or small area and substantially influenced by edge effects, and isolated from other areas of native vegetation.

From Table 5 fauna habitat quality within the study area was Poor but Poor to Moderate within the Darch Road verge. Lots 4 and 5 have been subjected to multiple types of disturbance, including

- Clearing,
- Heavy grazing (no native understorey remaining), and
- Planting of non-endemic trees and shrubs.

Other than exotic grass, the site generally lacks native understorey vegetation, limiting refuge and forage resources for most groups of native fauna.

There are large trees present across the site, described in Section 3.9.3. Most of the planted trees were non-native, species unlikely to develop large hollows, or were within the road verge. The lack of midstorey vegetation reduces the habitat suitability of the site for many species (e.g. WRP and many birds). Ecotones (areas between habitat types) may still offer foraging opportunities for raptors and owls.

Degraded, seasonally wet areas identified in 2019 that would have provided habitat for various fauna, such frogs, snakes and water birds were dry in winter 2024. The small dams are unlikely to support fish (such as Balston's Pygmy Perch), species that rely on fish during their lifecycle, (Carter's Freshwater Mussel) or permanent water (Water Rats, Blue Billed Duck, or Bitterns).

3.9.2 Suitable DBH trees and hollows

Hollow bearing trees are critical elements for many fauna species, including arboreal mammals (such as phascogales and possums) and bats and birds (such as owls and black cockatoos). Animals can be selective in their use of tree hollows, preferentially using hollows of a particular size, shape and orientation. Many hollow-dependant fauna are considered as threatened, which is often at least partially attributed to a lack of suitable nesting sites (Koch 2008).

Hollows take many years to form. The onset of hollow-formation is dependent on damage to the tree, animals (vertebrates or invertebrates), or the dropping of branches. Young and healthy trees can quickly heal after damage, and subsequently, trees less than 100 years old are unlikely to contain hollows. Hollows suitable for use by black cockatoos are usually 150+ years old (Koch 2009; Inions et al. 1989; Johnstone et al 2015; Whitford et al 2013; Mawson et al. 1994 and Wayne 2005).

Suitable DBH trees are those that are hollow bearing, or greater than 50 cm diameter at breast height (DBH) that may develop large hollows in the future for typical trees in the Southwest, including Marri and Jarrah (Commonwealth of Australia 2012, 2022). Wheatbelt species such as Wandoo and Salmon Gums may develop hollows at 30 cm DBH. Multi-stemmed trees are low height (generally less than 20 m high) with smaller branches above head height, lacking the thick branches or a defined trunk thick enough to support large hollows. They are not considered suitable DBH trees in this report. Planted, non-native trees are also generally less likely to develop large hollows and have therefore been excluded. Karri, being fast growing, are not likely to develop hollows until they are at least 75 cm DBH.

3.10 Black cockatoo profiles

Baudin's cockatoo (*Zanda baudinii*)
EN (EPBC Act), EN (BC Act)

Carnaby's cockatoo (*Zanda latirostris*)
EN (EPBC Act), EN (BC Act)

Forest Red-tailed Black Cockatoo (FRTBC) (*Calyptorhynchus banksii naso*)
VU (EPBC Act), VU (BC Act)

The study area falls within the modelled distribution for of all three black cockatoo species (breeding for Baudins and FRTBC and non-breeding for Carnaby's cockatoo) (SEWPAC 2012, DCCEEW 2022). Scattered records occur locally for all three black cockatoo species (ALA 2024) (Birdlife Australia, 2024) (DBCA 2024).

For nesting, black cockatoos show a preference for (SW Environmental pers obs):

- Large senescing trees,
- Hollows not angled more than 45 degrees from vertical,
- Entrances of at least 12 cm but usually much larger (20-30 cm),
- Deep or well sheltered hollows in the main trunk, or large branches which are able to provide a floor space of at least 30 cm diameter or more.

All three species of black cockatoo are of similar size and utilise similar types of hollows when breeding. The actual species of tree is unimportant to each individual species. For example, Carnaby's cockatoo use Marri in the Marri Forest and Wandoo when in the Wheatbelt. All three species are known to use the same individual hollows when not occupied in the breeding season by another black cockatoo species (Kirkby pers comm, 2019). Suitable hollows may be used interchangeably with other medium sized parrots such as Corellas and Galahs. Following breeding, black cockatoos assemble into flocks and move through the landscape searching for food, usually foraging within six kms of a night roost (Commonwealth of Australia 2012).

While breeding, black cockatoos will generally forage within a 6–12 km radius of their nesting site. Baudin's cockatoo feeds on a variety of foods including nectar and seeds from *Hakea* and *Banksia* spp., though its main food is Marri, from which it takes seeds, grubs, and nectar. Its long bill is adapted to removing seeds from marri fruit capsules. FRTBC feed mainly on the seeds of Jarrah and Marri but also Blackbutt, Albany Blackbutt, Sheoak, Snottygobble and introduced native and non-native species, such as Lemon-scented Gum, Spotted Gum and Cape Lilac. Carnaby's cockatoo is known to forage in native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as *Banksia*, *Hakea*, and *Grevillea* spp. It forages in pine plantations, Eucalypt woodland and forest, individual trees and small stands of these species (SEWPAC 2012).

Black cockatoos rely on access to watering points in selecting night roost sites, with roost sites usually within two kms of a watering point where they often drink in the afternoon following daytime feeding (DCCEEW 2022).

3.11 Western False Pipistrelle

Western False Pipistrelle (*Falsistrellus mackenziei*)

Not listed (EPBC Act), not listed (BC Act), Priority 4

This microbat occurs in wet sclerophyll forest dominated by Karri, and in the high rainfall zones of the Jarrah and Tuart forests. Since 1961, the species has been collected at 34 locations in south-west Australia. It is known from 27 operational forest blocks. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri, Sheoak and Peppermint trees are often co-dominant at its collection localities (DEWHA, 2009). This species roosts in tree hollows in colonies of 5 to 30 bats (Aust Museum, 2009) (Phillips & Inwards 1985). The species feed on flying insects between below the forest canopy.

3.12 WRP species profile

Western ringtail possum (WRP) (*Pseudocheirus occidentalis*)

CE (EPBC Act), CE (BC Act)

Critical habitat for the species as outlined in the Western Ringtail Possum (*Pseudocheirus occidentalis*) Recovery Plan (Department of Parks and Wildlife, 2017) (the Recovery Plan) is defined as follows:

> Habitat critical to survival for western ringtail possums is not well understood, and is therefore based on the habitat variables observed where western ringtail possums are most commonly recorded. These appear to vary between key management zones. The common themes however are high nutrient foliage availability for food, suitable structures for protection/nesting, and canopy continuity to avoid/escape predation and other threats. Long-term survival of the species requires linkages between suitable habitat patches and as such habitat critical to survival incorporates this. Vegetation communities critical to the species include long unburnt mature remnants of peppermint (*Agonis flexuosa*) woodlands with high canopy continuity and high foliage nutrients (high in nitrogen and low toxin levels); jarrah (*Eucalyptus marginata*)/marri (*Corymbia calophylla*) forests and woodlands with limited anthropogenic disturbance (unlogged or lightly logged, and a low intensity and low frequency fire history), that are

intensively fox-baited and have low indices of fragmentation; coastal heath, jarrah/marri woodland and forest, peppermint woodlands, myrtaceous heaths and shrublands, Bullich (*Eucalyptus megacarpa*) dominated riparian zones and karri forest. Any habitat where western ringtail possums occur naturally are considered critical and worthy of protection.

WRP local snapshot

The DBCA (2024) data shows 527 WRP records within five km of the study area, heavily clumped around the Margaret River township, indicating that this is associated with higher survey effort and reporting in urban and peri urban areas.

FEDERAL

The study area is outside of the mapped extent of the three habitat categories, determined by the Australian Government for WRP in the southern Swan Coastal Plain (DEWHA, 2009) in the *Significant impact guidelines for the vulnerable western ringtail possum (Pseudocheirus occidentalis) in the southern Swan Coastal Plain*. As a planning tool this document is outdated and no longer being referenced by DCCEEW. Any assessment and loss of habitat would now be assessed solely under the general *Commonwealth Matters of National Environmental Significance – Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999* (DEWHA, 2009).

WESTERN AUSTRALIA (STATE)

Any clearing of WRP habitat would be assessed by DWER or relevant agencies with reference to the WRP Recovery Plan (Department of Parks and Wildlife, 2017). Three key management zones have been identified in the Plan. These are areas known to currently, or previously support large numbers of WRP. WRP within these zones are considered to be the most important extant populations at present:

1. Swan Coastal Plain zone: the peppermint woodlands and peppermint/tuart forests on the southern extremity of the Swan Coastal Plain, extending from north of Bunbury to Augusta, but principally around Busselton. The study area occurs within this key management zone.
2. Southern Forest zone: Jarrah forests near Manjimup where peppermint is generally absent (Jones 2004, Wayne et al. 2005a, 2005c, 2006).
3. South Coast zone: a diverse range of vegetation types between Walpole and Cheynes Beach, but principally in near-coastal limestone heath, Jarrah marri thicket woodland and forest, riparian, peppermint woodland and karri forest vegetation.

Key threatening processes operating on the WRP are complex, interactive and are often population specific.

PREVIOUS SURVEYS

Biota (2020) Regional Population Assessment of WRP

Biota (2020) undertook a regional survey of WRP which estimated a combined number of over 20,000 WRP within the areas surveyed, from the three regional populations. The surveys targeted over 113,340 ha over 45 sites on the Swan Coastal Plain, Cape to Cape, Upper Warren and around Albany subpopulations. The surveys identified 3,675 individual WRP.

Population estimates within the study areas included the Swan Coastal Plain management zone at 9,270 individuals, the Southern Forest management zone at 7,500 individuals and the South Coast management zone at 3,340 WRP. The study area falls within the Cape to Cape subpopulation of the Swan Coastal Plain management zone in Biota (2020). These results were based on density sampling and provide an estimate of population size for the Swan Coastal Plain subpopulation, along with providing context to other subpopulations.

Within the Cape to Cape subpopulation, a total area of 4,320 ha was surveyed across eight sites with 627 unique individuals recorded (density of 0.14 animals / ha). The closest survey site was Woodjtup National Park (10 Mile Brook Dam), around two km east of the Darch Road. No WRP were encountered over a total of 10 km of transects, though being natural areas, the habitat may not align to those at Darch Road.

3.12.2 Fauna recorded locally

Local fauna records

Local records within 10 km of the study area are provided in Appendix D. A total of 199 vertebrate species were recorded:

- 13 amphibians
- 130 birds
- 29 mammals
- 27 reptiles

Marine or aquatic dependant species (fish) were not included in the surveys. Some near coastal or wetland taxa may be included in the list even though they do not use the site. At least five of the listed fauna are introduced species.

Invertebrates and short-range endemics

Surveys did not include invertebrates. Where invertebrates are collected during surveys, a high percentage are likely to be unknown, or for known species there can be limited knowledge or information on their distribution (Harvey 2002). Although invertebrate surveys were not specifically required as part of the scope of work, the presence/absence of any invertebrates of conservation significance was noted.

Conservation significant fauna

There are 25 vertebrate fauna (one frog, 13 birds, 11 mammals) of conservation significance that may occur locally, not necessarily at the site, based on the evaluation provided in Appendix B.1. Additionally, five invertebrates and three fish of conservation significance may also occur locally (Table 6).

Table 5: Threatened and Priority fauna recorded, or that may occur, within 10 km of the study area

Class	Family Genus species	Vernacular	Status Federal	Status WA
AMPH	**Myobatrachidae** *Geocrinia alba*	White bellied frog	CR	EN
AVES	**Ardeidae** *Ardea ibis*	Cattle egret	IA	-
	Ardea modesta	Great egret	IA	-
	Botaurus poiciloptilus	Australasian bittern	EN	EN
	Ixobrychus flavicollis	Black bittern		P2
	Atrichornithidae *Atrichornis clamosus*	Noisy scrub-bird	EN	EN
	Cacatuidae *Calyptorhynchus banksii naso*	Forest red-tailed black cockatoo	VU	VU
	Calyptorhynchus baudinii	Baudin's cockatoo	EN	EN
	Calyptorhynchus latirostris	Carnaby's cockatoo	EN	EN
	Falconidae *Falco peregrinus*	Peregrine falcon	-	OS
	Megapodiidae *Leipoa ocellata*	Malleefowl	VU	VU
	Pandionidae *Pandion haliaetus*	Osprey	EN	EN
	Strigidae *Ninox connivens connivens*	Barking owl (SW pop.)	-	P3
	Tyto novaehollandiae subsp. novaehollandiae	Masked owl (southern subsp)	-	P3
MAMMALS	**Dasyuridae** *Dasyurus geoffroii*	Chuditch	VU	VU
	Phascogale tapoatafa	Southern brush-tailed phascogale	-	S
	Setonix brachyurus	Quokka	VU	VU
	Myrmecobiidae *Myrmecobius fasciatus*	Numbat	EN	EN
	Macropodidae *Macropus irma*	Western brush wallaby	-	P4
	Muridae *Hydromys chrysogaster*	Water rat	-	P4
	Peramelidae *Isoodon obesulus fusciventer*	Southern brown bandicoot, Quenda	-	P4
	Potoroidae *Bettongia penicillata*	Brush-tailed bettong, woylie	EN	CR
	Pseudocheiridae *Pseudocheirus occidentalis*	Western ringtail possum	CR	CR
	Thylacomyidae *Macrotis lagotis*	Bilby	VU	VU
	Vespertilionidae *Falsistrellus mackenziei*	Western false pipistrelle	-	P4

Class	Family Genus species	Vernacular	Status Federal	Status WA
FISH	**Galaxiidae** *Galaxiella munda*	Mud minnow, Western dwarf galaxias	-	EN
	Geotriidae *Geotria australis*	Pouched lamprey	-	P3
	Percichthyidae *Nannatherina balstoni*	Balston's pygmy perch	VU	VU
INVERTEBRATE	**Carabidae** *Trichosternus relictus*	Ground beetle (Margaret River)	-	P3
	Kawaniphila pachomai	Vernal grey katydid	-	P1
	Hyriidae *Westralunio carteri*	Carter's freshwater mussel	VU	VU
	Parastacidae *Cherax tenuimanus*	Hairy marron	CR	CR
	Engaewa pseudoreducta	Margaret River burrowing crayfish	CR	CR

3.12.3 Fauna recorded

Twenty-three species of fauna were identified during the 2019 survey (Table 7 and Appendix B.2). This is only a portion of the fauna that may utilise the study area; some may use it as part of a larger patch or may visit at different times of the year due to variations in seasonal habitat opportunities. Additional fauna that are likely to occur but were not recorded include birds, frogs, snakes ,lizards and bats. Four of the recorded species are introduced (*). Additional introduced species that are likely to periodically occur within the study area include House Mouse, Black rat, Fox and Cat.

Table 6: Fauna observed within the study area

Class	Family	Species Name	Vernacular Name
AVES	ACANTHIZIDAE	*Acanthiza apicalis*	Inland thornbill
		Acanthiza chrysorrhoa	Yellow-rumped thornbill
	ALCEDINIDAE	*Dacelo novaeguineae**	Kookaburra
	ANATIDAE	*Chenonetta jubata*	Australian wood duck
	ARDEIDAE	*Ardea pacifica*	White-necked heron
		Egretta novaehollandiae	White-faced heron
	ARTAMIDAE	*Cracticus tibicen*	Australian magpie
	CACATUIDAE	*Calyptorhynchus latirostris*	Carnaby's cockatoo
	COLUMBIDAE	*Phaps chalcoptera*	Common bronzewing
	CORVIDAE	*Corvus coronoides*	Australian raven
	MALURIDAE	*Malurus splendens*	Splendid fairy-wren
	MELIPHAGIDAE	*Anthochaera carunculata*	Red wattlebird
	PACHYCEPHALIDAE	*Colluricincla harmonica*	Grey shrike-thrush
		Pachycephala rufiventris	Rufous whistler
	PHASIANIDAE	*Gallus gallus**	Chicken

	PSITTACIDAE	*Barnardius zonarius*	Australian ringneck
		Platycercus icterotis	Western rosella
	RHIPIDURIDAE	*Rhipidura albiscapa*	Grey fantail
		Rhipidura leucophrys	Willie wagtail
MAMMALIA	BOVIDAE	*Bos Taurus**	Cow
	LEPORIDAE	*Oryctolagus cuniculus**	Rabbit
	PSEUDOCHEIRIDAE	*Pseudocheirus occidentalis*	Western ringtail possum
REPTILIA	SCINCIDAE	*Egernia kingii*	Kings skink

3.12.4 Conservation significant fauna

Based on the site survey and the threatened fauna evaluation table, three birds and two mammals of conservation significance could occur and have a likely chance of being impacted, if they do occur. An extract of the threatened fauna evaluation table (Appendix E) is given below (Table 8). Threatened fauna identified from the study area included Carnaby's cockatoo and WRP. Baudin's cockatoo and FRTBC may occur as foraging species are present. The Western False Pipistrelle may also occur given that suitable habitat is present, although the species wasn't surveyed for using bat detection methodologies.

Table 7: Fauna of conservation significance that may occur within the study area

Family Genus species	Vernacular	Status Federal	Stat. WA	Presence of habitat	Likelihood of occurrence
Cacatuidae *Calyptorhynchus banksii naso*	Forest red-tailed black cockatoo (FRTBC)	VU	VU	Present - supporting	Possible visitor – foraging
Zanda baudinii	Baudin's cockatoo	EN	EN	Present - supporting	Possible visitor – foraging
Zanda latirostris	Carnaby's cockatoo	EN	EN	Present - supporting	Present based on forage evidence
Pseudocheiridae *Pseudocheirus occidentalis*	Western ringtail possum	CR	CR	Present - core	Present
Vespertilionidae *Falsistrellus mackenziei*	Western false pipistrelle	-	P4	Present - supporting	Possible

Black Cockatoos

The site contains suitable foraging habitat (Marri trees) for Baudin's cockatoo, Carnaby's cockatoo and FRTBC. Foraging habitat within the lot boundaries was restricted to only six Marri DBH trees within the degraded habitat type 3. Marri Woodland over pasture / Poor fauna habitat quality and less than 0.2 ha of canopy area.

There were 46 suitable DBH trees recorded over 50 cm DBH. Half (23) are within the road verge (see Figure A-6). Only five trees contained hollows, two within the road reserve, one in Lot 4 and two in Lot

5. None of which showed obvious signs of chewing or use by black cockatoos in 2019. They were reassessed by drone in 2024 and all found as unlikely to be or unsuitable for black cockatoo breeding. As such, there were no current black cockatoo breeding hollows observed within the lots or road verges. Although potentially unsuitable for black cockatoos, they may still be utilised by other fauna (WRP).

No black cockatoo roosts were recorded within the study area. The nearest mapped Baudin's or Carnaby's cockatoo roost (AUGMARR002) occurs approximately one kilometre west of the project (thought it had no records in the data) (DBCA 2024).

Western False Pipistrelle

Given the presence of Peppermint/Marri/Karri and hollow trees, habitat for the Western False Pipistrelle is potentially suitable. If a population of Western False Pipistrelle was present at the site, it may be roosting in the hollow trees. Retention of hollows on site would be a priority for this species.

WRP

WRP were observed through scats and dreys during diurnal surveys in 2019 at Lot 5, and although no evidence of the species was observed in 2024, they may occur within the *3. Marri Woodland over pasture / Poor fauna habitat quality* and *4. Marri Woodland (roadside remnant) / Poor to Moderate fauna habitat quality* (totalling 0.9 ha). There is a limited potential for WRP to utilise individual tree hollows in *1. Cleared or parkland cleared with plantings / Poor fauna habitat quality*. The species is unlikely to occur within *2. Mixed Eucalypt Forest (planted) / Poor fauna* habitat quality due to the lack of refuge and midstorey.

3.13 Dieback

The study area is highly degraded and likely to be considered uninterpretable. No dead or dying dieback indicator species were observed through the site. No further action is required.

3.14 Reserves and conservation areas

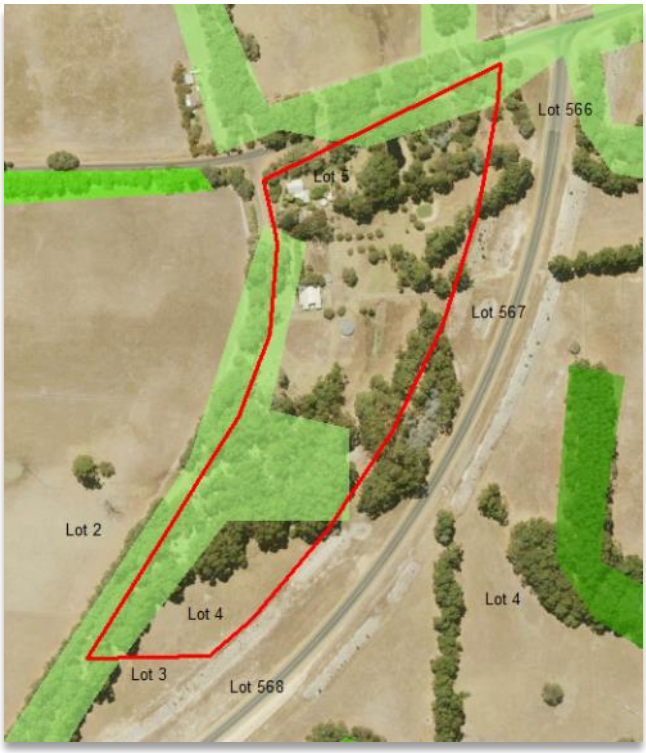
Several reserves associated with residential subdivisions, the Wadandi Trail and other land under the care and control of the Shire of Augusta – Margaret River, occur east of the Project. The closest is approximately 800m away (see Figure A-2).

The Bramley National Park and circa 250 ha of Class 'C' Timber Reserve are located approximately 500m east of the Project. They are linked to other vegetation patches to the west by the vegetated Rosa Brook and Darch Road verges, and more extensively through private property about 500m south of the Project. No Shire or DBCA lands will be adversely impacted by the project.

3.15 Habitat connectivity, linkage and corridor values

The South West Regional Ecological Linkages (SWREL) project (Molloy et al 2009) identifies regional scale ecological linkages and aims to respond to the issues of fragmentation and climate change

through land use planning policy and procedures. It also seeks to retain native vegetation and fauna habitat and reduce the loss of biodiversity and ecological function in the Southwest.



The SWREL axis lines can be summarised as a series of vegetation patches which, due to their proximity, act as habitat stepping stones, thereby facilitating ecological processes and movement of organisms within and across the landscape (i.e. at the landscape scale). The study area is located approximately 2500 m from the nearest axis line, with the Darch Road verge and the small section in the centre of the project assigned a proximity value of *1a: with and edge touching or <100 m from a linkage*. See Figure 3-3.

Figure 3-3 SWREL proximity value 1a across the study area (Molloy et al 2009)

The capacity for fauna to move is generally related to size; the larger the animal generally the greater the ability for the animal to cover a greater area (Molloy et al 2009). Studies referred to in the SWREL Technical Report generally indicate (simplified) that

- Small mammals may cross widths of up to 100 m while dispersing,
- Small insectivorous passerines may cross gaps up to 20 m but not over 80 m,
- Arthropods and small lizards are generally sedentary in nature and unlikely to move between patches,
- Small invertebrates (as pollinators) will generally not disperse over 100 m,
- Frogs will generally disperse over 150m.

The above indicates that while vegetation gaps will, to some degree, compromise the capacity of fauna to persist, gaps of <100 m will not bring about a significant barrier to the dispersal of many fauna species. A gap of 1000 m between patches of remnant vegetation is recognised as a major barrier to the movement of many fauna species and represents a threshold, of which once crossed, presents a major decline in biotic interaction.

Even with clearing within the lots, the vegetated Darch Road reserve would maintain some connectivity through this section and impacts to linkage at a landscape scale would be considered low.

3.16 Heritage

3.16.1 Aboriginal heritage

The Aboriginal Heritage Act 1972 (AHA) makes provision for preservation on behalf of the community of places and objects customarily used by - or traditional to - the original inhabitants of Australia or their descendants. The closest registered site under the AHA is the Margaret River and its tributaries (ID 4495), a mythological site. The closest section of the registered site, as mapped, falls approximately 350 m north of the Project (PDLH, 2018). Given the degraded nature of the drainage features within the study area, they are not likely to be considered tributaries of the Margaret River, nor would they be considered to form part of Site (ID 4495).

The project also falls within the buffer zone of 'Rosa Brook Road (Margaret River Lore Ground) Other Heritage Place 4494' described as a Ceremonial Camp, Meeting Place, Battle ground. It is listed as Stored Data / Not a Site under the AHA and is therefore not a registered site. No actions are required under the AHA.

3.16.2 Heritage – other

Items or places of heritage significance are listed under the Australian Heritage Database (DotEE, 2024) State inHerit database (Government of WA, 2024), or at a local level under the Shire of Augusta-Margaret River Municipal Inventory (2012). There are no items or places listed on these inventories or databases associated with or near the Project site.

3.17 Bushfire management

Based on regional Bush Fire Prone Mapping (Department of Fire and Emergency Services, 2024), the site is mapped within the designated bushfire-prone area. An assessment of the bushfire risk is required under the *Planning and Development (Local Planning Scheme) Regulations 2015* and the Building Code of Australia in line with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7). SPP 3.7 stipulates that to reduce vulnerability to bushfire, the identification of bushfire risks are to be considered in decision making at all stages of the planning and development process. A Bushfire Management Plan has been prepared by Working on Fire Planning (2021) and should be read in conjunction with this EAR.

3.18 Noise and vibration

There are few nearby residences. Apart from the involved landowner at Lot 5, the nearest receivers are in the adjacent Lot 3 and 9007 (across Rosa Glen Road). The development of additional lots is unlikely to have a significant impact on nearby receivers, however an acoustic assessment may be required to determine appropriate buffer distances at the subdivision stage.

4 Potential impacts and recommendations

4.1 Direct impacts

Potential direct impacts will be largely associated with the clearing requirements outlined in the Project Bushfire Management Plan. These impacts are indicative and are subject to a final subdivision plan. For the purposes of the EAR, anticipated direct impacts are assumed as:

- Total clearing within the building envelopes (each approximately 800-1000 m^2) within final locations yet to be determined.
- Clearing the surrounding Asset Protection Zones (APZ) canopy <15% crown density, with removal of most understorey vegetation. The clearing footprint is also yet to be determined.
- Minor clearing for crossovers, site lines and building access. These are not currently known, though impacts are considered to be low.

There may be opportunities to further reduce or mitigate some of the impacts through the subdivision design phase and recommendations in any Management Plans that may need to be prepared.

Fauna habitat quality within the proposed building envelopes and APZ are considered Poor. Hollow-bearing trees, however, provide important and potentially critical habitat features for some fauna groups. Building envelopes are able to be located to avoid the five hollow-bearing trees.

Typical impacts associated with clearing native vegetation may include:

- Direct loss of vegetation
- Direct loss of fauna habitat and mortality of individual animals and plants (resources). This would mostly impact common, conservation secure species, particularly smaller, less mobile animals.
- Loss of mature vegetation (which also provides more flowers, nectar, fruit, seeds, refuge for fauna)
- Loss of below ground biomass (such as seed banks)
- Changes to vegetation, flora and fauna assemblages near and around the site
- Fragmentation of habitat connectivity and populations

These impacts will be low, due to the Completely Degraded to Degraded condition of vegetation.

Habitat connectivity is discussed in Section 3.15. The maximum proposed clearing is not likely to impair core local or regional linkage and/or landscape function.

4.2 Indirect Impacts

Development, including clearing, may result in indirect impacts. Indirect impacts may be associated with the construction period (short term) and cumulative impacts of land management once subdivided (long term). Activities that are likely to cause indirect impacts include:

- Deliberate/accidental clearing or disturbance of native vegetation,
- Machinery access,
- Compaction of soils,
- Noise, dust and vibration, and
- Increased visitation and use of the site by humans and introduced species.

Indirect impacts of the Project are assessed as negligible, considering:

- Vegetation at the site is in a Completely Degraded to Degraded condition (EPA 2016),
- Existing Poor habitat quality does not support a high diversity of flora or fauna,
- Hollow-bearing trees can be retained,
- The site is already accessible to foxes and rabbits, and
- Most impacts will be associated with direct impacts (clearing for building envelopes).

Potential indirect impacts will be able to be reduced or mitigated through appropriate environmental management along with the implementation of recommendations associated with this report.

Based on the review of environmental factors in Section 3, the following factors are unlikely to be impacted by the proposed subdivision enough to warrant further investigation or specific management:

- Existing land uses
- Geology (landform and soils)
- Contaminated sites
- Dieback
- Nearby reserves / conservation areas
- Habitat connectivity, linkage, and corridor values
- Heritage (Aboriginal and other)

Table 8: Environmental factors, potential impacts and recommendations

Environmental factor	Nature of potential impact	Recommendations
Acid Sulfate Soils (ASS)	The study area is mapped as Class 2 (2g, p4) risk of ASS (DER, 2010). Class 2 includes moderate to low risk of ASS occurring within 3 m of the natural surface but a high to moderate risk of ASS occurring beyond 3 m. The depth beyond 3 m could potentially be disturbed by soil excavation and dewatering associated with civil works including: • works involving lowering of the water table (temporary or permanent), • earthworks extending beyond 3 m below the natural ground surface, and • works within 500 m of wetlands. Waterlogged soils may be associated with low laying areas and natural drainage shown in Figure 3. If any soil excavation and dewatering is likely to occur in or near	Stantec (2021) notes that as road excavations will be limited to the top 300 mm, and trenching limited to approximately 0.9 m deep electrical reticulation requirements, activation of ASS is considered unlikely. Stantec (2021) recommends an environmental consultant confirm that the proposed minor surface excavations will not require ASS management at the subdivision stage. The objective of an ASS investigation is to determine the extent to which soils and groundwater will be disturbed and to determine the nature and extent of ASS and non-ASS that may be impacted by the proposal. This should

	these areas, further ASS investigations are recommended at the subdivision stage.	be confirmed through the completion of an ASS self-assessment form and if necessary, the preparation of an Acid Sulfate Soil and Dewatering Management Plan (ASSDMP) at the subdivision stage. The ASSDMP has the objective of preventing potentially adverse impacts to the environment as a result of soil acidification related to earthworks and dewatering activities.
Hydrology - Surface water	Four farm dams and a network of artificial drainage channels present. Hydrology of the study area has been recently altered (reduced run on) due to the onsite capture and management of stormwater in the adjacent subdivision west of Darch Road. Minimal risk of flooding across the site, although there is a moderate to high hazard of some flooding for 30% of Cowaramup wet vales phase soil unit (CoCOvw). The site does not appear to be within a mapped 100 Year ARI Floodplain Area (SLIP 2024). Lots 4 and 5 located within the Margaret Town subarea of the Busselton Coast Surface Water Management Area. A Site and Soil Evaluation report was prepared to assess the site soils for their capability for onsite sewage management by a combination of soil survey, permeability studies, laboratory assessment and a desktop review of published soil survey information. Sandy loam soil, degrading into clay at depth, was observed in all test pits in the Site and Soil Evaluation Report (E&LM 2023). The report found that there is enough land application area space available on the proposed new lots. Permeability is generally good so at most 225 m^2 of irrigated area for a secondary treatment system is required on the new lots. Depending on Council regulations, there could be more or less footprint for leach drains/flatbeds. For secondary treatment systems the irrigation area can easily be located away from the dwellings. Effluent is typically pumped; hence drains can be longer than 20 m.	Preparation of a Local Water Management Strategy (LWMS) and an Urban Water Management Plan (UWMP) is not recommended, due to the small nature of the development and no change in stormwater behaviour associated with the site (Stantec 2021). The proposed development however should ensure that existing stormwater flow patterns are not disrupted or cut off. In order to minimise the potential for sediment transport to the creek line, providing a minimum of 10 m vegetation between water ways and nearest impermeable area is recommended (Stantec 2021). Onsite effluent disposal systems should a have setback of more than 30 m from any well, bore, stream, river or water course intended for consumption by humans (including non-perennial streams). Further on-site investigations i.e. biophysical assessment to determine foreshore areas and buffer zones may be required at the subdivision stage. Margaret Town subarea of the Busselton Coast Surface Water Management Area - any extraction of surface water requires a license from DWER to ensure environmental requirements are met and to prevent over extraction of the resource. Sewer and drainage to be designed in line with the recommendations of the Site and Soil Evaluation report (E&LM 2023).
Hydrology - Wetlands	The Project is mapped as palusvale and floodplain in the DBCA Geomorphic Wetlands dataset (SLIP 2024). The dataset for the Margaret River area has not been reviewed and yet to be assigned a conservation category. The mapped areas are highly degraded and may no longer be representative of wetland given the hydrological changes within the Project area due to changes in land use upstream.	
Hydrology - Groundwater	The study area falls within a RIWI Act Proclaimed Groundwater Area, the Blackwood Groundwater Area.	A groundwater licence will be required to take water from a well or artesian bore, or do any other activity that utilises groundwater.
Biological - Vegetation	No conservation significant vegetation communities were found on site (Steam EW 2018). Impacts to native	Crossovers should be sited to minimise clearing within the Darch Road reserve.

	vegetation within Lots 4 and 5 will be low, due to the Completely Degraded to Degraded condition of vegetation, including areas of planted exotic and non-endemic species. The road verge vegetation along Darch Road was assessed as being in a Good condition (EPA 2016).	A Site Revegetation Plan should be prepared, approved and implemented for the revegetation of any drainage areas with appropriate native species to the specifications of the Local Government.
Biological - Flora	No conservation significant flora or communities found (Steam EW 2018). Vegetation within Lots 4 and 5 was in a Completely Degraded to Degraded condition. The road verge vegetation along Darch Road was assessed as being in a Good condition (EPA 2016). Existing surveys from 2018 may be out of date in this area.	Targeted flora surveys should be considered for the proposed crossovers to ensure no impacts to threatened flora, at the subdivision stage.
Biological - Weeds	*Asparagus asparagoides* (bridal creeper), *Rubus ulmifolius* (Blackberry) and *Zantedeschia aethiopica* (Arum lily) are listed as declared pest plants under the BAM Act, potentially along with Iridaceae plants along the Rosa Brook Road.	Weed management should be undertaken at the subdivision stage.
Biological – Fauna	Fauna habitat quality is Poor to Moderate over the site, with the majority of the lot areas providing Poor habitat quality. The site contains Marri trees which are suitable black cockatoo foraging habitat. Foraging habitat within the lot boundaries was restricted to only six Marri DBH trees within the degraded habitat type 3. Marri Woodland over pasture / Poor fauna habitat quality and less than 0.2 ha of canopy area. 46 suitable DBH trees recorded, half (23) within the road verge. Only five trees contained hollows, two within the road reserve and one in Lot 4 and two in Lot 5, none of which were considered to be suitable for black cockatoo breeding. The hollows may be utilised by WRP. WRP may occur within the *3. Marri Woodland over pasture / Poor fauna habitat quality* and *4. Marri Woodland (roadside remnant) / Poor to Moderate fauna habitat quality* (totalling 0.9 ha). They may also utilise individual tree hollows in *1. Cleared or parkland cleared with plantings / Poor fauna habitat quality*.	Avoid hollow bearing trees if possible, at the subdivision stage. Where clearing of potential black cockatoo and WRP habitat is proposed, the requirement for an EPBC Act referral will need to be considered at the subdivision stage. Fauna management protocols and actions will need to be implemented prior to and during clearing activities, potentially through implementation of a Fauna Management Plan. An authorised fauna spotter should be present to manage the clearing of any potential WRP habitat.
Bushfire management	Based on regional Bush Fire Prone Mapping (Department of Fire and Emergency Services, 2024) the site is mapped within the designated bushfire prone area and subject to SPP 3.7. Exact clearing locations are not finalised however as the site is predominately cleared/paddock trees there are significant opportunities to place house envelopes in existing cleared areas.	Any Bushfire Management Plans prepared for this project should be read in conjunction with this EAR. The final lot layout and building envelopes / APZ will be finalised for the subdivision stage.
Noise and vibration	Few nearby residences, apart from the involved landowner at Lot 5. The development of additional lots is unlikely to have a significant impact on nearby receivers.	Acoustic assessment may be required to determine appropriate buffer distances at the subdivision stage.

5 Conclusions

There are no critical environmental constraints identified through this Environmental Assessment Report that would result in the Project not proceeding. The following values were noted through the assessment:

- Impacts to native vegetation within Lots 4 and 5 will be low, due to the Completely Degraded to Degraded condition of vegetation, including areas of planted exotic and non-endemic species.
- No conservation significant flora or communities were found within the study area (Steam EW 2018).
- Fauna habitat quality is Poor to Moderate over the site, with the majority of the lot areas providing Poor habitat quality.
- The site contains Marri trees which are suitable black cockatoo foraging habitat. Foraging habitat within the lot boundaries was restricted to only six Marri DBH trees within the degraded habitat type 3. Marri Woodland over pasture / Poor fauna habitat quality and less than 0.2 ha of canopy area.
- No evidence of black cockatoo breeding or roosting was recorded within the study area.
- There is a limited potential for WRP to utilise individual tree hollows in *1. Cleared or parkland cleared with plantings / Poor fauna habitat quality*. The species is unlikely to occur within *2. Mixed Eucalypt Forest (planted) / Poor fauna* habitat quality due to the lack of refuge and midstorey.

Further considerations are provided below:

- Activation of ASS is considered unlikely however the Completion of an ASS self-assessment form will be required and if necessary, the preparation and implementation of an ASSDMP at the subdivision stage.
- Preparation of a LWMS and an UWMP is not recommended due to the small nature of the development and no change in stormwater behaviour associated with the site (Stantec 2021). The proposed development however should ensure that existing stormwater flow patterns are not disrupted or cut off.
- Onsite effluent disposal systems should a have setback of more than 30 m from any well, bore, stream, river or water course intended for consumption by humans (including non-perennial streams). Subdivision design should be in line with the (then) Department of Water's Operational Policy 4.3: Identifying and establishing waterways foreshore areas (2012).
- Extraction of surface water will require a license from DWER to ensure environmental requirements are met.
- Drainage should be designed in line with the recommendations of the Site and Soil Evaluation report (E&LM 2023).
- A Site Revegetation Plan should be considered to reduce residual impact on WRP, with appropriate native species to the specifications of the Local Government

- Minimise clearing of native vegetation where possible, particularly the trees over 50 cm DBH and the vegetation complex Cowaramup (Cw1 – Valleys) along Darch Road.
- Where clearing of potential black cockatoo and WRP habitat is proposed, impacts should be assessed against the EPBC Act at the subdivision stage.
- Fauna management protocols and actions will need to be implemented prior to and during clearing activities, potentially through implementation of a Fauna Management Plan. An authorised fauna spotter should be present to manage the clearing of any potential WRP habitat.
- Any Bushfire Management Plans prepared for this project should be read in conjunction with this EAR, with house locations sited to minimise clearing of vegetation.
- Retain the five hollow trees if possible (two of which are in the road verge).

6 References

Atlas of Living Australia (ALA) (2024) https://www.ala.org.au/ Accessed July 2024

Australian Government (2009) *Interim Biogeographic Regionalisation of Australia (IBRA) Version 6.1*, Department of the Environment, Water, Heritage and the Arts. Retrieved 26/07/2016 from http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html

BirdLife International (2024) Birdata database. https://birdata.birdlife.org.au/

Beard J (1981). *Vegetation Survey of Western Australia*. 1:1 000 000 Series. Sheet 7 - Swan. Map and Expanatory Notes. University of Western Australia Press, Nedlands

Commonwealth of Australia. (2001). *Biodiversity Conservation Research: Australia's Priorities*.

Commonwealth of Australia (2016). *Banksia Woodlands of the Swan Coastal Plain: a nationally-protected ecological community*, Commonwealth of Australia.

Department of Environment. (DE), (2017) website, accessed September 2017 http://www.environment.gov.au/land/nrs/science/ibra

Department of Environmental Regulation (2010). ASS Risk Map Fact Sheet.

Department of Environmental Regulation (2014). *A guide to the assessment of applications to clear native vegetation; Under Part V Division 2 of the Environmental Protection Act 1986*. Department of Environmental Regulation, Perth, Western Australia.

Department of Parks and Wildlife (DPaW) (2018). *NatureMap*, Western Australian Herbarium. http://naturemap.dec.wa.gov.au/default.aspx. Accessed July 2018.

Department of Parks and Wildlife (DPaW) (2018). *Florabase*, Western Australian Herbarium.

Department of Environment and Conservation (2011) *Plants Used by Carnaby's Black Cockatoo,* list prepared by Christine Groom, Department of Environment and Conservation 15 April 2011

Department of Planning, Lands and Heritage (DPLH), Aboriginal Heritage Inquiry System (AHIS) search on 21/11/2018.

Department of the Environment and Energy. (DoEE) (2018a). *Threatened ecological communities under the EPBC Act*. http://www.environment.gov.au/cgibin/sprat/public/publiclookupcommunities. Accessed October 2018

Department of the Environment and Energy. (DoEE) (2018b). *Protected Matters Search Tool report*. Generated August 2018

Department of the Environment and Energy. (DoEE) (2018d). *Environment Protection and Biodiversity Conservation Act. Species Profile and Threats Database*. http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl accessed September 2018.

Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) (2012) *EPBC Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered), Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable), Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*

Department of the Environment, Water, Heritage and the Arts (DEWHA), (2013) Commonwealth Matters of National Environmental Significance – *Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999.*

Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2012) *Commonwealth EPBC Act referral guidelines for three threatened black cockatoo species:*

Carnaby's cockatoo (endangered), Zanda latirostris, Baudin's cockatoo (vulnerable), Zanda baudinii, and Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso.

Environment Australia (2001) *National objectives and targets for biodiversity conservation 2001–2005*. http://www.environment.gov.au/resource/national-objectives-and-targets-biodiversity-conservation-2001%E2%80%932005

Environmental & Landscape Management (E&LM) (2023). Site and Soil Evaluation report for Lots 4, 5 and 31 Darch Road, Margaret River

EPA (2016). Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment. Environmental Protection Authority, Western Australia.

Environmental Protection Authority (2020) Technical Guidance Terrestrial vertebrate fauna surveys for environmental impact assessment

Environmental Protection Authority (2000). Environmental Protection of Native Vegetation in Western Australia. EPA Position Statement No. 2. EPA, Perth

Environmental Protection Authority (2006). *Level of Assessment for Proposals affecting Natural Area within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region*. Guidance Statement No. 10, June 2006, Perth.

Environmental Protection Authority (EPA) (2009). *South West Regional Ecological Linkages. Environmental protection Bulletin No. 8*. EPA, Perth, Western Australia

Environmental Protection Authority (EPA) (2016a). *Technical Guidance – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment*. EPA, Perth.

Gorrod, E. and Keith, D.A. (2008) '*Observer variation in field assessments of vegetation condition: implications for biodiversity conservation*' Evaluating vegetation condition measure for cost-effective biodiversity investment planning; ACERA Project No. 0706, Australian Centre of Excellence for Risk Analysis

Government of Western Australia 2006, State planning policy 2.9: Water resources, Western Australian Planning Commission, Perth.

Harvey, M. S. (2002) Endemism among the Australian fauna: some examples from nonmarine environments. *Invertebrate Systematics* **16**: 555–570.

Hearn, R., Williams, K., Comer, S., and Beecham, B., (2002) Warren (WAR subregion) Department of Conservation and Land Management and the Western Australian Museum.

Inions, G.B., Tanton, M.T., and Davey, S.M. (1989) *Effect of Fire on the Availability of Hollows in Trees Used by the Common Brushtail Possum, Trichosurus Vulpecula Kerr, 1792, and the Ringtail Possum, Pseudocheirus Peregrinus Boddaerts, 1785*. Australian Wildlife Research 16(4) 449 – 458. CSIRO Publishing.

Johnstone, R.E. & T. Kirkby (2008). Distribution, status, social organisation, movements and conservation of Baudin's Cockatoo (*Zanda baudinii*) in South-west Western Australia. Records of the Western Australian Museum. 25:107-118.

Johnstone, R.E., T. Kirkby and Mannion, M., (2015). Trials on the use and effectiveness of artificial nest hollows for Carnaby's Cockatoo at Cataby Western Australia. The Western Australian Naturalist 29(4): 250–262 (2015).

Johnstone, R.E., Sarti, K. and Kirkby, T. (2010a) Baudin's Cockatoo *Zanda baudinii* information sheet. Western Australian Museum, Perth.

Johnstone, R.E., Sarti, K. and Kirkby, T. (2010b) Carnaby's Cockatoo *Zanda latirostris* information sheet. Western Australian Museum, Perth.

Johnstone, R.E., Sarti, K. and Kirkby, T. (2010c) Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* information sheet. Western Australian Museum, Perth.

Johnstone, R.E., Kirkby, T. and Sarti, K. (2013a). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. I. Characteristics of nest trees and nest hollows. Pacific Conservation Biology 19 (3): 121-142.

Johnstone, R.E., Kirkby, T. and Sarti, K. (2013b). The breeding biology of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould in south-western Australia. II. Breeding Behaviour and diet. Pacific Conservation Biology 19 (3):143-156.

Johnstone R.E., and Kirkby, T. (Undated) Carnaby's Cockatoo (Zanda latirostris), Baudin's Cockatoo (Zanda baudinii) and the Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii naso) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes. Report for the Department of Planning, Western Australia.

Jones, B.A., How, R.A., and Kitchener D.J. (1994a) A field study of *Pseudocheirus occidentalis* (Marsupialia: Petauridae). I, Distribution and habitat. Wildlife Research, 21: 175–187.

Jones, B.A., How, R.A., and Kitchener D.J. (1994b) A field study of *Pseudocheirus occidentalis* (Marsupalia: Petauridae). II. Population studies. Wildlife Research, 21: 189–201.

Jupp, T. (2000) The status of cockatoos in south-west Western Australia and conservation efforts by Perth Zoo, Int. Zoo Yb. 37: 80-86

Keighery BJ (1994). *Bushland Plant Survey: A guide to plant community survey for the community*. Wildflower Society of Western Australia (Inc.), Nedlands

Koch, A.J. (2008) '*Errors associated with two methods of assessing tree hollow occurrence and abundance in* Eucalyptus obliqua *forest, Tasmania'*, Forest Ecology and Management vol. 255; 674–685

Koch, A.J. (2009) Tree hollows in Tasmania: A guide. Published by CRC for Forestry and the Forest Practices Authority

Landgate (2024) Shared Location Information Platform (SLIP)

Mattiske EM and Havel JJ (1998). *Vegetation Complexes of the South-west Forest Region of Western Australia*. Maps and report prepared as part of the Regional Forest Agreement, Western Australia for the Department of Conservation and Land Management and Environment Australia.

Mawson, P and Long, J. L., (1994) Size and Age Parameters of Nest Trees Used by Four Species of Parrot and One Species of Cockatoo in South-west Australia, EMU Vol 94, 149-155

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.

Koch, A.J. (2008) 'Errors associated with two methods of assessing tree hollow occurrence and abundance in Eucalyptus obliqua forest, Tasmania', Forest Ecology and Management vol. 255; 674–685

Koch, A.J. (2009) Tree hollows in Tasmania: A guide. Published by CRC for Forestry and the Forest Practices Authority

Rayner, L., Ellis, M. and Taylor, J.E. (2011) '*Double sampling to assess the accuracy of ground-based surveys of tree hollows in eucalypt woodlands*', Austral Ecology 36: 252-260

Shared Location Information Platform (SLIP) Landgate (2024). Accessed June 2024.

Shedley E and Williams K (2014) *An assessment of habitat for western ringtail possum (Pseudocheirus occidentalis) on the southern Swan Coastal Plain*. Unpublished report for the Department of Parks and Wildlife, Bunbury, Western Australia.

Smith MG and Jones A (2018). *Threatened and Priority Flora List, 16 January 2018*. Department of Biodiversity, Conservation and Attractions: Kensington, WA.

Strahan, R. (1995) *The Mammals of Australia*, Strahan ed., Australian Museum/Reed Books.

SW Environmental and Kirkby, T. (2019) Thompsons Hill, Ryall State Forest, Donnybrook: Black Cockatoo breeding inspection results, Unpublished report to Main Roads WA.

Tille PJ and Lantzke NC (1990). *Busselton - Margaret River - Augusta. Land Capability Study*. Land Resources Series No 14. Perth, Agriculture WA.

Wayne A (2005) The ecology of the Koomal (*Trichosurus vulpecular hypoleucus*) and Ngwayir (*Pseudocheirus occidentalis*) in the jarrah forests of south-western Australia. PhD Thesis, Australian National University, Canberra.

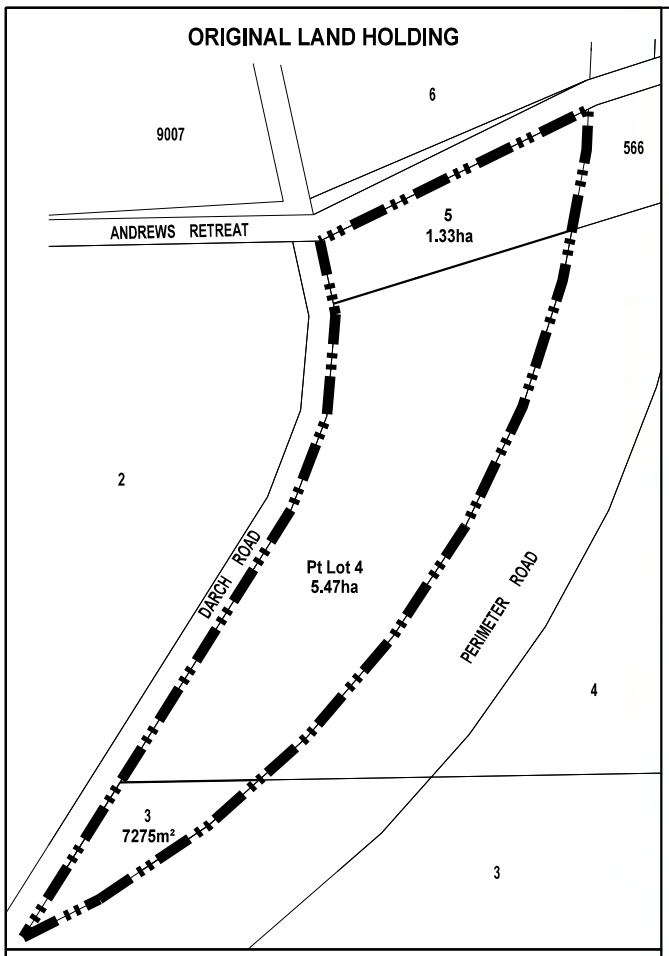
Weatherzone (2018) http://www.weatherzone.com.au/station.jsp?lt=site&lc=9746&list=ob

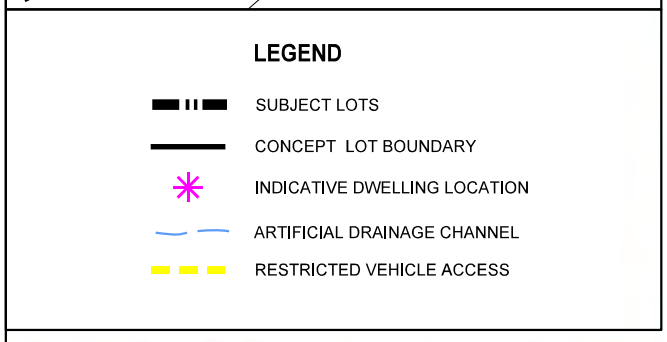
Western Australian Planning Commission 2008, Better urban water management, Western Australian Planning Commission, Perth.

Whitford (2002), Hollows in jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) trees: I. Hollow sizes trees attributes and ages, Forest Ecology and Management, Vol 160 pp 201-214

Appendix A Figures

Figure A-1 Concept Plan
Figure A-2 Locality
Figure A-3 Study area
Figure A-4 Soils
Figure A-5 Vegetation type and condition
Figure A-6 Suitable DBH trees
Figure A-7 Fauna habitat types and quality





LOT YIELD			LOT AREA		
Size	No. Lots	% Total Lots	Average Size	% of Total Area	Area
2000m² - 3000m²	3	23.08%	2228m²	8.87%	6685m²
3001m² - 4000m²	3	23.08%	3478m²	13.84%	10435m²
4001m² - 5000m²	3	23.08%	4731m²	18.83%	14194m²
5001m² - 10000m²	2	15.38%	6131m²	16.27%	12262m²
12001m² - 18000m²	1	7.69%	12300m²	16.32%	12300m²
18001m² - 20000m²	1	7.69%	19500m²	25.87%	19500m²
Total Number of Lots	13				

Minimum Lot Size 2000m² Average Lot Size 5798m²
Maximum Lot Size 19500m² Total Lot Area 75376m²

0 20 40 60 80
metres

NOTES

Base data supplied by Landgate

Aerial Photography Date - January 2020

Areas and dimensions shown are subject to final survey calculations.

All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.

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PLAN 5

CLIENT		N & K VEITCH
SCALE	:	1:2,000 @ A3
DATE	:	7 May 2024
PLAN No	:	4 DARCH-1-001
REVISION	:	K
PLANNER	:	SLB
DRAWN	:	BL

SUBDIVISION CONCEPT PLAN

PT. LOT 4 & LOTS 31 & 5 DARCH ROAD, MARGARET RIVER

LB PLANNING
TOWN PLANNING | URBAN DESIGN | LAND DEVELOPMENT CONSULTING

A 191A Naturaliste Terrace Dunsborough WA 6281
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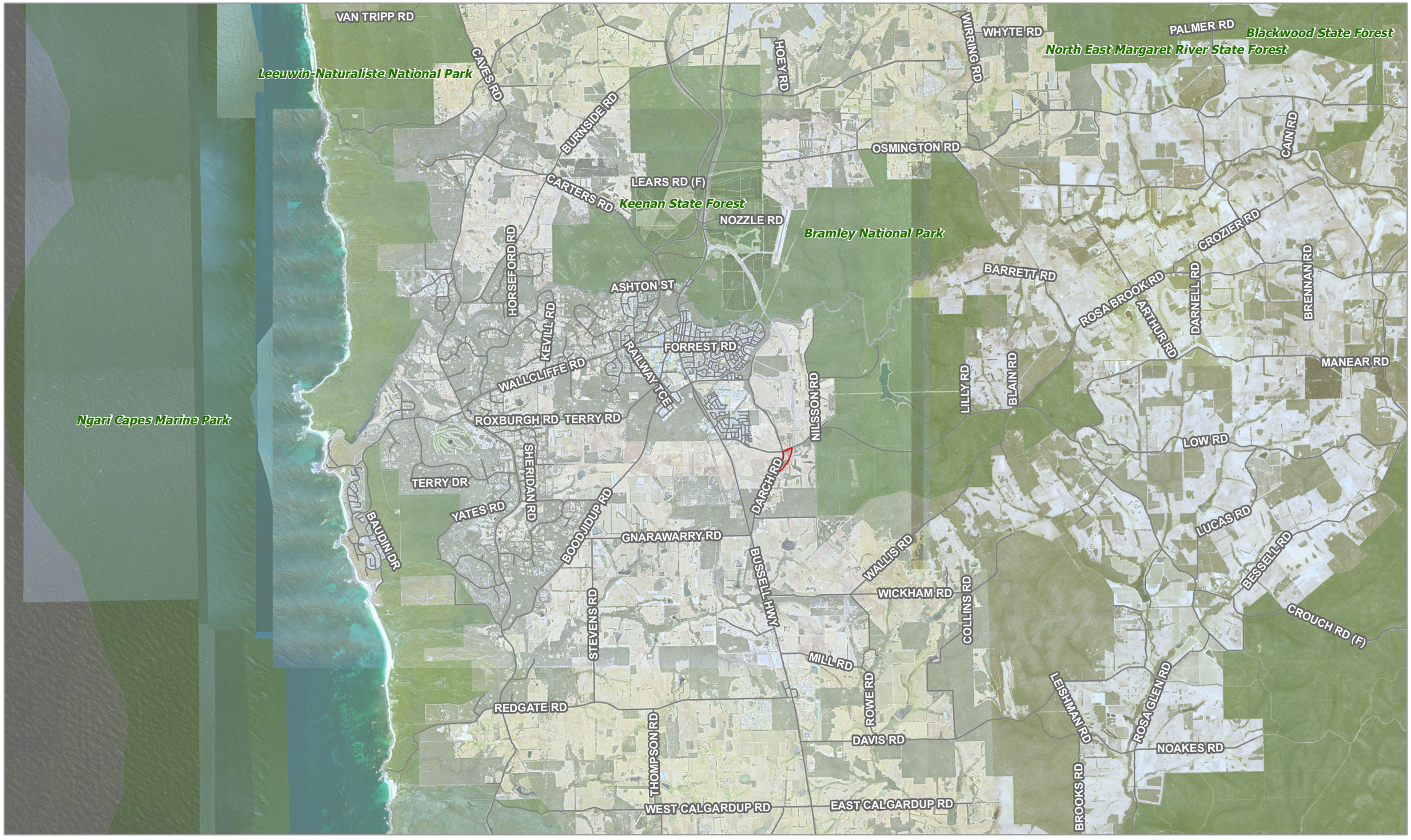


FIGURE A-2 LOCALITY

LOTS 4 AND 5 DARCH ROAD, MARGARET RIVER

Study area
Road
DBCA managed land



A3 @ 1:80000

0 500 1,000 2,000 m

GRID: GDA zone 50

N

Ref: SW533
Date: 15/07/2024 Author: SP

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

SW environmental
www.swenvironmental.com.au



FIGURE A-3 STUDY AREA

LOTS 4 AND 5 DARCH ROAD, MARGARET RIVER

— Road

--- Minor drainage line

Study area



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

SW environmental

www.swenvironmental.com.au

Ref: SW533
Date: 16/07/2024 Author: SP

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

ROSA BROOK RD

LOT 5

LOT 4

LOT 3

DARCH RD

216CoCOu

216CoCOvw

216CoCOw

216CoCOu

216CoCOvw

FIGURE A-4 SOILS

LOTS 4 AND 5 DARCH ROAD, MARGARET RIVER

Ref: SW533
Date: 16/07/2024 Author: SP

Road
Minor drainage line
Study area

Soil map unit (SLIP 2024)
216CoCOu
216CoCOvw
216CoCOw



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

SW environmental
www.swenvironmental.com.au



FIGURE A-5 VEGETATION TYPE AND CONDITION

LOTS 4 AND 5 DARCH ROAD, MARGARET RIVER

Ref: SW533
Date: 16/07/2024 Author: SP

- Road
- Minor drainage line
- Study area
- CC, Good
- CcEdAf, Degraded
- Cl, Completely degraded
- CmEdEg, Completely degraded



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

SW environmental
www.swenvironmental.com.au

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)



FIGURE A-6 SUITABLE DBH TREES

LOTS 4 AND 5 DARCH ROAD, MARGARET RIVER

Ref: SW533
Date: 16/07/2024 Author: SP

- Suitable DBH tree, no hollows
- Suitable DBH tree, with hollows (unlikely or not suitable for black cockatoo breeding)
- Farm dam
- Road
- Minor drainage line
- Study area

Habitat type, quality

- 1. Cleared or Parkland Cleared with Plantings, Completely degraded
- 2. Mixed Eucalypt Forest (planted), Poor
- 3. Marri Woodland over pasture, Poor to Moderate
- 4. Marri Woodland (roadside remnant), Good

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)



A3 @ 1:3000

0 10 20 40 m

GRID: GDA zone 50

N

SW environmental
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FIGURE A-7 FAUNA HABITAT TYPES AND QUALITY

LOTS 4 AND 5 DARCH ROAD, MARGARET RIVER

Farm dam
Road
Minor drainage line
Study area

Habitat type, quality
1. Cleared or Parkland Cleared with Plantings, Completely degraded
2. Mixed Eucalypt Forest (planted), Poor
3. Marri Woodland over pasture, Poor to Moderate
4. Marri Woodland (roadside remnant), Good



A3 @ 1:2990

0 10 20 40 m

GRID: GDA zone 50

N

SW environmental
www.swenvironmental.com.au

Ref: SW533
Date: 16/07/2024 Author: SP

Source: Base map © Esri and its data suppliers. SLIP Landgate (2024)

Appendix B Conservation codes

Fauna in WA may be afforded protection under the WA BC Act and or federal EPBC Act. Species listed as threatened or migratory under the above legislation are referred to collectively in this document as being 'conservation significant' or 'target' species. These terms include species and communities listed under the DBCA Priority lists.

BC Act

The WA BC Act and associated Regulations provide for the licensing and management of activities that affect biodiversity. The BC Act provides for the listing of threatened native animals (fauna) that need protection as critically endangered, endangered or vulnerable species because they are under identifiable threat of extinction (species).

The *Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2023)* under the *Biodiversity Conservation Regulations 2018* contain the lists of Threatened, Extinct and Specially Protected species under Part 2 of the BC Act. These are described below.

Threatened species and communities

- PD: Presumed totally destroyed (TECs only)
- CR: Critically endangered species
- EN: Endangered species
- VU: Vulnerable species

Extinct species

- EX: Extinct species
- EW: Extinct in the wild species

Specially protected species

- MI: Migratory species
- CD: Species of special conservation interest (conservation dependent fauna)
- OS: Other specially protected species

Priority species and communities

- Priority 1: Poorly-known species
- Priority 2: Poorly-known species
- Priority 3: Poorly-known species
- Priority 4: Rare, Near Threatened and other species in need of monitoring
- Priority Ecological Community (PEC): Where communities are considered rare but not (currently) threatened or there is insufficient information available for the community to be considered a TEC, communities can be listed as priority ecological communities (PECs).

A full description of conservation codes is provided in Appendix B.

EPBC Act

In accordance with Commonwealth legislation, the EPBC Act provides a list of 'Matters of National Environmental Significance' (NES), which includes significant fauna. Under the EPBC Act fauna matters of NES may be listed in any one of the following categories as defined in *Section 179* of the Act:

- Extinct,
- *Extinct in the wild,
- *Critically endangered,
- *Endangered,
- *Vulnerable,
- Conservation dependent.

*Only these categories are matters of NES under the Act.

The EPBC Act also lists migratory species that are recognized under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals). The EPBC Act is regulated by the DCCEEW.

IUCN Red List

The IUCN Red List is an inventory of the global conservation status of species and used to assist DBCA and other agencies in attributing a given threatened species status. It does not have any statutory authority and is not considered in detail in this assessment.

Appendix C Vascular flora list (2019)

Family	Genera	Species	Naturalised	Threatened	Mixed Eucalypts over pasture	Remnant Coymbia Woodland	Corymbia Woodland (road verge)
Amaranthaceae	*Alternanthera*	sp.			+		
Araceae	*Zantedeschia*	*aethiopica*	*				
Asparagaceae	*Asparagus*	*asparagoides*	*				
	Lomandra	*pauciflora*					+
Asteraceae	*Arctotheca*	*calendula*	*			+	
	Hypochaeris	*glabra*	*		+	+	
Cyperaceae	*Isolepis*	*marginata*			+		
	Lepidosperma	*squamatum*					+
	Lepidosperma	*tetraquetrum*					+
Dennstaedtiaceae	*Pteridium*	*esculentum*					+
Ericaceae	*Leucopogon*	*propinquus*					+
	Leucopogon	*verticillatus*			+		
Fabaceae	*Acacia*	*myrtifolia*			+		+
	Acacia	*saligna*				+	
	Hardenbergia	*comptoniana*					+
	Trifolium	sp.	*		+	+	
Geraniaceae	*Geranium*	sp.	*		+		
Goodeniaceae	*Dampiera*	*trigona*			+		
Haemodoraceae	*Anigozanthos*	*flavidus*					+
Hemerocallidaceae	*Caesia*	*micrantha*					+
Iridaceae	*Chasmanthe*	*floribunda*	*				+
	Gladiolus	sp.	*				+
	Romulea	*rosea*	*		+		
	Sparaxis	*bulbifera*	*		+		+
Juncaceae	*Juncus*	*articulatus*	*		+		
	Juncus	*microcephalus*	*		+	+	

	Juncus	*pallidus*			+	+	
Lamiaceae	*Stachys*	*arvensis*	*		+		
Myrtaceae	*Agonis*	*flexuosa*			+	+	
	Callistemon	sp. (planted bottlebrush)	*				
	Coymbia	*calophylla*				+	+
	Coymbia	*maculata*	*		+	+	
	Eucalytpus	*diversicolor*			+	+	+
	Eucalytpus	*grandis*	*		+		
	Eucalytpus	*marginata*					+
	Eucalytpus	*microcorys*	*		+		
	Eucalytpus	*patens*					+
	Melaleuca	sp (planted paper bark)	*			+	
	Taxandria	*linearifolia*					+
Orchidaceae	*Caladenia*	*latifolia*			+		
	Oxalis	*pes-caprae*	*				+
Poaceae	*Anthoxanthum*	*odoratum*	*		+	+	
	Briza	*maxima*	*				+
	Cenchrus	*clandestinus*	*		+	+	+
	Cynodon	*dactylon*	*				
	Ehrharta	*longiflora*	*			+	+
	Holcus	*lanatus*	*		+		
	Lolium	sp.	*			+	
Polygonaceae	*Rumex*	sp.	*		+	+	
Primulaceae	*Lysimachia*	*arvensis*	*		+		+
Proteaceae	*Hakea*	*amplexicaulis*					+
Rosaceae	*Rubus*	*?ulmifolius*	*				+
Rubiaceae	*Opercularia*	*hispidula*					+

Appendix D Potential fauna list and fauna recorded (2019)

Class	Family	Species Name	Vernacular Name	Observed (2019)
AMPHIBIA	HYLIDAE	*Litoria moorei*	Moore's Frog	
		Litoria adelaidensis	Slender Tree Frog	
	LIMNODYNASTIDAE	*Limnodynastes dorsalis*	Bullfrog	
		Heleioporus eyrei	Moaning Frog	
		Heleioporus inornatus	Plains Frog	
		Heleioporus albopunctatus	Western Spotted Frog	
	MYOBATRACHIDAE	*Crinia pseudinsignifera*	False Western Froglet	
		Crinia glauerti	Glauert's Froglet	
		Pseudophryne guentheri	Gunther's Toadlet	
		Geocrinia leai	Lea's Frog	
		Metacrinia nichollsi	Nicholl's Toadlet	
		Crinia georgiana	Tschudi's Froglet	
		Geocrinia alba	White-Bellied Frog	
AVES	ACANTHIZIDAE	*Acanthiza apicalis*	Inland Thornbill	Yes
		Calamanthus campestris	Rufous Fieldwren	
		Smicrornis brevirostris	Weebill	
		Gerygone fusca	Western Gerygone	
		Acanthiza inornata	Western Thornbill	
		Sericornis frontalis	White-Browed Scrubwren	
		Acanthiza chrysorrhoa	Yellow-Rumped Thornbill	Yes
	ACCIPITRIDAE	*Elanus axillaris*	Black-Shouldered Kite	
		Accipiter fasciatus	Brown Goshawk	
		Accipiter cirrocephalus	Collared Sparrowhawk	
		Hieraaetus morphnoides	Little Eagle	
		Pandion haliaetus	Osprey	
		Lophoictinia isura	Square-Tailed Kite	
		Circus approximans	Swamp Harrier	
		Aquila audax	Wedge-Tailed Eagle	
		Haliastur sphenurus	Whistling Kite	
	AEGOTHELIDAE	*Aegotheles cristatus*	Australian Owlet-Nightjar	
	ALCEDINIDAE	*Dacelo novaeguineae*	Kookaburra	Yes
		Todiramphus sanctus	Sacred Kingfisher	
	ANATIDAE	*Tadorna tadornoides*	Australian Shelduck	
		Chenonetta jubata	Australian Wood Duck	Yes
		Cygnus atratus	Black Swan	
		Stictonetta naevosa	Freckled Duck	
		Anas gracilis	Grey Teal	
		Anas platyrhynchos	Mallard Duck*	
		Biziura lobata	Musk Duck	
		Anas superciliosa	Pacific Black Duck	
	ARDEIDAE	*Ixobrychus flavicollis*	Black Bittern	
		Nycticorax caledonicus	Nankeen Night-Heron	

Class	Family	Species Name	Vernacular Name	Observed (2019)
		Egretta novaehollandiae	White-Faced Heron	Yes
		Ardea pacifica	White-Necked Heron	Yes
	ARTAMIDAE	*Cracticus tibicen*	Australian Magpie	Yes
		Artamus cinereus	Black-Faced Woodswallow	
		Artamus cyanopterus	Dusky Woodswallow	
		Cracticus torquatus	Grey Butcherbird	
		Strepera versicolor	Grey Currawong	
	ATRICHORNITHIDAE	*Atrichornis clamosus*	Noisy Scrub-Bird	
	BURHINIDAE	*Burhinus grallarius*	Bush Stone-Curlew	
	CACATUIDAE	*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo	
		Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Feed sign
		Calyptorhynchus banksii	Forest Red-Tailed Black Cockatoo	
		Eolophus roseicapillus	Galah	
		Cacatua pastinator	Western Corella	
	CAMPEPHAGIDAE	*Coracina novaehollandiae*	Black-Faced Cuckoo-Shrike	
		Lalage sueurii	White-Winged Triller	
	CASUARIIDAE	*Dromaius novaehollandiae*	Emu	
	CHARADRIIDAE	*Charadrius ruficapillus*	Red-Capped Dotterel	
	CLIMACTERIDAE	*Climacteris rufa*	Rufous Treecreeper	
	COLUMBIDAE	*Phaps elegans*	Brush Bronzewing	
		Phaps chalcoptera	Common Bronzewing	Yes
		Ocyphaps lophotes	Crested Pigeon	
		Streptopelia senegalensis	Laughing Turtle-Dove*	
		Columba livia	Rock Pigeon*	
		Streptopelia chinensis	Spotted Dove*	
	CORVIDAE	*Corvus coronoides*	Australian Raven	Yes
	CUCULIDAE	*Cacomantis flabelliformis*	Fan-Tailed Cuckoo	
		Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	
		Cacomantis pallidus	Pallid Cuckoo	
		Chrysococcyx lucidus	Shining Bronze-Cuckoo	
	DASYORNITHIDAE	*Dasyornis broadbenti*	Rufous Bristlebird	
	ESTRILDIDAE	*Stagonopleura oculata*	Red-Eared Firetail	
	FALCONIDAE	*Falco longipennis*	Australian Hobby	
		Falco berigora	Brown Falcon	
		Falco cenchroides	Nankeen Kestrel	
		Falco peregrinus	Peregrine Falcon	
	HIRUNDINIDAE	*Petrochelidon nigricans*	Tree Martin	
		Hirundo neoxena	Welcome Swallow	
	MALURIDAE	*Malurus elegans*	Red-Winged Fairy-Wren	
		Stipiturus malachurus	Southern Emu-Wren	
		Malurus splendens	Splendid Fairy-Wren	Yes
	MEGAPODIIDAE	*Leipoa ocellata*	Malleefowl	

Class	Family	Species Name	Vernacular Name	Observed (2019)
	MELIPHAGIDAE	*Lichmera indistincta*	Brown Honeyeater	
		Melithreptus brevirostris	Brown-Headed Honeyeater	
		Melithreptus chloropsis	Gilbert's Honeyeater	
		Phylidonyris novaehollandiae	New Holland Honeyeater	
		Anthochaera carunculata	Red Wattlebird	Yes
		Gavicalis virescens	Singing Honeyeater	
		Gliciphila melanops	Tawny-Crowned Honeyeater	
		Acanthorhynchus superciliosus	Western Spinebill	
		Anthochaera lunulata	Western Wattlebird	
		Epthianura albifrons	White-Fronted Chat	
		Melithreptus lunatus	White-Naped Honeyeater	
	MEROPIDAE	*Merops ornatus*	Rainbow Bee-Eater	
	MONARCHIDAE	*Grallina cyanoleuca*	Magpie-Lark	
		Myiagra inquieta	Restless Flycatcher	
	MOTACILLIDAE	*Anthus novaeseelandiae*	Australian Pipit	
	NECTARINIIDAE	*Dicaeum hirundinaceum*	Mistletoebird	
	NEOSITTIDAE	*Daphoenositta chrysoptera*	Varied Sittella	
	NUMIDIDAE	*Numida meleagris*	Helmeted Guineafowl*	
	PACHYCEPHALIDAE	*Falcunculus frontatus*	Crested Shrike-Tit	
		Pachycephala pectoralis	Golden Whistler	
		Colluricincla harmonica	Grey Shrike-Thrush	Yes
		Pachycephala rufiventris	Rufous Whistler	Yes
		Pachycephala occidentalis	Western Whistler	
	PARDALOTIDAE	*Pardalotus punctatus*	Spotted Pardalote	
		Pardalotus striatus	Striated Pardalote	
	PETROICIDAE	*Melanodryas cucullata*	Hooded Robin	
		Microeca fascinans	Jacky Winter	
		Petroica boodang	Scarlet Robin	
		Eopsaltria griseogularis	Western Yellow Robin	
		Eopsaltria georgiana	White-Breasted Robin	
	PHALACROCORACIDAE	*Microcarbo melanoleucos*	Little Pied Cormorant	
		Phalacrocorax varius	Pied Cormorant	
	PHASIANIDAE	*Coturnix ypsilophora*	Brown Quail	
		Coturnix pectoralis	Stubble Quail	
	PODARGIDAE	*Podargus strigoides*	Tawny Frogmouth	
	PODICIPEDIDAE	*Tachybaptus novaehollandiae*	Australasian Grebe	
	PSITTACIDAE	*Barnardius zonarius*	Australian Ringneck	Yes
		Neophema elegans	Elegant Parrot	
		Parvipsitta porphyrocephala	Purple-Crowned Lorikeet	

Class	Family	Species Name	Vernacular Name	Observed (2019)
		Purpureicephalus spurius	Red-Capped Parrot	
		Polytelis anthopeplus	Regent Parrot	
		Neophema petrophila	Rock Parrot	
		Platycercus icterotis	Western Rosella	Yes
	RALLIDAE	*Gallirallus philippensis*	Banded Rail	
		Gallinula tenebrosa	Dusky Moorhen	
		Fulica atra	Eurasian Coot	
		Porphyrio melanotus	Pukeko	
		Porphyrio porphyrio	Purple Swamphen	
		Porzana tabuensis	Spotless Crake	
	RHIPIDURIDAE	*Rhipidura albiscapa*	Grey Fantail	Yes
		Rhipidura leucophrys	Willie Wagtail	Yes
	STRIGIDAE	*Ninox novaeseelandiae*	Southern Boobook	
	SULIDAE	*Morus serrator*	Australasian Gannet	
	THRESKIORNITHIDAE	*Threskiornis molucca*	Australian White Ibis	
		Threskiornis spinicollis	Straw-Necked Ibis	
	TIMALIIDAE	*Zosterops lateralis*	Silvereye	
	TURNICIDAE	*Turnix varius*	Painted Button-Quail	
	TYTONIDAE	*Tyto alba*	Barn Owl	
		Tyto novaehollandiae	Masked Owl	
MAMMALIA	BOVIDAE	*Bos taurus*	Cow	Yes
	BURRAMYIDAE	*Cercartetus concinnus*	Western Pygmy-Possum	
	CANIDAE	*Canis familiaris*	Dingo	
	DASYURIDAE	*Phascogale tapoatafa*	Brush-Tailed Phascogale	
		Dasyurus geoffroii	Chuditch	
		Sminthopsis fuliginosus	Dusky Dunnart	
		Sminthopsis gilberti	Gilbert's Dunnart	
		Antechinus flavipes	Yellow-Footed Antechinus	
	EQUIDAE	*Equus caballus*	Horse	
	LEPORIDAE	*Oryctolagus cuniculus*	Rabbit	Scat
	MACROPODIDAE	*Setonix brachyurus*	Quokka	
		Notamacropus eugenii	Tammar Wallaby	
		Notamacropus irma	Western Brush Wallaby	
		Macropus fuliginosus	Western Grey Kangaroo	
	MURIDAE	*Rattus fuscipes*	Bush Rat	
		Mus musculus	House Mouse	
		Rattus rattus	Ship Rat*	
		Hydromys chrysogaster	Water-Rat	
	MYRMECOBIIDAE	*Myrmecobius fasciatus*	Numbat	
	PERAMELIDAE	*Isoodon obesulus*	Southern Brown Bandicoot	
	PHALANGERIDAE	*Trichosurus vulpecula*	Common Brushtail Possum	
	PSEUDOCHEIRIDAE	*Pseudocheirus occidentalis*	Western Ringtail Possum	Scat

Class	Family	Species Name	Vernacular Name	Observed (2019)
	TACHYGLOSSIDAE	*Tachyglossus aculeatus*	Short-Beaked Echidna	
	THYLACOMYIDAE	*Macrotis lagotis*	Bilby	
	VESPERTILIONIDAE	*Chalinolobus morio*	Chocolate Wattled Bat	
		Chalinolobus gouldii	Gould's Wattled Bat	
		Nyctophilus major	Greater Long-Eared Bat	
		Nyctophilus geoffroyi	Lesser Long-Eared Bat	
		Vespadelus regulus	Southern Forest Bat	
REPTILIA	CHELIDAE	*Chelodina colliei*	Oblong Turtle	
	ELAPIDAE	*Echiopsis curta*	Bardick	
		Pseudonaja affinis	Dugite	
		Notechis scutatus	Tiger Snake	
		Elapognathus coronatus	Western Crowned Snake	
	GEKKONIDAE	*Christinus marmoratus*	Marbled Gecko	
	PYGOPODIDAE	*Lialis burtonis*	Burton's Snake-Lizard	
		Pygopus lepidopodus	Common Scaly-Foot	
	SCINCIDAE	*Tiliqua rugosa*	Bobtail	
		Cryptoblepharus buchananii	Buchanans Snake-Eyed Skink	
		Menetia greyii	Common Dwarf Skink	
		Ctenotus labillardieri	Common South-West Ctenotus	
		Lerista elegans	Elegant Slider	
		Egernia kingii	Kings Skink	Yes
		Hemiergis peronii	Lowlands Earless Skink	
		Ctenotus impar	Odd-Striped Ctenotus	
		Lampropholis guichenoti	Pale-Flecked Garden Sunskink	
		Morethia obscura	Shrubland Morethia Skink	
		Egernia napoleonis	South-Western Crevice-Skink	
		Hemiergis gracilipes	South-Western Mulch-Skink	
		Lerista distinguenda	South-Western Orange-Tailed Slider	
		Lerista microtis	South-Western Slider	
		Morethia lineoocellata	West Coast Morethia Skink	
		Lissolepis luctuosa	Western Mourning Skink	
		Acritoscincus trilineatus	Western Three-Lined Skink	
	TYPHLOPIDAE	*Anilios australis*	Southern Blind Snake	
	VARANIDAE	*Varanus rosenbergi*	Heath Monitor	

Appendix E Threatened Fauna Evaluation

Table E.1 provides an evaluation of the presence of habitat and the likelihood of occurrence for conservation significant (target) fauna species. The species list was derived from database searches, literature and expert consultation, and assessed against habitat observed within the study area. The potential to be impacted depends on the nature of the impacts proposed, habitat utilised by the target species and the likelihood of occurrence.

The presence of habitat is broken into four categories:

- **Present - core:** Potential or known habitat present within the study area. Consists of "habitat critical to the survival of a species" which refers to core areas that are necessary for activities such as foraging, breeding, roosting, or dispersal, necessary for the long-term maintenance of the species to maintain genetic diversity and long term evolutionary development (Department of the Environment 2013) or habitat types recognised in recovery plans or guidelines.
- **Present - supporting:** Likely to provide dispersal, transitory or supporting habitat that may support core / critical habitat areas, such as small areas of lesser quality habitat where an animal has a large home range.
- **Marginal:** Habitat present is not typical but may be suitable, or habitat is typical, but condition and microhabitat requirements of species are not present.
- **Absent:** No potential or known habitat is present within the project area.

There are four categories for likelihood of occurrence:

- **Nil:** Species known or predicted to occur within the locality but no suitable habitat within the study area.
- **Unlikely:** Species known or predicted within the locality. Suitable habitat may be present in the study area, but the proximity of nearest records suggests it is unlikely to occur.
- **Possible:** Suitable habitat present and the species could occur in the study area based on the proximity of nearest records.
- **Present:** Species was recorded during the field investigations.

Some fauna have been excluded as they are not relevant to the proposal or would not be impacted:

- Marine (e.g. seals, dolphins, whales, penguins).
- Marine migratory species (e.g. Albatrosses) or where breeding is in the northern hemisphere, e.g. those from the family Scolopacidae: Shorebirds and waders, e.g. Hooded plover.
- Species considered regionally extinct or misidentified or outside of the animals known distribution (e.g. Malleefowl, Numbat, Rufous bristlebird, Western whipbird, Woylie).

Conservation status is as per the (federal) EPBC Act and (WA) DBCA Parks and Wildlife Service's Threatened and Priority Fauna List last updated April 2024. Refer to Appendix B for Conservation Codes.

Table E.1 Evaluation of the presence of habitat and the likelihood of occurrence for conservation fauna significant species within the study area

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
AMPHIBIAN	**Myobatrachidae** *Geocrinia alba*	White Bellied Frog	CR	EN	*Geocrinia alba* inhabit swampy flows along drainage depressions in an area of low topography (relief < 80m) near the junction of the Leeuwin-Naturaliste Ridge and Blackwood Plateau. Breeding sites are associated with sandy soils, dense overstorey vegetation dominated by *Homalospermum firmum, Agonis linearifolia, Astartea fascicularis*, and a dense ground layer of rhizomatous vegetation, usually composed of *Pseudoloxocarya sp., Loxocarya sp. And Tetrarrhena laevis* (Wardell-Johnson & Roberts 1993).	Absent	None	Nil
AVES	**Ardeidae** *Ardea ibis*	Cattle Egret	IA	-	Waders that occur in stock paddocks, pastures, crop lands, wetlands, mudflats, drains, irrigation areas and estuaries (Pizzey and Knight 2007).	Present - supporting	Possible, infrequent visitor	Unlikely; abundant similar habitat locally
	Ardea modesta	Great Egret	IA	-				
	Botaurus poiciloptilus	Australasian Bittern	EN	EN	The Australasian Bittern occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats. In the south-west it is found in beds of tall rush mixed with, or near, short fine sedge or open pools. The species also occurs around swamps, lakes, pools, rivers and channels fringed with lignum (*Muehlenbeckia* sp.), canegrass (*Eragrostis* sp.) or other dense vegetation. The species occasionally ventures into areas of open water or onto banks. In the SW WA, it is confined to a relatively small number of regularly occupied locations. These locations probably number less than 70, including: less than five north of Perth; less than 10 in the greater Perth metropolitan area; less than 10 south to Busselton; less than 10 in the Lake Muir district;	Absent	Unlikely	Nil

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
					less than 10 from Augusta to Walpole; less than 10 around Albany; and less than 10 around Esperance and Cape Arid. Most of these sites are discrete basin/sumpland wetlands with local catchments, and many depend on the surface expression of groundwater (SPRAT 2017).			
	Ixobrychus flavicollis	Black Bittern		P2	Found in both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation, e.g. shadowy leafy waterside trees: casurinas, eucalypts, paperbarks, tidal creeks and mudflats. In the case that permanent water is present, the species may also occur in flooded grassland or adjacent forest and woodland. It nests on a sheltered horizontal branch over water (Pizzey and Knight 2007).	Marginal	Unlikely	Nil
	Atrichornithidae *Atrichornis clamosus*	Noisy scrub-bird	EN	EN	They require subtropical to temperate rainforests >600 m in elevation with closed forests that are within 5–15 meters in height. The Noisy Scrub-bird occurs almost entirely within Two Peoples Bay Nature Reserve, Waychinicup National Park, Mount Manypeaks Nature Reserve, Arpenteur Nature Reserve, Bald Island Nature Reserve and some additional non-conservation focused reserves (SPRAT 2018).	None	None	None
	Cacatuidae *Calyptorhynchus banksii naso*	Forest Red-tailed Black Cockatoo	VU	VU	The FRTBC is a large, iconic forest cockatoo, endemic to the southwest corner of WA. The species may breed locally (SEWPaC 2012). Formerly common, but now rare to uncommon and patchily distributed, the species has disappeared from about 30% of its former range. It has suffered a marked decline in numbers over the past 60 years. The main reasons for this decline include the	Present – supporting	Possible visitor – foraging	Yes

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
					destruction and fragmentation of habitat (especially Jarrah Marri Forest), the apparent decline in Marri along the eastern side of the Darling Scarp, logging, the impact of hollow competitors, fire and possibly climate change (Johnstone, Kirkby and Sarti 2013a, b). FRTBC occurs throughout the Jarrah Marri Karri forested areas but in recent years has been foraging and nesting along the Swan Coastal Plain. Group sizes vary from small family groups and pairs to larger gatherings at roost sites. FRTBC nest in hollows Jarrah, Marri, Blackbutt, Bullich and Wandoo. Hollows have been recorded from 6.5 – 33 m above ground (Johnstone Kirkby and Sarti 2015). FRTBC have been recorded breeding in all months but with peaks in Spring and Autumn. There are also years when very little if any breeding takes place i.e. 2008 and 2009 (Johnstone and Kirkby unpublished data). FRTBC feed mainly on the seeds of Jarrah and Marri but also Blackbutt, Albany Blackbutt, Sheoak, Snottygobble and introduced native and non-native species such as Lemon-scented Gum, Spotted Gum and Cape Lilac (SPRAT 2019). FRTBC are known to roost in Jarrah, Marri, Blackbutt, Bullich and introduced eucalypt species.			
AVES	*Calyptorhynchus baudinii*	Baudin's cockatoo	EN	EN	Baudin's cockatoo is a large, iconic forest cockatoo endemic to the southwest corner of WA. The species breeds locally (SEWPaC 2012). It has suffered a substantial decline in number in the past 50 years. Direct causes of this decline include large numbers shot by orchardists, fragmentation of habitat and the impact of hollow competitors (Johnstone and Kirkby 2008). Depending on their	Present - supporting	Present based on forage evidence	Yes

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
					region of origin, Baudin's cockatoo is a resident, a post nuptial nomad or a migrant, with the bulk of the population vacating the coldest parts of their range (i.e. the Karri forest) in the autumn and migrating northwards during the non-breeding season. Small numbers also appear resident in a few places, including the Leeuwin – Naturaliste Ridge and Manjimup (Johnstone and Kirkby 2008). Flock sizes vary from small family groups to large aggregations at roosting sites. Breeding mainly takes place in forested areas from August to November (egg laying dates) (Tony Kirkby pers comm). In the non-breeding season, Baudin's cockatoo is mainly an inhabitant of the Jarrah Marri Forest but is also frequently seen in farmland and orchards. It feeds on a variety of foods including nectar and seeds from Hakeas and Banksia spp., apples, persimmons, and macadamias. Its main food is Marri, from which it takes seeds, grubs, and nectar. Its long bill is adapted to removing seeds from marri fruit capsules. Roost sites are usually in smooth barked Eucalypts (occasionally rough barked Eucalypts, i.e. Marri, Jarrah and Blackbutt) including Wandoo, Flooded Gum, Bullich and smooth barked exotic Eucalypts including plantations (Johnstone and Kirkby 2008).			
	Calyptorhynchus latirostris	Carnaby's cockatoo	EN	EN	The species is a postnuptial nomad, tending to move west after breeding. Carnaby's cockatoo mainly occurs in or near Eucalypt woodlands, especially those dominated by Wandoo or Salmon Gum, and sometimes reported in forests of Marri, Jarrah, Karri and Tuart. Nesting hollows may be located anywhere over two metres from ground,	Present - supporting	Possible visitor – foraging	Yes

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
					mainly in the Wheatbelt (Cale 2003, SPRAT 2019, WA Museum 2010). This species is currently expanding its breeding range westward and south into the Jarrah Marri Forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain. This may be due to climate change. Breeding occurs mainly from early July to mid-December. Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick, for example, adjacent pine forest or remnant vegetation (Johnstone and Kirkby, Undated). It is known to forage in native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia, Hakea, and Grevillea spp. It forages in pine plantations, Eucalypt woodland and forest, individual trees and small stands of these species (SEWPAC 2012). Carnaby's cockatoos are known to roost in Jarrah, Marri, Blackbutt, Bullich, exotic Eucalypt species and pines.			
	Falconidae *Falco peregrinus*	Peregrine Falcon	-	OS	Peregrine Falcons occur in woodland, plains, gorges, wetlands but tend to breed either in stick-nests in trees or nest on cliff ledges. It appears that hollows and large abandoned nests of other birds may be used where cliff ledges are limited. Breeds Aug-Dec. Where good habitat occurs and the density of Peregrine Falcons is high, active nests may occur within 2.5km of each other. The diet of the Peregrine Falcon includes wood duck, pigeons and doves, galahs, rosellas and cockatoo, starlings and larks (Olsen et al. 2006).	Present - supporting	Possible visitor – foraging	Unlikely; abundant similar habitat locally

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
	Megapodiidae *Leipoa ocellata*	Malleefowl	VU	VU	It is mostly located to the south and west of a line extending from Cape Farquhar, which lies north of Carnarvon, to the Eyre Bird Observatory in the south-east of Western Australia. Occurs in semi-arid and arid zones of temperate Australia, where it occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine Callitris woodlands, acacia shrublands, Broombush (*Melaleuca uncinata*) vegetation or coastal heathlands. The breeding habitat of the Malleefowl, within its home range, is characterised by light soil and abundant leaf litter (DEC 2010).	Absent	Unlikely	Nil
	Pandionidae *Pandion haliaetus*	Osprey	EN	EN	Generally coastal species that feeds on fish. Nests in large trees or on islands, pilons etc (Pizzey and Knight 2007).	Marginal	Unlikely	Nil
	Strigidae *Ninox connivens connivens*	Barking Owl (SW pop.)	-	P3	Occurs in forest, woodlands, dense scrub, foothills, river red gums and other large trees near water courses penetrating open country. Nests in large hollows (Pizzey and Knight 2007). A late winter breeder with most eggs laid July to September, the young are fledged in about 35 days.	Present - supporting	Possible visitor – foraging	Unlikely; abundant similar habitat locally
	Tyto novaehollandiae subsp. novaehollandiae	Masked Owl (southern subsp)	-	P3	Inhabits forests, open woodlands and farmlands with large trees, including timber watercourses paperbark woodlands. Widespread but very sparse, they breed any time of the year when conditions are favourable with a nesting period of about three months (Pizzey and Knight 2007).	Present - supporting	Possible visitor – foraging	Unlikely; abundant similar habitat locally
MAM	**Dasyuridae**	Chuditch	VU	VU	Quolls may occupy a range of habitats including forest, woodland and desert, though in the SW they	Absent	Unlikely due to small patch	Unlikely

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
	Dasyurus geoffroii				are largely restricted to Jarrah forest or scattered through the southern and eastern wheat belt (DEC 2010). Current records indicated that this only represents approximately 5% of their former range. Habitat critical to Western Quoll are large areas of undisturbed habitat which a sufficient variety of key food and other resources such as large hollow logs, burrows or small caves at ground level for denning. To be suitable as den sites, logs must have a diameter of at least 30 cm but usually greater than 50 cm, a hollow diameter of 7–20 cm and generally 1m long (Orell & Morris 1994). Annually, an adult female Chuditch will utilise an estimated average of 66 logs and 110 burrows within her home range. A large amount of den sites are required for both sexes. They occupy relatively large home ranges, with males utilizing over 15 km^2 and females, 3-4 km^2 (Orell & Morris 1994).		size, lack of cover or den habitat	
	Phascogale tapoatafa	Southern Brush-tailed Phascogale	-	S	This arboreal species is found in a variety of forest types. Ideal habitat for this species consists of dry sclerophyll forest and open woodland (Jarrah, Marri, and mixed Jarrah Karri) that contain hollow bearing trees and sparse ground cover. Their many nesting sites include hollow tree limbs, rotten stumps and even birds' nests. Lactating females prefer a large tree cavity with a small entrance with a nest made of bark, feathers and fur. A female's home range covers 20 to 70 hectares, a male's home ranges over laps females and increases during breeding season. It is predominantly carnivorous, foraging on arthropods, invertebrates, small vertebrates and nectar (Strahan 1995).	Marginal	Unlikely, mostly too degraded and open with lack of HBTs.	Unlikely

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
	Setonix brachyurus	Quokka	VU	VU	The understorey structure of the habitats currently used by Quokka consist of dense, low vegetation that provides refuge from predation (Hayward 2002). The mainland habitats include dense riparian vegetation (Hayward et al. 2005), but also (from SPRAT 2017) • heath and shrubland, • Swamp Peppermint (*Taxandria linearifolia*) dominated swamps in Jarrah forest, • swampy shrublands, • swordgrass-dominated understorey, • regrowth areas of the Karri forest, • Bullich swamp forest, • Paperbark (Melaleuca spp.) swamp. A low density of near-surface fuel, a complex vegetation structure and a varied fire-age mosaic best predict the probability of occupancy of quokka in the southern forest (DEC 2013; Australia Museum 2014).	Absent	None	Nil
	Myrmecobiidae *Myrmecobius fasciatus*	Numbat	EN	EN	A termite specialist that once occurred along much of arid and semi –arid southern Australia it is now restricted to a few remnant forests of Wandoo, Powderbark Wandoo or Jarrah in sw Aust, e.g. Dryandra and Perup Forests. (Menkhorst and Knight 2013).	Absent	None	Nil
	Macropodidae *Macropus irma*	Western Brush Wallaby	-	P4	Optimum habitat for the Western Brush Wallaby includes open Jarrah forest or woodland and seasonally wet flats with low grasses and scrubby thickets, but also areas of mallee and heathland. Common dietary flora includes *Carpobrotus edulis,*	Absent	None	Nil

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
					Cynodon dactylon and *Nuytsia floribunda* (DEC, 2012).			
	Muridae *Hydromys chrysogaster*	Water Rat	-	P4	The Water rat is usually found in permanent fresh or brackish water but can be found in marine environments. Fresh water habitats include swamps, lakes, dams even urban drainage swamps. Typically forages close to the shoreline, restricting its movements to shallow water (up to 2 m in depth) (CSIRO, 2004).	Marginal	Unlikely	Unlikely
	Peramelidae *Isoodon obesulus fusciventer*	Southern Brown Bandicoot	-	P4	Bandicoot habitat consists of dense scrubby, often swampy vegetation with a dense cover up to one metre high particularly near watercourses/wetlands. It often feeds in adjacent forest (Jarrah and Wandoo) and woodlands that are burnt on a regular basis. Nests can be concealed next to or under old logs, shrubs or piles of debris and are made up of ground litter piled up over a shallow depression providing internal chambers. Home ranges vary with population density, and range from 5-8.6 ha for males and 1-6 ha for females (DEC 2010). Feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous fungi. Their searches for food often create distinctive conical holes in the soil (DECC 2010).	Marginal	Unlikely due to lack of native understorey – no signs of feeding observed	Unlikely
	Potoroidae *Bettongia penicillata*	Brush-tailed Bettong, Woylie	EN	CR	The animals consume roots, tubers, underground fungi and insect larvae. Habitat includes tall eucalypt forest and woodland, dense myrtaceous shrubland, kwongan (proteaceous) or mallee heath. They are mostly nocturnal. In open woodlands, they occupy large home ranges (15-45ha, with a core defended area of c.5ha (Claridge et al 2007). Isolated populations also occur at Francois Peron	Absent, locally extinct.	Too degraded and open.	Nil

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
					National Park (NP), Kalbarri NP, Nambung NP, Julimar Forest, Avon Valley NP, Dryandra Woodland, Boyagin Nature Reserve (NR), Tutanning NR and North Karlgarin NR (DEC 2012).			
	Pseudocheiridae *Pseudocheirus occidentalis*	Western Ringtail Possum	CR	CR	The WRP is a medium-sized marsupial weighing up to 1.3 kg and 40 cm in body length with dark brown fur above and cream to grey fur underneath. The tail grows to 41 cm long and terminates in a white tip. Once widely distributed across southern and southwestern WA, it now has a patchy distribution with extensive local declines in the northern and inland parts of the original range (DEWHA 2009). High numbers occur WRP locally in the database results – nearly 3000 records within 5 km (ALA 2024) (DBCA 2024).). WRP populations now mostly inhabit Peppermint and Peppermint-Tuart associations from Bunbury to Albany. The highest densities of WRP occur in the Swan Coastal Plain and South Coast (Biota 2019; Shedley et al. 2014). Peppermint leaves form the basis of the WRP diet in coastal areas, but when unavailable, the dominant myrtaceous species are preferred. In the inland forest, Jarrah and Marri are the main food source. Garden plant varieties are also exploited in urban areas. WRP also feed on new shoots, flowers, leaves and/or fruiting bodies from a range of flora including *Nuytsia floribunda, Acacia saligna, Hardenbergia comptoniana, Allocasuarina fraseriana, E. gomphocephala, E. rudis, Melaleuca viminea, M. cuticularis, M. rhaphiophylla, Kunzea glabrescens* and *Xylomelum occidentale* (Shedley and Williams 2014). WRP use a range of nest and shelter sites to avoid predators and exposure to the weather. Dreys are constructed in the canopy if hollows are not available. Adequate nest and shelter sites are necessary components of good quality habitat (Jones 1994, Shedley and Williams 2014).	Present - core	Present	Possible

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
					Breeding is in mid-winter with young emerging from the pouch in spring. There can be a breeding event in late summer / early spring with young emerging from the pouch in April. The second breeding event seems to depend on conditions, including whether young persisted through summer and is usually a smaller percentage of females (R. Teale, pers comm.). Fox predation is one of the main threats and causes of mortality to WRP (Wayne 2005) along with the loss and fragmentation of native vegetation. This is due to their high dependence on midstorey and overstorey vegetation for food, shelter and protection from predators.			
	Thylacomyidae *Macrotis lagotis*	Bilby	VU	VU	Bilbies are found in a range of habitats from arid rocky soils with little ground cover to semi-arid shrublands and woodlands. They also known to inhabit spinifex and tussock grassland regions (Australian Museum website, 2017).	Absent, locally extinct.	Unlikely, too degraded and open.	Nil
	Vespertilionidae *Falsistrellus mackenziei*	Western False Pipistrelle	-	P4	It occurs in wet sclerophyll forest dominated by Karri (*Eucalyptus diversicolor*), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) forests. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*E. calophylla*), Sheoak (*Casuarina heugeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (DotEE, 2018). This species roosts in tree hollows (Phillips & Inwards 1985) in colonies of 5 to 30 bats (Aust Museum, 2009). The species feed on flying insects between below the forest canopy.	Present - supporting	Possible visitor – foraging	Possible (wasn't surveyed for)

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
FISH	**Galaxiidae** *Galaxiella munda*	Mud minnow, Western dwarf galaxias	-	EN	Occur in slow-running, tea-colored streams usually in sandy areas. Also found in swamps, small ponds and roadside ditches. Also lives in the vegetated shallows of some freshwater lakes. Water is typically acidic (pH 4.5-6.5) and darkly tannin-stained. An inhabitant of temporary waters, capable of aestivating in damp bottom sediments over summer (Allen et al 2002) (Smith et al 2002).	Marginal	Unlikely, no fish observed in the artificial drainage channel.	Unlikely
	Geotriidae *Geotria australis*	Pouched Lamprey	-	P3	Found between Margaret River and Denmark. After metamorphosis, young adults migrate downstream to estuaries and coastal waters, where they feed parasitically by rasping flesh from other fishes with their toothy tongues. They eventually cease feeding and migrate back to freshwater to breed (Gomon and Bray, 2011).	Absent	Unlikely	Nil
	Percichthyidae *Nannatherina balstoni*	Balston's Pygmy Perch	VU	VU	Balston's Pygmy Perch is a small freshwater fish that grows to a maximum length of around 90 mm (commonly 60 mm). This species is brownish dorsally and silver below, usually with a prominent brown mid-lateral stripe and a series of vertical brown bars on sides giving a cross-hatched pattern Balston's Pygmy Perch inhabits acidic, tannin-stained freshwater pools, streams and lakes in peat flats within 30 km of the coast of south-west Western Australia, preferring shallow water, and commonly associated with tall sedge thickets and inundated riparian vegetation (SPRAT 2018)	Marginal	Unlikely, no fish observed in the artificial drainage channel.	Unlikely
INVERT	**Carabidae** *Trichosternus relictus*	A ground beetle (Margaret River)	-	P3	Has been found under logs in Eucalyptus woods (Bennelongia Pty Ltd, 2013).	Absent	Unlikely	Nil

Class	Family Genus species	Vernacular	Status Federal	Stat. WA	Requirements	Presence of habitat	Likelihood of occurrence	Potential to be impacted
	Kawaniphila pachomai	Vernal Grey Katydid	-	P1	A cricket known from only two records on NatureMap, one in Karragullen and the other from heathland in Margaret River (Naturemap 2018).	Absent	Unlikely	Unlikely
	Hyriidae *Westralunio carteri*	Carters Freshwater Mussel	VU	VU	Carters Freshwater Mussel is the only freshwater mussel found in southwest WA. It is a bivalve found in freshwater streams, rivers, billabongs, ponds, wetlands and lakes inland from the coast mostly areas with muddy, silty and sandy bottoms and flowing permanent water. Tracks can be seen along banks and sandy/muddy patches of stream bed where they are present (http://www.musselwatchwa.com). Native fish are critical to the Mussel's lifecycle - larval mussels attach themselves to native fish to spread their population and develop into juvenile mussels. Mussels move along the bottom using a muscular tongue-like appendage known as a foot. Unlike their marine and estuarine cousins, they do not attach to structures. This allows them to move with receding water levels and position themselves to the best feeding spots (Murdoch University, 2010).	Marginal – no natural water features associated with the Project	Unlikely	Nil
	Parastacidae *Cherax tenuimanus*	Hairy Marron	CR	CR	The Hairy Marron only occurs in the Margaret River and upper headwaters in the SW of WA.	Absent	Unlikely	No
	Engaewa pseudoreducta	Margaret River Burrowing Crayfish	CR	CR	The Margaret River Burrowing Crayfish is endemic to south-west WA and occurs in two subpopulations, Treeton and Payne Road.	None	Unlikely	No

References

Allen, G.R., S.H. Midgley and M. Allen (2002). *Field guide to the freshwater fishes of Australia. Western Australian Museum, Perth, Western Australia*. p394

Andrew, D. (2015) *The Complete Guide to Finding the Mammals of Australia*. CSIRO Publishing.

Atlas of Living Australia (ALA) occurrence download at https://bie.ala.org.au accessed 11/2018

Australia Museum (2014) Website, accessed 23/10/2014 from http://australianmuseum.net.au/Quokka#sthash.mjeA3Cge.pdf

Australian Museum website (2017) https://australianmuseum.net.au/greater-bilby Accessed September 2017.

Bain, K., Halley, M., Barton, B., Wayne, A., McGilvray, A., Wilson, I., and Wayne, J. (2016) *Survival of quokkas in the 2015 Northcliffe bush fire: understanding the impact of intense and broadscale fire on an important population of quokkas in the southern forest of Western Australia*.

Bennelongia Pty Ltd (2013) *Cooljarloo West Proposal: Short Range Endemic Fauna, Pilot and Targeted Surveys*

Burbidge, A, Woinarski, J, and Harrison, P. (2012) *The Action Plan for Australian Mammals,* CSIRO Publishing, pp 545

Burnham, Q. (2014). *Systematics and biogeography of the Australian burrowing freshwater crayfish genus Engaewa Riek (Decapoda: Parastacidae*). Ph.D. Thesis. School of Natural Sciences, Edith Cowan University.

Burnham, Q., A. Koenders & P. Horwitz (2012). *The status of the critically endangered freshwater crayfish Engaewa pseudoreducta (Crustacea: Parastacidae) in south-western Australia*. Records of the Western Australian Museum. 27:45-54.

Burnham, Q.F. (2005). *The systematics of the reducta complex of the burrowing freshwater crayfish Engaewa Riek. Hons. Thesis*. Perth: Edith Cowan University.

Burnham, Q.F., A. Koenders & P. Horwitz (2007). *Field studies into the biology and conservation requirements of Engaewa species in the South-West and Warren DEC Regions.* Final Report Prepared for Department of Environment and Conservation 30 November 2007.

Bush B, Maryan B, Browne-Cooper R, Robinson D. (2007) *Reptiles and Frogs in the Bush: Southwestern Australia*, University of Western Australia Press

Cale, B. (2003) Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan 2002-2012. Department of Conservation and Land Management, Perth.

Claridge, A., Seebeck, J. and Rose, R. (2007) *Bettongs, Potoroos and the Musky Rat-kangaroo*, Australian Natural History Series, CSIRO Publishing, Victoria

CSIRO (2004) '*Hydromys chrysogaster' Water for a healthy country* – Taxon Attribute Profiles webpage, accessed online at http://www.anbg.gov.au/cpbr/WfHC/Hydromys-chrysogaster/index.html

Department of Environment and Conservation (DEC) (2008) www.naturebase.net Accessed July 2008.

Department of Environment and Conservation (DEC) (2010) *Fauna species profile*, accessed from http://www.dec.wa.gov.au/content/view/3432/1999/ in 2010

Department of Environment and Conservation (DEC) (2012) *Western Brush Wallaby Fauna Profile* https://www.dpaw.wa.gov.au/images/documents/plants-animals/animals/animal_profiles/ Accessed September 2017.

Department of Environment and Conservation (DEC) (2013). *Quokka Setonix brachyurus Recovery Plan. Wildlife Management Program No. 56*. Department of Environment and Conservation, Perth, WA.

Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) (2012) *EPBC Act 1999 referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered), Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable), Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*

Department of Parks and Wildlife (DPaW) (2014). *Western Ringtail Possum (Pseudocheirus occidentalis) Recovery Plan. Wildlife Management Program No. 58.* Department of Parks and Wildlife, Perth, WA.

Gomon, M and Bray D, (2011), *Pouch Lamprey, Geotria australis, in Fishes of Australia*, accessed 22 Oct 2014, http://www.fishesofaustralia.net.au/home/species/3415

Hayward, M. (2002) *The ecology of the Quokka (Setonix brachyurus) (Macropodidae: Marsupialia) in the Northern Jarrah Forest of Australia*. Ph.D. Thesis. University of New South Wales, Sydney.

Hayward, M. (2002). *The ecology of the Quokka (Setonix brachyurus) (Macropodidae: Marsupialia) in the Northern Jarrah Forest of Australia*. Ph.D. Thesis. University of New South Wales, Sydney.

Hayward, M. W. (2005). *Diet of the Quokka (Setonix brachyurus Macropodidae: Marsupialia) in the northern Jarrah forest of Western Australia*. Wildlife Research. 32(1):15-22.

Hayward, M.W., P.J. de Tores & P.B. Banks (2005). *Habitat use of the Quokka, Setonix bracyhurus (Macropodidae: Marsupalia), in the Northern Jarrah Forest of Australia*. Journal of Mammalogy. 86(4):683-688.

Hayward, M.W., de Tores, P.J., Dillon, M.J. and Banks, P.B. (2007) *Predicting the occurrence of the quokka, Setonix brachyurus (Macropodidae: Marsupialia), in Western Australia's northern jarrah forest*, Wildlife Research, 34: 194-199

Inions, G.B., Tanton, M.T., and Davey, S.M. (1989) *Effect of Fire on the Availability of Hollows in Trees Used by the Common Brushtail Possum, Trichosurus Vulpecula Kerr, 1792, and the Ringtail Possum, Pseudocheirus Peregrinus Boddaerts, 1785*. Australian Wildlife Research 16(4) 449 – 458. CSIRO Publishing.

Jupp, T. (2000) *The status of cockatoos in south-west Western Australia and conservation efforts by Perth Zoo*, Int. Zoo Yb. 37: 80-86

Smith, K.D., Knott, B., Jasinska, E. (2002) *Biology of the Black-stripe minnow Galaxiella nigrostriata, (Galaxiidae) in an acidic, black-water lake in Melaleuca Park near Perth, Western Australia*. Records of the Western Australia Museum. Vol 21 : Part 3

Menkorst, P., and Knight, F. (2013) *A Field Guide to Mammals of Australia* 3rd Ed.

Murdock University (2010) *WA's south-west mussels in serious decline* accessed http://media.murdoch.edu.au/help-needed-to-strengthen-wa%E2%80%99s-south-west-mussels in January 2015.

Olsen, J., Fuentes, E. Dykstra, R. and Rose, A.B. (2006) '*Male Peregrine Falcon Falco peregrinus fledged from cliff-nest found breeding in stick-nest*', Australian Field Ornithology 23: 8-14

Orell, P. And Morris, K. (1994) *Chuditch Recovery Plan 1992-2001*, Department of Conservation and Land Management, WA

Phillips, W. R. and Inwards, S. J. (1985) 'The *Tasmanian Pipistrelle:* Pipistrellus tasmaniensis *Gould 1858: Annual activity and breeding cycles*' Macroderma 1: 2-11.

Pizzey, G., Knight, F. & Menkhorst, F. (2007) *A field guide to the birds of Australia,* Sydney

Schodde, R. and Tidemann, S. C., Eds. (2007) *Readers Digest Complete Book of Australian Birds,* 2nd edition, Readers' Digest (Australia) Pty Ltd, NSW

Shedley E and Williams K (2014) *An assessment of habitat for western ringtail possum (Pseudocheirus occidentalis) on the southern Swan Coastal Plain*. Unpublished report for the Department of Parks and Wildlife, Bunbury, Western Australia.

SPRAT (2009-2018) *Species Profile and Threat Database*, Department of the Environment, Water, Heritage and the Arts, Canberra website, http://www.environment.gov.au/sprat.

Strahan, R. (1995) *The Mammals of Australia*, Strahan ed., Australian Museum/Reed Books.

WA Museum (2010) *Carnaby's* Cockatoo, accessed online at http://www.museum.wa.gov.au/explore/online-exhibitions/cockatoo-care/carnabys-cockatoo in October 2010

Wardell-Johnson, G. & J.D. Roberts (1993). *Biogeographic barriers in a subdued landscape: the distribution of Geocrinia rosea (Anura: Myobatrachidae) complex in south western Australia*. *Journal of Biogeography*. 20:95-108.

Water and Rivers Commission (2000) WN14 January 2000, *Lamprey Guides fact sheet*

Wayne A (2005) *The ecology of the Koomal (Trichosurus vulpecular hypoleucus) and Ngwayir (Pseudocheirus occidentalis) in the jarrah forests of south-western Australia*. PhD Thesis, Australian National University, Canberra.

Wilson, S. and Swan, G. (2017) *A Complete Guide to Reptiles of Australia*

Appendix F Suitable DBH tree data

y_proj	x_proj	Species	Height (m)	DBH (cm)	Hollows	H1_typ	H_1_hght	Size_1_cm	H2_typ	H_2_hght	Size_2_cm	H3_typ	H_3_hght	Size_3_cm	BC breeding suitability
6238554	324270	Marri	30	60	0										
6238568	324269	Marri	25	50	0										
6238570	324273	Marri	30	90	0										
6238577	324283	Marri	25	60	0										
6238604	324297	Karri	30	90	0										
6238621	324307	Marri	20	50	0										
6238639	324317	Marri	20	50	0										
6238640	324320	Karri	25	70	0										
6238675	324337	Marri	15	80	3	Vertical	10	20+	Knot	15	10_15	Knot	10	<10	Not suitable
6238686	324346	Marri	35	100	3	Vertical	30	20+	Knot	20	15_20	Spout	20	<10	Not suitable
6238705	324352	Marri	20	50	0										
6238715	324357	Marri	15	90	0										
6238743	324377	Marri	20	50	0										
6238804	324394	Marri	20	80	0										
6238829	324398	Marri	20	70	0										
6238838	324396	Marri	20	50	0										
6238842	324399	Marri	20	50	0										
6238843	324399	Marri	25	60	0										
6238853	324400	Marri	20	60	0										
6238740	324384	Marri	15	50	0										
6238722	324380	Marri	20	50	0										
6238717	324382	Marri	25	80	0										
6238710	324392	Marri	15	50	0										
6238726	324409	Marri	20	50	0										
6238733	324405	Marri	20	50	0										
6238840	324527	Karri	30	120	3	Spout	30	20+	Spout	30	20+	Knot	25	15_20	Unlikely to be suitable
6238867	324548	Marri	30	50	0										
6238864	324544	Marri	30	50	0										
6238861	324542	Marri	30	50	0										
6238839	324556	Marri	30	50	0										
6238838	324555	Marri	30	50	0										
6238832	324545	Marri	20	60	0										
6238938	324421	Marri	20	60	0										
6238940	324432	Marri	20	60	0										
6238944	324440	Marri	20	60	0										

y_proj	x_proj	Species	Height (m)	DBH (cm)	Hollows	H1_typ	H_1_hght	Size_1_cm	H2_typ	H_2_hght	Size_2_cm	H3_typ	H_3_hght	Size_3_cm	BC breeding suitability
6238950	324452	Marri	20	100	0										
6238961	324459	Marri	20	50	0										
6238961	324459	Karri	25	70	0										
6238954	324462	Karri	25	70	0										
6238964	324469	Marri	20	60	0										
6238966	324477	Marri	20	50	0										
6238963	324477	Karri	25	70	0										
6238950	324531	Stag	25	90	2	Vertical	20	20+	Knot	8	10_20				Not suitable
6238983	324496	Marri	15	50	0										
6238988	324525	Karri	15	60	0										
6238967	324538	Karri	25	70	1	Vertical	20	20+							Not suitable

Family	Genera	Species	Naturalised	Threatened	Mixed Eucalypts over pasture	Remnant Coymbia Woodland	Corymbia Woodland (road verge)
Amaranthaceae	*Alternanthera*	sp.			+		
Araceae	*Zantedeschia*	*aethiopica*	*				
Asparagaceae	*Asparagus*	*asparagoides*	*				
	Lomandra	*pauciflora*					+
Asteraceae	*Arctotheca*	*calendula*	*			+	
	Hypochaeris	*glabra*	*		+	+	
Cyperaceae	*Isolepis*	*marginata*			+		
	Lepidosperma	*squamatum*					+
	Lepidosperma	*tetraquetrum*					+
Dennstaedtiaceae	*Pteridium*	*esculentum*					+
Ericaceae	*Leucopogon*	*propinquus*					+
	Leucopogon	*verticillatus*			+		
Fabaceae	*Acacia*	*myrtifolia*			+		+
	Acacia	*saligna*				+	
	Hardenbergia	*comptoniana*					+
	Trifolium	sp.	*		+	+	
Geraniaceae	*Geranium*	sp.	*		+		
Goodeniaceae	*Dampiera*	*trigona*			+		
Haemodoraceae	*Anigozanthos*	*flavidus*					+
Hemerocallidaceae	*Caesia*	*micrantha*					+
Iridaceae	*Chasmanthe*	*floribunda*	*				+
	Gladiolus	sp.	*				+
	Romulea	*rosea*	*		+		
	Sparaxis	*bulbifera*	*		+		+
Juncaceae	*Juncus*	*articulatus*	*		+		
	Juncus	*microcephalus*	*		+	+	

	Juncus	*pallidus*			+	+	
Lamiaceae	*Stachys*	*arvensis*	*		+		
Myrtaceae	*Agonis*	*flexuosa*			+	+	
	Callistemon	sp. (planted bottlebrush)	*				
	Coymbia	*calophylla*				+	+
	Coymbia	*maculata*	*		+	+	
	Eucalytpus	*diversicolor*			+	+	+
	Eucalytpus	*grandis*	*		+		
	Eucalytpus	*marginata*					+
	Eucalytpus	*microcorys*	*		+		
	Eucalytpus	*patens*					+
	Melaleuca	sp (planted paper bark)	*			+	
	Taxandria	*linearifolia*					+
Orchidaceae	*Caladenia*	*latifolia*			+		
	Oxalis	*pes-caprae*	*				+
Poaceae	*Anthoxanthum*	*odoratum*	*		+	+	
	Briza	*maxima*	*				+
	Cenchrus	*clandestinus*	*		+	+	+
	Cynodon	*dactylon*	*				
	Ehrharta	*longiflora*	*			+	+
	Holcus	*lanatus*	*		+		
	Lolium	sp.	*			+	
Polygonaceae	*Rumex*	sp.	*		+	+	
Primulaceae	*Lysimachia*	*arvensis*	*		+		+
Proteaceae	*Hakea*	*amplexicaulis*					+
Rosaceae	*Rubus*	*?ulmifolius*	*				+
Rubiaceae	*Opercularia*	*hispidula*					+

Appendix E

Servicing and Electrical Report

Prepared by Stantec

Lots 4 & 5 Darch Road, Margaret River

Civil & Electrical Servicing Report

Prepared for: Peringillup Noms P/L (atf The Veitch Family Trust)

Attention: Neville Veitch

Date: 10 August 2021

Prepared by: Dean Kelly BEng MIEAust and Rocco Pienaar

Ref: 45630

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Stantec

Revision

Revision	Date	Comment	Prepared By	Approved By
001	4/12/2019	Draft Issue	L. Sutherland	D. Kelly
002	19/02/2020	Final Issue	D. Kelly / R/Pienaar	D. Kelly
003	11/08/2020	Subdivision Plan adjusted	D. Kelly	D. Kelly
004	10/08/2021	Subdivision Concept Plan updated	R. Martin	R. Martin

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1. Executive Summary

The proposed development is described within Section 2.1 of this report.

The existing lot is currently served by roads, electricity and communications. Water and Sewer are accommodated by rainwater tanks and onsite sewer treatment/disposal.

The proposed lots are understood to be serviced by the existing road, modified existing electricity supply, modified existing communications, new rainwater tanks and new sewer ATU's.

No changes to the existing stormwater configuration are expected given the proposed low development density and the existing clay (virtually impermeable) nature of the site.

Reshape, widening and sealing the existing Darch Road may be a requirement by the local authority. WGE/STANTEC recommend:

- the road is retained as a rural cul-de-sac road to discourage use by everyone other than the local residential traffic.
- Avoid kerbing to maintain the existing stormwater behaviour of the area. E.g. widen to accommodate minimum requirements and two coat seal but no kerbing.

Electricity supply to proposed lots is anticipated to require removal of existing overhead infrastructure and replacement thereof with an underground supply network. No major complications are foreseen

Communications is anticipated to consist of a Fibre ready pit and conduit network. No major complications are foreseen

The main issues which are considered to pose the most significant risk to the cost of engineering infrastructure required for the potential development site are:

- Servicing requirements detailed in this report have been based on current scheme plans and our understanding of servicing strategy as advised by the Developer. This is subject to Authority consideration and direction.

- No investigation has been undertaken for the extent of Acid Sulphate Soils (ASS) and treatment requirements. Risk mapping available from the Department of Water and Environmental Regulation website identifies the site having low to moderate risk of ASS however, insignificant surface excavation to accommodate road works and electrical installation is unlikely to result in activation of ASS.

From an Engineering perspective, WGE/STANTEC see no issues which would prevent development of the existing lots into low density "special residential" lots.

2. Introduction

2.1 General

Wood & Grieve Engineers now part of Stantec (WGE/STC) has been engaged by Peringillup Noms P/L to prepare this report in relation to the engineering infrastructure required for the proposed subdivision development of Lots 4 & 5 Darch Road, Margaret River within the Shire of Augusta & Margaret River.

This report discusses the following engineering and infrastructure items necessary to service the proposed development:

- Road Infrastructure
- Sewer Reticulation
- Stormwater Infrastructure
- Water Reticulation
- Gas Reticulation
- Electrical Reticulation
- Communications

This report outlines the existing, and future servicing strategies that are expected to be required should development of Lots 4 & 5 Darch Road should be implemented. The information presented in this report is based on a concept subdivision plan as shown below.

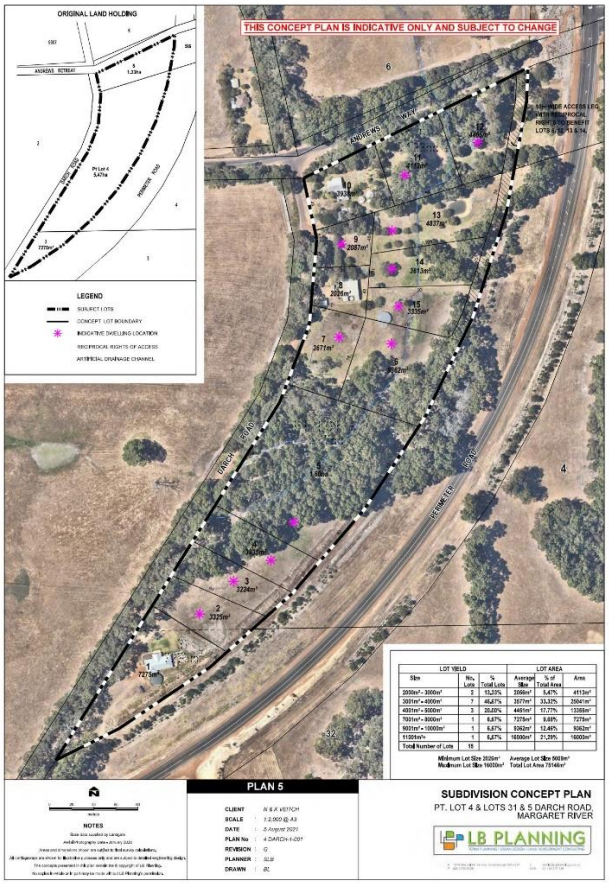


Figure 1 - Subdivision Concept Plan

2.2 Geology and Topography

The Site comprises of existing Lots 4 and 5 Darch Road, which is within the Shire of Augusta and Margaret Rive, and totals approximately 5.5Ha in area. The Site is generally bounded by Darch Road to the west, Perimeter Road to the south and east, and Rosa Brook Road to the north. The northern third of the site is generally cleared, of the southern two thirds, half is covered with blue gums and tuarts and the other half is cleared, as seen in Figure 2.

The geology of the site comprises of roughly 150mm of topsoil, 800mm of sand underlined by sandy/clayey soil. As indicated on the geotechnical report by Civil/Structural Engineer Pty Ltd, which is attached in Appendix B.



Figure 2 Existing Site Layout

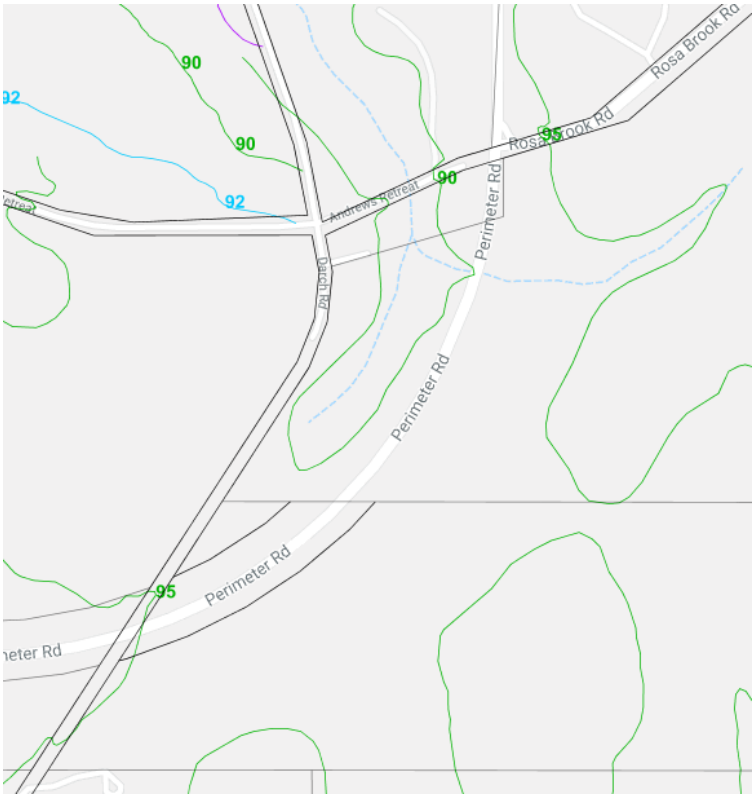


Figure 3 Esinet Contours

The topography of the site naturally grades north into a natural creek line that runs through the middle of the site. The south-west corner of the site is elevated at approximately RL 95m AHD and grades towards the creek line at approximately RL90m AHD. This information was sourced from the Water Corporations "Esinet" and may vary in accuracy. A survey of the site is required to comprehensibly understand the site conditions. The Geotechnical Investigation conducted by Civil/Structural Consulting Pty Ltd shows the full extent of the creek line and associated dams, as seen in Figure 6.

2.3 Groundwater

Based on the Geotechnical Report no groundwater was observed in the test hole and effluent test pit locations. However, as the sub-surface soil consists of clay which has a low permeability, the groundwater table may increase (perched in the more permeable layers above the clay) during and after rainfall events. Refer to the Geotechnical report for a full summary of the groundwater conditions at individual test pit locations.

Based on historical experience with Brookfield and Rapids Landing construction, groundwater impact (i.e. dewatering highly unlikely) on shallow trenching is not anticipated and the "sandy/Clays" are likely to become impermeable after the initial rain events.

Due to no significant excavation, ground water is not considered as having a significant impact on the proposed development or future residential properties if built in accordance with relevant Australian Standards. i.e. Don't build the floor level below the outside ground level. Don't undertake excavation or road construction in winter.

2.4 Acid Sulphate Soils

A review of the Department of Water and Environmental Regulation's Acid Sulphate Soil Risk Map, Lower South West (DWER-052) identifies that the site is in a moderate to low risk area, as seen below in Figure 4.

As road excavations are limited to the top 300mm, and trenching being limited to approximately 0.9m deep electrical reticulation requirements, activation of ASS is considered unlikely.

WGE/Stantec recommends the client to engage an environmental consultant to confirm the proposed minor surface excavations will not require ASS management.



Figure 4 - ASS Risk Map

3. Engineering Infrastructure

3.1 Earthworks

Due to the large size of the lots, WGE/Stantec sees no reason for changing the existing topography to accommodate residential development.

Subject to future lot owner's personal preference in relation to residential house locations, minor filling below the future residences to accommodate floor slab construction could be considered (by the future lot owners).

To maintain the existing stormwater characteristics of the site, bulk earthworks should be avoided.

3.2 Road Infrastructure

The Site is bounded by three existing roads:

- Darch Road to the west which appears to be a gravel track to enable access to the existing lots. In order to discourage use of this road by the general population, WGE/Stantec recommends consideration be given to upgrading the road to include:
    - Reshape to provide a consistent driving surface and thus improve safety of road users.
    - Recondition the surface of the basecourse.
    - Provide a 6m wide hot bitumen spray seal to reduce maintenance costs.

- The Perimeter Road to the south and east. i.e. MRWA sealed road with no lot access.

- Rosa Brook Road to the north, which is a sealed road. Based on the concept plan a proposed 10m wide battle axe will be provided to service lots 9 and 10.

Fire access tracks (anticipated to consist of 100mm thick compacted limestone pavement) for lots 9-13 are proposed as indicated in Figure 1.

The battle-axe pavement is anticipated to consist of 150mm thick limestone subbase course and 100mm gravel base with a width of 5.5m as per Shire requirements. Given the special residential nature of the development, sealing of the battle-axe can be considered as discretionary from an engineering perspective. The proposed battle-axe is anticipated to match existing ground levels, to avoid interfere with the pre-development stormwater flow paths.

Lot crossovers will be built by individual lot owners to Shire standards.

3.3 Sewer Reticulation

3.3.1 Existing Sewer Reticulation

Currently, no sewerage infrastructure exists within close proximity to the Site, with the nearest existing gravity sewers being over 2km away to the North-West of the site in Rapid Landing Estate and this sewer is not planned to service this catchment.

Existing residences utilise onsite sewer treatment/disposal.

3.3.2 Proposed Sewer Treatment/Disposal

An extract of the Water Corporation's long-term sewer planning for the areas is provided below in Figure 5. The sewers which ultimately service the catchment of the proposed Development are not likely to be constructed anytime soon and planning is subject to change by the Water Corporation.

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 Alternative Treatment Units (ATUs).

The geotechnical and effluent report by Civil/Structural Consulting Pty Ltd provides advice in relation to the suitability of the existing soil profile and groundwater levels for onsite effluent disposal. Refer to Government Sewerage Policy- Section 3.4.: *For subdivision applications where on-site sewage disposal is proposed*, for the site requirements for on-site sewage systems.

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.

It is understood that future lot buyers will arrange approvals and installation of an ATU for each site.

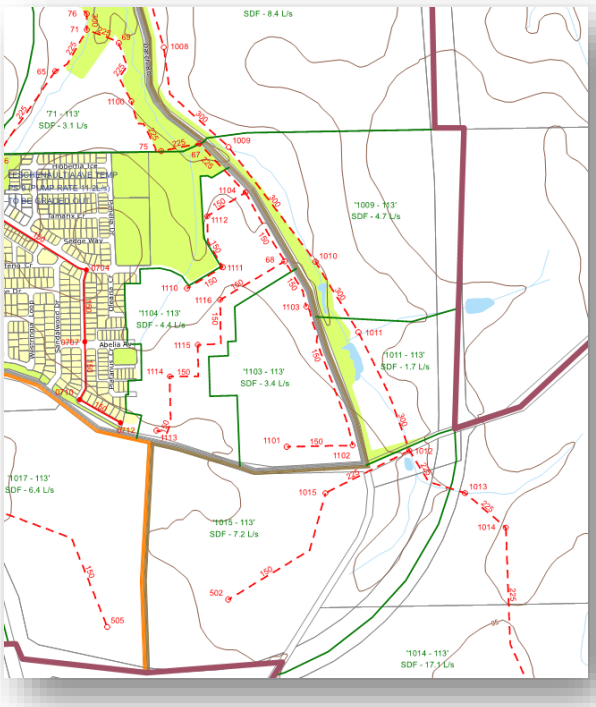


Figure 5 Water Corporation Long Term Sewer Scheme

3.4 Water Reticulation

3.4.1 Existing Water Supply to Residences

Currently, no water reticulation infrastructure exists within close proximity to the Site and it is unlikely to be extended in the short-term. Water will need to be supplied by rainwater tanks fed from roof catchment.

Existing residences on the site capture sufficient rainwater for their needs.

3.4.2 Proposed Water Supply to Residences

It is understood that future lot owners will arrange stormwater tanks to suit their specific needs/demands and associated plumbing as part of the building development.

Calculations of indicative water demand and supply calculations are shown below.

DEMAND

- 4 people per residence.
- Water Demand = 210 litres per person /per day = 76.65kL per person/per annum = 306.6kL/residence per year

AVAILABILITY/SUPPLY

- Average roof area per residence = 340m^2
- Average annual rainfall for Margaret River = 957.6mm/year (Bureau of Meteorology, 2019).
- Assumed water tank size (GT330) 11.36m diameter x 3.23m height. Capacity of 328,096L (Pioneer Water Tanks, 2019)

Water Consumption Calculation

- Water Demand per household per year = 4 x 76.65kL = 306.6kL/year
- Water Supply = Catchment Area x Average Annual Rainfall = 340m^2 x 0.9576m/year = 325.58m^3/year =325.58kL/year
- Therefore, Water Supply > Water Demand.

3.5 Stormwater Infrastructure

3.5.1 Existing Stormwater System

The existing stormwater system consists of

- Intermittent creek line,
- Offline and online dams,
- Overflow from stormwater tanks,
- Overland flows,
- No pit and pipe system internally in the development area,
- Culvert below the Perimeter road directing minor external catchment to the existing stream system,
- Culvert below Darch road directing minor external catchment to the existing stream system.

3.5.2 Proposed Stormwater System

The proposed stormwater strategy for the site is to consist of:

- Match the pre-development stormwater flow patterns utilising the existing creek line and dams,
- minimising the use of pit and pipe systems.

This can be achieved because of the proposed low-density development of the site, the use of rainwater tanks and the pre-development low permeability of the existing soil that will result in little or no change to the existing stormwater behaviour.

As seen in Figure 6, a natural creek line and 3 dams exist in the site boundary. This is a local valley that collects runoff water from the perimeter road to the South and East. The proposed development needs to ensure these stormwater flow patterns are not disrupted or cut off.

In order to minimise the potential for sediment transport to the creek line, providing a minimum of 10m vegetation between water ways and nearest impermeable area is recommended.

Preparation of a Local Water Management Strategy (LWMS) and an Urban Water Management Plan (UWMP) is not recommended, due to the small nature of the development and no change in stormwater behaviour associated with the site.

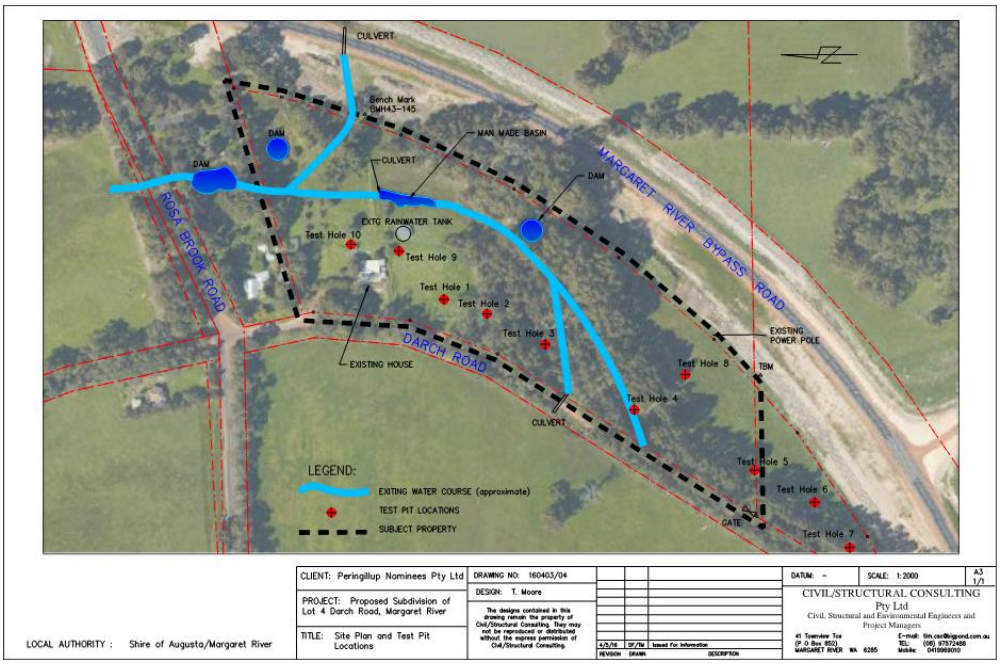


Figure 6 Site Plan and Test Pit Locations - Civil/Structural Consulting

3.6 Gas Reticulation

3.6.1 Existing Gas Reticulation System

No gas reticulation exists within the Perimeter Road or Rosa Brook road reserve.

3.6.2 Proposed Gas Reticulation System

Servicing the site with gas reticulation is not considered viable due to lack of existing infrastructure in the region.

If desirable, lot owners could install gas bottles on their properties.

3.7 Electrical Reticulation

3.7.1 Existing Infrastructure

An analysis of Western Powers DFIS system has been conducted to determine the existing power supply configuration surrounding the development. The existing Western Power network surrounding the site consists of existing overhead LV and HV cables that traverse the site, as well as overhead infrastructure to the North of Rosa Brook Road. There are 3 x existing power supplies on the land (lots 1, 8 & 11). These existing supplies will be removed as part of the subdivision and the lots will be resupplied using underground cabling.

3.7.2 Infrastructure capacity and proposed upgrades

Based on the proposed development layout, we have estimated the demand load to be in the order of 65kVA.

In order to service the proposed subdivision, we anticipate all existing overhead infrastructure (poles, conductor, transformers) will be removed and a new underground supply network will be established as per current Western Power policy. This will require a new single phase high voltage cable be installed along the existing road reserve boundary from the existing power pole on the Northern side of Rosa Brook Rd (cnr Rosa Brook and Perimeter Rd) to a location on the Southern end of Lot 1 (in the Perimeter Road reserve) where the cable will be jointed onto an existing underground cable.

Individual lots will be serviced from pillar units (green domes) located within alternate lots and the pillars will obtain power from pad mounted transformers located on 4 of the lots.

The above works will require the developer to obtain permission from the landowner on the Northern side of Rosa Brook Rd for Western Power to undertake modifications to the existing overhead infrastructure on that land.

The works will also require permission from MRWA for minor works to be undertaken in their road reserve at the southern end of Lot 1.

If the project proceeds, negotiation with Western Power is anticipated in order to refine the design solution to minimise interaction with the MRWA perimeter road reserve.

3.8 Communications

An analysis of NBN's DBYD has been conducted in order to determine the location of the existing NBN network to service this development.

WGE/STANTEC anticipate the proposed subdivision 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 Rosa Brook Road from where Telstra/NBN will install fibre optic or copper cabling to the development.

4. Limitations of the Report

WGE/STANTEC are not licensed financial advisors and any information within this report/email/communication/opinion of potential costs/estimate should not be considered as financial advice or an investment recommendation.

Information, opinions and opinions of potential costs are provided as a reflection of WGE/STANTEC opinion of potential costs associated with the design information related to the relevant engineering infrastructure prior to undertaking detailed design or obtaining approvals or obtaining a tender price from suitably qualified and experienced Construction Contractors or obtaining tax invoices from relevant Authorities.

The opinions and opinion of potential costs or information provided should be read in conjunction with the assumptions and basis of design associated with the various infrastructure components and/or in consideration of the limited information available at the time of preparing the opinion.

The opinions and opinion of potential costs or information provided has been based on incomplete information and as such, an inherent error is attached to this information. If this information is used for budgeting purposes, a contingency should also be considered in addition to the opinion of construction / maintenance / operational costs.

The opinion of potential costs or information provided are developed using:

- Representative construction rates for items regularly encountered within development projects similar to the project being the subject of this report.
- Previous experience and "order of magnitude" quantity calculations for items not regularly encountered. e.g. one off design of sewer pump station and control system.
- Information provided by material suppliers for items regularly encountered. e.g. sewer main pipe.
- Information available at the time of preparing our opinion.
- Construction methods assumed by WGE. i.e. may be different to actual construction method chosen by the Contractor.
- Risk profile/s determined by the individual engineer who has assessed the project and associated information. i.e. may be more or less risk adverse than the Contractor/s who ultimately price the project.

"Representative construction rates" may not be the lowest or highest rates previously provided to WGE by Contractors for similar works but, are what WGE consider to have a reasonable likelihood of being realised if the detailed design and documentation were approved and subject to a suitable tender process.

Use of the information is on the basis that the user:

- understands the limitations of the information and opinions provided within the report,
- understands the risks and,
- accepts all consequences associated with the information within the report.
- indemnifies WGE of all claims relating to the information.

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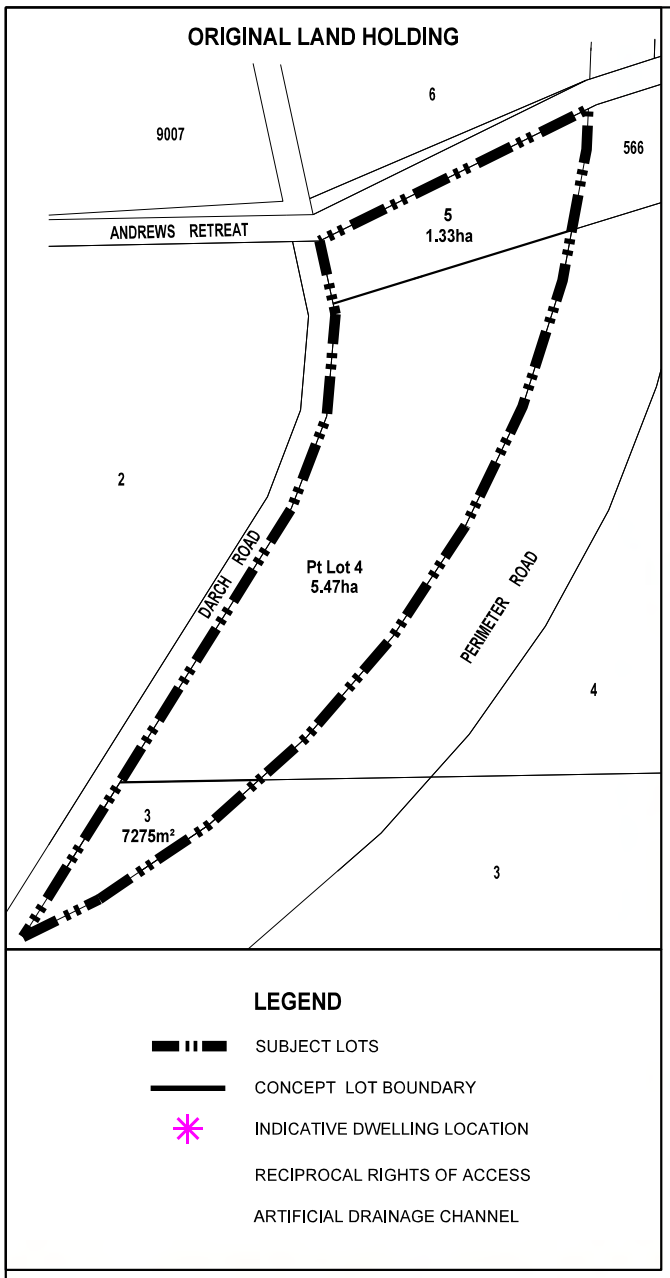
5. References

Bureau of Meteorology, 2019, *Climate statistics for Australian locations.* Available from: http://www.bom.gov.au/climate/averages/tables/cw_009746.shtml [04 December 2019]

Shire of Augusta and Margaret River, 2019, *Water*. Available from: https://www.amrshire.wa.gov.au/sustainability/sustainable-development/water [04 December 2019]

Pioneer Water Tanks, 2019, *Water Tank Sizing Chart.* Available from: https://pioneerwatertanks.com.au/water-tank-sizes/ [04 December 2019]

6. Appendix A – Subdivision Concept Plan



THIS CONCEPT PLAN IS INDICATIVE ONLY AND SUBJECT TO CHANGE

10m WIDE ACCESS LEG WITH RECIPROCAL RIGHTS TO BENEFIT LOTS 6, 12, 13 & 14.

LOT YIELD			LOT AREA		
Size	No. Lots	% Total Lots	Average Size	% of Total Area	Area
2000m² - 3000m²	2	13.33%	2056m²	5.47%	4113m²
3001m² - 4000m²	7	46.67%	3577m²	33.32%	25041m²
4001m² - 5000m²	3	20.00%	4451m²	17.77%	13355m²
7001m² - 8000m²	1	6.67%	7275m²	9.68%	7275m²
9001m² - 10000m²	1	6.67%	9362m²	12.46%	9362m²
11001m²+	1	6.67%	16000m²	21.29%	16000m²
Total Number of Lots	15				

Minimum Lot Size 2026m² Average Lot Size 5009m²
Maximum Lot Size 16000m² Total Lot Area 75146m²

0 20 40 60 80
metres

NOTES

Base data supplied by Landgate

Aerial Photography Date - January 2020

Areas and dimensions shown are subject to final survey calculations.

All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.

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PLAN 5

CLIENT		*N & K VEITCH*
SCALE	:	*1:2,000 @ A3*
DATE	:	*5 August 2021*
PLAN No	:	*4 DARCH-1-001*
REVISION	:	*G*
PLANNER	:	*SLB*
DRAWN	:	*BL*

SUBDIVISION CONCEPT PLAN

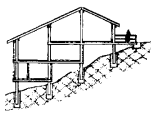
PT. LOT 4 & LOTS 31 & 5 DARCH ROAD, MARGARET RIVER

LB PLANNING
TOWN PLANNING | URBAN DESIGN | LAND DEVELOPMENT CONSULTING

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7. Appendix B – Geotechnical Report

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REPORT TO GEOTECHNICAL INVESTIGATION

and EFFLUENT DISPOSAL STUDY FOR

LOT 4 DARCH ROAD, MARGARET RIVER

REPORT FOR: Mr. M Hunt

OF: RPS Australia

CLIENT: Peringillup Nominees Pty Ltd

REPORT BY: T Moore

OF: Civil/Structural Consulting Pty Ltd

DATE: May 2016

Civil/Structural Consulting Pty Ltd

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GEOTECHNICAL and EFFLUENT CAPACITY REPORT FOR PROPOSED DEVELOPMENT AT LOT 4 DARCH ROAD, MARGARET RIVER May 2016

1.0 BACKGROUND

On 6th April 2016 this office was commissioned by Mr Mark Hunt, on behalf of the Client Perringillup Nominees Pty Ltd, to carry out a geotechnical investigation and effluent capacity investigation of relevant areas for proposed subdivision and residential construction, at the site Lot 4 Darch Road, Margaret River, and provide a report thereof.

1.1 THE SITE

See Appendix A for site plan and landform.

The subject site is 5.4713 hectares in area and situated approximated 2.2km south east of Margaret River town centre, 9km east from the coast. It was originally part of a larger lot zoned "General Agriculture" but this western portion has been severed off by the recent construction of the Margaret River Perimeter Bypass Road.

It is bounded in the east by the Margaret River by-pass road, then State Forest. The northern third of the property in the past was a functioning horse farm with residence, sheds, fenced yards and training areas.

There are two seasonal water courses traversing the subject property (see Appendices A and G), neither were running at the time of investigation. One originates on the farm to the west of the subject site then traverses to the north with a small dam central on the property and a detention basin toward the north with a second dam near the northern boundary. The second water course originates on the eastern side of the Margaret River Bypass and traverses the north-eastern corner of the subject property before joining the other water course, exiting the property through the northern boundary and crossing Rosa Brook Road. It then continues north becoming a tributary of Darch Brook which is itself a tributary of the Margaret River, some 2km north.

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1.1 THE SITE (Cont.)

With regard to vegetation the northern third of the property is cleared. Of the southern two thirds, a half is covered with tuarts and planted karri trees (to about 350mm diameter) parkland cleared with minor undergrowth. The other half is cleared. See photographs below.

Soil layers were damp due to the passage of water through the more permeable upper layers of the soil profiles from recent rains, but there were no signs of a high water table in any of the Test Pits.



Fig 1: Test Hole 3 (facing north)



Fig 2: Test Hole 6 (facing east)

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2.0 GEOTECHNICAL INVESTIGATION

Lot 4 Darch Road, Margaret River was visited and assessed for geotechnical considerations, including: excavation of test pits; ground slopes; ground types; soil types (including sampling and soil tests by NATA registered soils laboratory); surface and sub-surface water flows and type and proximity of vegetation.

The results of the investigation are presented in report form for each of the areas. See Appendix B for copies of the reports and Appendix C for laboratory test results of the clay fractions of the soils.

An Acid Sulphate Soils study is not within the scope of this investigation. The subject lot is classed as Moderate to Low Risk of ASS within 3m of the natural surface (see Appendix F).

2.1 SUMMARY OF FIELDWORK AND SITE CLASSIFICATIONS (GEOTECHNICAL)

NOTE

- Full Geotechnical Investigation Reports are provided in Appendix B.
- Test Hole locations are shown in Appendix A.
- Laboratory Soil Test Results (Clays) are provided in Appendix C.

TEST PIT	SITE CLASSIFICATION
1	S
2	S
3	A to S
4	A to S
5	A to S
(6)	S
(7)	A to S
8	A to S
9	A to S
10	A to S

NOTE:. Test pits in brackets are outside the subject land.

Refer to CSIRO Information Sheet (Appendix H) for further details on general definitions of Site Classifications.

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3.0 EFFLUENT DISPOSAL INVESTIGATION

The areas proposed for development were visited and assessed for all factors affecting effluent disposal, including: ground types; presence of catchments; falls to the land; landforms; ability of the various areas to accept effluent; permeability of the soils in the various areas; and water movement - both surface and sub-surface.

Copies of the Effluent Site and Soil Evaluation Report, which contain soil profiles to the relevant depths and evaluation of the relevant areas are presented in Appendix D.

The soil profiles for geotechnical purposes have been logged up to depths of 2m and are also useful as a part of effluent disposal assessment. They are contained in Appendix B.

3.1 TYPES OF EFFLUENT DISPOSAL SYSTEMS

Generally speaking there are four main types of domestic effluent disposal systems considered in this report. The choice as to which is the most suitable is determined by the capacity of the discharge area to receive and process the nutrients and biochemical oxygen demand (b.o.d.) on an ongoing basis. The possibility of excessive effluent flows or concentration which may exceed the capacity of the receiving system to process on an ongoing basis is to be avoided.

The capacity of various systems to receive and process effluent on an ongoing basis varies, for example a healthy stand of dense natural vegetation founded in loamy, gravelly soils will have a higher capacity than a warm, low flow stream system (see also Section 5.1 below).

The domestic effluent disposal systems considered in this report are:

TYPE ONE
Standard concrete settling tanks with in-ground leach drains fed by gravity.
TYPE TWO
The above standard system combined with a pump tank which allows the in-ground leach drains to be placed at any suitable location and not requiring fall to an area lower than the settling tanks.

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3.1 TYPES OF EFFLUENT DISPOSAL SYSTEMS (Cont.)

TYPE THREE

Standard concrete settling tanks with semi-inverted or fully-inverted leach drains located with fall from the settling tanks.

TYPE FOUR

Alternative treatment systems which treat the effluent to a point acceptable for discharge onto purpose designed receival areas.

Design Load Rates (DLR) are relevant to Types One to Three..
Design Irrigation Rates (DIR) are relevant to Type Four.

General principles to be followed when disposing of effluent are:

- Maintain a reasonable distance from stream flows and catchments to stream flows (this distance would depend on the "barriers" to effluent flow between the disposal area and the stream/catchment such as: belts of vegetation; ground water flows; surface water flows and permeability of the soil, 30m would be a suitable minimum in this case);
- Maintain a reasonable distance from water supplies such as bores and dams (the above considerations apply here also); and
- Be aware of the "robustness" of the system with regard to processing effluent on an ongoing basis.

Mitigating structures may be included in an effluent disposal system, such as subsoil drains uphill of the disposal area if sub-surface water flow is likely to be a problem; surface cut-off drains to re-direct surface runoff should there be a catchment contributing to the disposal area; below ground barriers if it is desirable to reduce downhill migration of effluent.

3.2 SUMMARY OF FIELDWORK AND CALCULATIONS (EFFLUENT)

NOTE

- Full Site and Soil Evaluation Reports are provided in Appendix D.
- Test Pit locations and landforms are shown in Appendix A.
- Phosphorous Retention Index Laboratory test results are presented in Appendix E.

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3.2 SUMMARY OF FIELDWORK AND CALCULATIONS (EFFLUENT) (Cont.)

EFFLUENT TEST PIT	SOIL CATEGORY	DESIGN LOAD RATE (mm/d)	PRI	DESIGN IRRIGATION RATE (mm/day)	DEPTH TO LOW PERMEABILITY" LAYER (mm) approximate
1	1	30	8.4	5	>1500
2	2	30	83	5	1500
3	1	30	2.7	5	>1500
4	1	30	4.1	5	1500
5	1 to 2	30	480	5	1200
(6)	2/3	25	>500	4	1500
(7)	2	30	270	5	1500
8	4	15	-	3.5	1000
9	2	30	28	5	1200
10	1	30	5.7	5	>1500

NOTE: Soil category, DLR, DIR and PRI are values at the anticipated depth of effluent disposal. Test pits in brackets are outside the subject land.

4.0 CONCLUSIONS AND RECOMMENDATIONS - GEOTECHNICAL

All of the sites assessed as a part of this study are suitable for construction of residential or light commercial structures using commonly accepted methods of construction.

Matters to consider during design, earthworks and construction include: compaction of the existing ground; sub-surface water flows; presence, depth to and reactivity of clays in the foundations; possible ground disturbance and below ground structures in the previously occupied areas; proximity to seasonal water ways and proximity and types of vegetation.

Whilst a fairly rigorous investigation of the various areas has been carried out, the reports contained in Appendix B should be considered preliminary only. Further investigation necessary for classification of specific sites under AS2870, for design and construction purposes of any proposed structures, should be carried out at the appropriate time.

The subject site has a "moderate to low risk" of acid sulphate soils being present within 3m of the natural surface (see Appendix F). An Acid Sulphate Soils investigation is not within the scope of this investigation/report. It is likely that an ASS investigation was carried out during the preliminary design phase of the Margaret River Perimeter Bypass Road, and this is likely to be relevant to the subject site.

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4.0 CONCLUSIONS AND RECOMMENDATIONS – GEOTECHNICAL (Cont.)

A Local Water Management Study is not within the scope of this investigation/report. It is likely that a LWMS has been carried out previously in this area and this is likely to be relevant to the subject site.

5.0 CONCLUSIONS AND RECOMMENDATIONS - EFFLUENT

Design and construction of the effluent disposal systems is to comply with AS1547-2012, Health Department of WA and Local Authority requirements.

There is very little likelihood of "deep sewer" servicing this area in the foreseeable future (certainly not within ten years).

Having regard for those considerations in Section 5.1 below, any of the disposal systems detailed in Section 3.1 above are suitable on the subject site.

5.1 EFFLUENT DISPOSAL CONSIDERATIONS

Factors affecting "safe" effluent absorption and assimilation into the environment which are relevant to this subject site are:

- High to moderate permeability of the upper soil profiles.
- Proximity of the disposal area to catchments for the seasonal creeklines, effluent disposal should not occur within 30m of these area.
- Surface water flow (a minor consideration).
- Sub-surface water flow (especially at the level of the low permeability layer).
- Robustness of the receiving environment, in particular moderate phosphate retention/assimilation capacity and density and health of vegetation.
- Minimum lot size 2000m^2.

The preferred siting for the onsite effluent disposal systems is where we have a moderately permeable soil containing minor clays or silts (silty/clayey soils have an improved phosphate retention capacity).

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5.1.1 HIGH WATER TABLE

No watertable, nor signs of a water table were observed in any of the geotechnical test holes or effluent test pits.

Temporary inundation at the low permeability clay layer may be an issue after heavy sustained rainfall.

5.1.2 PHOSPHOROUS RETENTION CAPACITY

Phosphorous is present in domestic effluent (most commonly as phosphates). It can cause problems under certain circumstances if it accumulates in water bodies.

The capacity of soils to absorb and assimilate phosphorus varies. "Poor" sandy soils have a very low capacity to deal with phosphorous, which tends to wash out and can accumulate in nearby water bodies, with likely resulting environmental problems.

Phosphorous Retention Index (PRI) provides us with a measure of the capacity of a soil to retain phosphorous, thus allowing it to be assimilated into the environment. A reading below 5 would indicate a poor phosphate retention capacity. From 10 to 50 would indicate a moderate to poor PRI and above 50 would indicate a good PRI.

The upper layers of soils from the subject area are sandy. These are underlain with silty/clayey soils. The upper layers would have a low capacity to assimilate phosphates, but as we go deeper the capacity of assimilation increases. It is accepted that the robustness of a soil is improved by the planting of high nutrient absorbing vegetation, and this is recommended to be carried out.

See Section 3 above, and Appendices D and E for further details.

END REPORT

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Civil, Structural & Environmental
Engineers & Project Managers

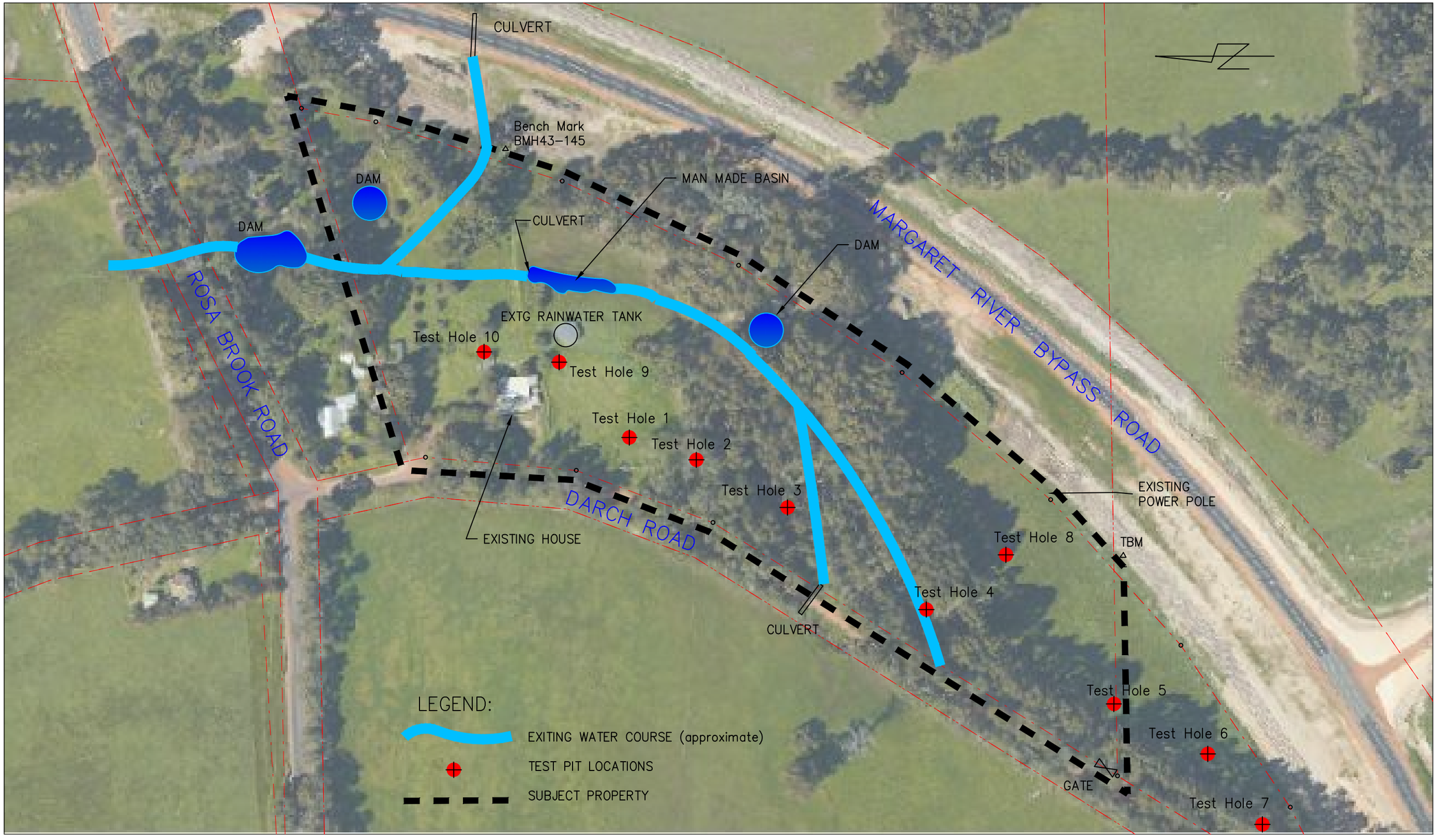
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APPENDIX A

PLAN WITH LOCATIONS OF GEOTECHNICAL TEST HOLES AND EFFLUENT TEST PITS

LOT 20 DARCH ROAD, MARGARET RIVER



LOCAL AUTHORITY : Shire of Augusta/Margaret River

CLIENT: Peringillup Nominees Pty Ltd

PROJECT: Proposed Subdivision of Lot 4 Darch Road, Margaret River

TITLE: Site Plan and Test Pit Locations

DRAWING NO: 160403/04

DESIGN: T. Moore

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REVISION	DRAWN	DESCRIPTION
4/5/16	DF/TM	Issued For Information

DATUM: –

SCALE: 1:2000

A3
1/1

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APPENDIX B

GEOTECHNICAL SOIL PROFILES

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GEOTECHNICAL TEST PIT RESULTS

NOTE: TEST HOLE LOCATIONS ARE SHOWN IN APPENDIX A

SITE Lot No.: 4 Street: Darch Road

Location: Margaret River

CLASSIFICATION OF SITES by soil profile identification
in accordance with AS2870-2011.

The site classifications range from
"A TO S"
for all sites investigated

THE FOLLOWING COMMENTS APPLY TO THE SITES ASSESSED
WITH REGARD TO GEOTECHNICAL INVESTIGATIONS

COMMENTS

1) Having regard for geotechnical conditions, all sites, as detailed on plans, are suitable for construction of residential or light commercial structures using commonly accepted methods of construction.
2) Representative testing has been carried out by a NATA Registered Soil Laboratory to the clay fractions of the soil profiles, see Appendix C for test results.
3) No water table, nor signs of any water table were observed in any test holes. Rainfall may permeate through the more permeable upper layers and sit over the less permeable lower clay layers during extended periods of heavy rainfall, until it migrates downhill.
4) It is important to note that there are two seasonal water courses (not running at the time of investigation) traversing the subject property (see Appendix G). One originates on the farm to the west of the subject site then traverses to the north with a small dam central on the property and a detention basin toward the north with a second dam near the northern boundary. The second water course originates on the eastern side of the Margaret River Bypass and traverses the north-eastern corner of the subject property before joining the other water course, exiting the property through the northern boundary and crossing Rosa Brook Road. It then continues north becoming a tributary of Darch Brook which is itself a tributary of the Margaret River.
5) Removal of any large trees or rocks required for construction of buildings, roads etc will necessitate grubbing of roots greater than 50mm diameter. Resultant holes will require battering 1 vertical to 3 horizontal and proper placement of suitable backfill, then suitable compaction will be required, layer thickness will depend on method of compaction (For sand - 1 tonne plate compactor maximum 300mm, 10 tonne vibrating drum roller maximum 600mm).
6) Classification of individual sites depends primarily on the presence or absence of reactive clay in the soil profile, the depth to the clay and the anticipated variation in moisture content. Reactive clay was present in most test holes fairly low in the soil profile.
7) Classification of sites is preliminary only. Sites are to be fully assessed on an individual basis at time of construction of any proposed structures.

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COMMENTS (Cont)

8) Where classification is shown as being between categories, the final classification will be dependant upon the depth of stable overburden to the reactive clay that is retained during construction of earthworks AND the degree to which the moisture content is stabilised during the proposed development. No removal of overburden will result in the classification closer to the lower category. Removal of all overburden will result in classification closer to the higher category.
9) Classifications given assume a suitable density to proposed buildings is provided. Where necessary pre-compaction of sites is to be carried out prior to any construction occurring.
10) All profile measurements are from existing Natural Ground Level.
11) CSIRO Information Sheet is enclosed (Appendix H).
12) All sites are located within 13km of coast. Wind classification N1 ground floor and N2 second storey.

SOIL PROFILES, TEST RESULTS and PRELIMINARY CLASSIFICATIONS

TEST HOLE 1

0 to 200 – Dark brown silty/sandy topsoil, grass covered.
200 to 900 – Grey/light brown fine sand.
900 to 1800 (EOH) – Grey/orange/pale brown sandy clay/clayey sand, dry, clumping (Sample One from 1700).

TEST RESULTS

Linear Shrinkage = 11% LL = 44%
Plasticity Index = 28% PL = 16%
Passing 75μm sieve = 34%

Site Classification "**S**"

TEST HOLE 2

0 to 150 – Dark brown silty/sandy topsoil, grass covered.
150 to 450 – Light brown fine sand, small roots.
450 to 1200 – Light brown/orange clayey sand.
1200 to 1800 (EOH) – Grey mottled red/orange clay, red increases with depth. (Sample Two from 1700).

TEST RESULTS

Linear Shrinkage = 12% LL = 52%
Plasticity Index = 29% PL = 23%
Passing 75μm sieve = 41%

Site Classification "**S**"

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TEST HOLE 3

0 to 200 – Grey/brown sandy topsoil, grass covered.
200 to 1000 – Grey sand.
1000 to 1800 (EOH) – Grey/orange clayey sand, orange colour and clay content increase with depth (Clay results between TH2 and TH4).

Site Classification "**A to S**"

TEST HOLE 4

0 to 150 – Grey/brown sandy topsoil, grass covered.
150 to 1000 – Grey/brown sand.
1000 to 1300 – Grey/brown clayey sand.
1300 to 1900 (EOH) – Brown/orange/grey sandy clay. (Sample Four from 1800).

TEST RESULTS

Linear Shrinkage = 9.0% LL = 31%
Plasticity Index = 16% PL = 15%
Passing 75μm sieve = 35%

Site Classification "**A to S**"

TEST HOLE 5

0 to 150 – Dark brown silty topsoil, grass covered.
150 to 800 – Brown/yellow sand.
800 to 1700 – Grey/orange sandy clay, clay content increases with depth. (Clay results from 1600 as per TH8)

Site Classification "**A to S**"

TEST HOLE 6

0 to 150 – Dark brown sandy topsoil, grass covered.
150 to 600 – Orange/brown gravelly/clayey/sand.
600 to 700 – Silty organic sludge (burnt roots/stumps).
700 to 1500 – Orange/grey/red gravelly (laterite) clay,
1500 to 1700 (EOH) – Red/grey clay, minor gravel (laterite). (Sample Six from 1600)

TEST RESULTS

Linear Shrinkage = 12.0% LL = 68%
Plasticity Index = 36% PL = 32%
Passing 75μm sieve = 36%

Site Classification "**S**"

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TEST HOLE 7

0 to 150 – Dark brown sandy topsoil, grass covered.
150 to 300 – Orange/brown gravelly sand.
300 to 1300 – Orange/brown sandy gravel (laterite).
1300 to 1700 (EOH) – Grey/orange/red sandy clay, minor quartz gravel. (Clay results from 1600 as per TH6).

Site Classification "**A to S**"

TEST HOLE 8

0 to 120 – Dark brown/grey loamy topsoil, grass covered.
120 to 400 – Grey silty sand, moderately permeable.
400 to 900 – Grey sandy clay/clayey sand, low to moderate permeability.
900 to 1200 – Grey with minor orange flecks clay with minor grit, low permeability.
1200 to 2000 (EOH) – Grey flecked orange/red clay, minor sand and quartz grit. (Sample Eight from 1600).

TEST RESULTS

Linear Shrinkage = 11.0% LL = 42%
Plasticity Index = 23% PL = 19%
Passing 75μm sieve = 42%

Site Classification "**A to S**"

TEST HOLE 9

0 to 150 – Grey sandy topsoil, grass covered.
150 to 1000 – Yellow/orange sand with minor silt, firm, permeable.
1000 to 1400 – – Yellow/orange flecked dark orange sandy clay, minor grit, low to moderate permeability.
1400 to 1950 (EOH) – Grey flecked dark orange clay, minor grit. (Clay results from 1600 as per TH8).

Site Classification "**A to S**"

TEST HOLE 10

0 to 200 – Dark brown sandy topsoil, grass covered.
200 to 1000 – Orange/brown sand, permeable.
1000 to 1700 – Orange/brown clayey sand, moderate permeability.
1700 to 1900 (EOH) – Orange/brown sandy clay. (Clay results from 1800 as per TH8)

Site Classification "**A to S**"

Signed:..... Date: 6/5/2016

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APPENDIX C

LABORATORY SOIL TEST RESULTS (CLAYS)

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Laboratory: Geotech Bunbury
Phone: 08 9726 2187 Fax: 08 9721 2348
Email: paul.kent@cardno.com

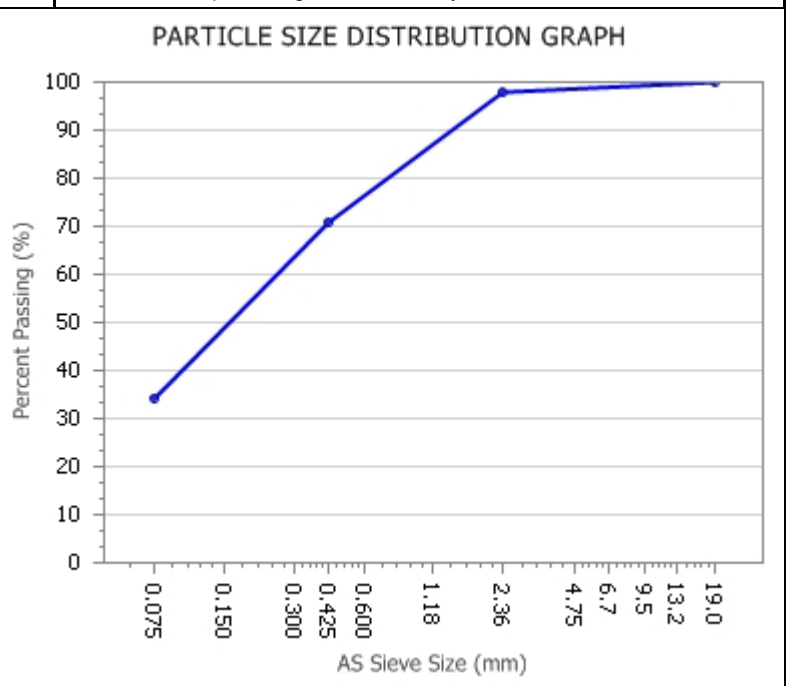
QUALITY OF MATERIALS REPORT

Client:	Civil/Structural Consulting Pty Ltd	Report Number:	5029/R/6481-1
Client Address:	41 Townview Tce , MARGARET RIVER	Project Number:	5029/P/451
Project:	Darch View, Margaret River	Lot Number:	TH 1
Location:	South West WA	Internal Test Request:	5029/T/2341
Component:		Client Reference/s:	
Area Description:		Report Date / Page:	20/05/2016 Page 1 of 1

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1

Sample Number	5029/S/13148	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	4/05/2016		
Sampled By	Client Sampled		
Date Tested	16/05/2016	Material Source	-
Att. Drying Method	Oven Dried	Material Type	-
Atterberg Preparation	Dry Sieved	Material Description	Light Brown Sandy CLAY

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
2.36		**98**	
0.425		**71**	
0.075		**34**	



Test Result	Specification Minimum	**Result**	Specification Maximum
Liquid Limit (%)		**44**	
Plastic Limit (%)		**16**	
Plastic Index (%)		**28**	
Linear Shrinkage (%)		**11.0**	

Test Result	Specification Minimum	**Result**	Specification Maximum
0.075/0.425 Fines Ratio		**0.48**	
PI x 0.425 Ratio (%)		**1990.8**	
LS x 0.425 Ratio (%)		**782.1**	
Linear Shrinkage Defects	-		

Remarks

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

Accreditation Number: 5029

Approved Signatory: Janine Fischer
Form ID: W85Rep Rev 1

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Email: paul.kent@cardno.com

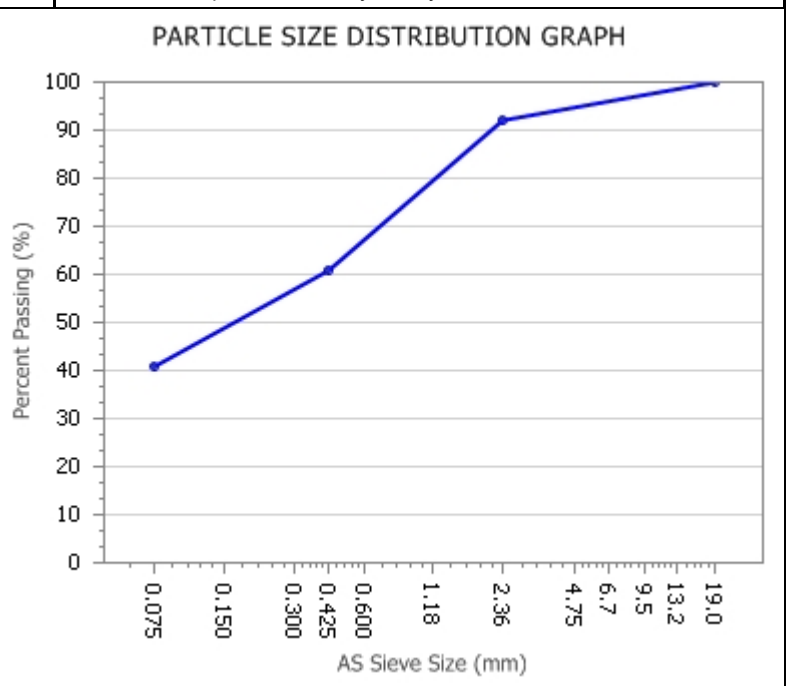
QUALITY OF MATERIALS REPORT

Client:	Civil/Structural Consulting Pty Ltd	Report Number:	5029/R/6480-1
Client Address:	41 Townview Tce , MARGARET RIVER	Project Number:	5029/P/451
Project:	Darch View, Margaret River	Lot Number:	TH 2
Location:	South West WA	Internal Test Request:	5029/T/2341
Component:		Client Reference/s:	
Area Description:		Report Date / Page:	20/05/2016 Page 1 of 1

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1

Sample Number	5029/S/13149	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	4/05/2016		
Sampled By	Client Sampled		
Date Tested	16/05/2016	Material Source	-
Att. Drying Method	Oven Dried	Material Type	-
Atterberg Preparation	Dry Sieved	Material Description	Red Grey Sandy CLAY

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
2.36		**92**	
0.425		**61**	
0.075		**41**	



Test Result	Specification Minimum	**Result**	Specification Maximum	Test Result	Specification Minimum	**Result**	Specification Maximum
Liquid Limit (%)		**52**		0.075/0.425 Fines Ratio		**0.68**	
Plastic Limit (%)		**23**		PI x 0.425 Ratio (%)		**1760.3**	
Plastic Index (%)		**29**		LS x 0.425 Ratio (%)		**728.4**	
Linear Shrinkage (%)		**12.0**		Linear Shrinkage Defects	-		

Remarks

NATA

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Form ID: W85Rep Rev 1

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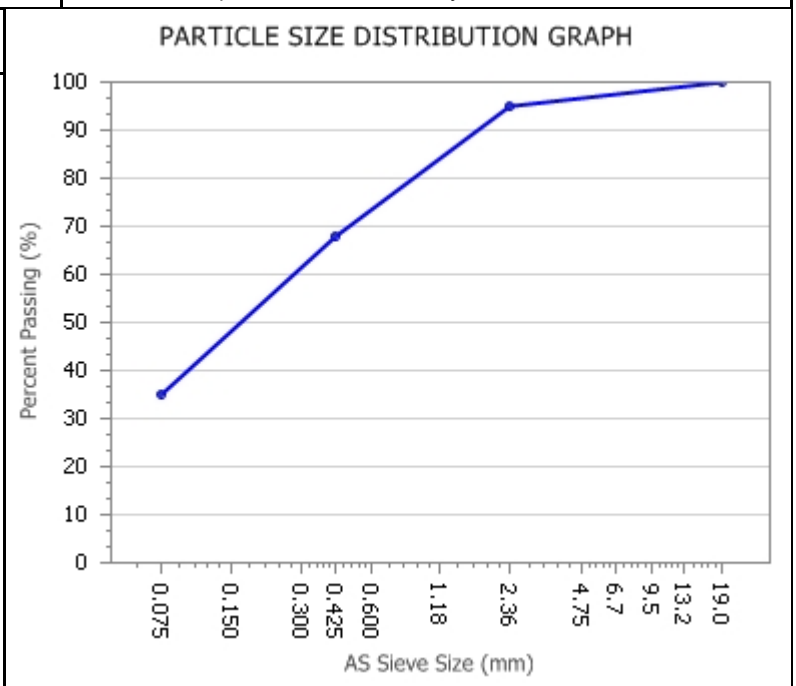
QUALITY OF MATERIALS REPORT

Client:	Civil/Structural Consulting Pty Ltd	Report Number:	5029/R/6479-1
Client Address:	41 Townview Tce , MARGARET RIVER	Project Number:	5029/P/451
Project:	Darch View, Margaret River	Lot Number:	TH 4
Location:	South West WA	Internal Test Request:	5029/T/2341
Component:		Client Reference/s:	
Area Description:		Report Date / Page:	20/05/2016 Page 1 of 1

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1

Sample Number	5029/S/13150	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	4/05/2016		
Sampled By	Client Sampled		
Date Tested	16/05/2016	Material Source	-
Att. Drying Method	Oven Dried	Material Type	-
Atterberg Preparation	Dry Sieved	Material Description	Red Brown Sandy CLAY

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
2.36		**95**	
0.425		**68**	
0.075		**35**	



Test Result	Specification Minimum	**Result**	Specification Maximum	Test Result	Specification Minimum	**Result**	Specification Maximum
Liquid Limit (%)		**31**		0.075/0.425 Fines Ratio		**0.52**	
Plastic Limit (%)		**15**		PI x 0.425 Ratio (%)		**1081.6**	
Plastic Index (%)		**16**		LS x 0.425 Ratio (%)		**608.4**	
Linear Shrinkage (%)		**9.0**		Linear Shrinkage Defects	-		

Remarks

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
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Accreditation Number: 5029

Approved Signatory: Janine Fischer
Form ID: W85Rep Rev 1

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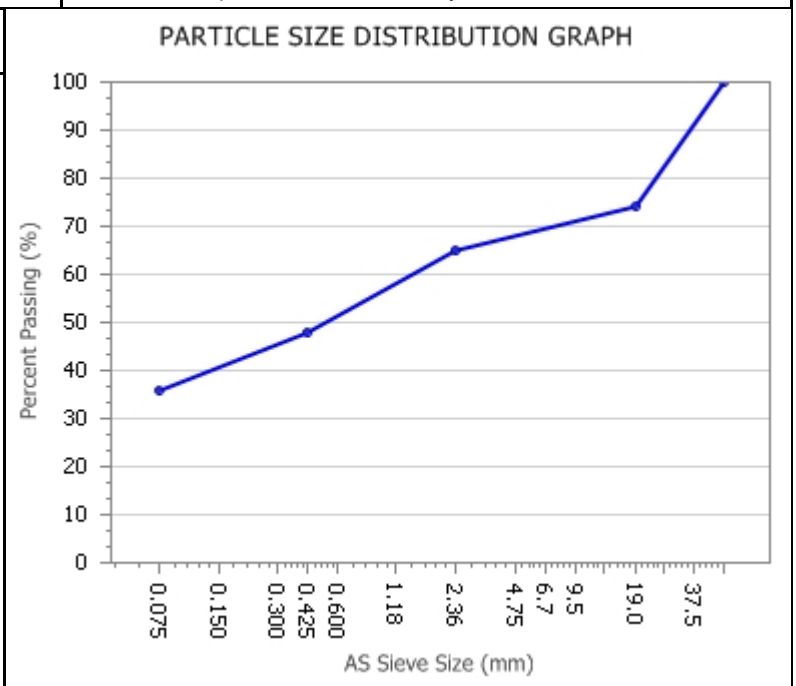
QUALITY OF MATERIALS REPORT

Client:	Civil/Structural Consulting Pty Ltd	Report Number:	5029/R/6482-1
Client Address:	41 Townview Tce , MARGARET RIVER	Project Number:	5029/P/451
Project:	Darch View, Margaret River	Lot Number:	TH 6
Location:	South West WA	Internal Test Request:	5029/T/2341
Component:		Client Reference/s:	
Area Description:		Report Date / Page:	20/05/2016 Page 1 of 1

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1

Sample Number	5029/S/13151	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	4/05/2016		
Sampled By	Client Sampled		
Date Tested	16/05/2016	Material Source	-
Att. Drying Method	Oven Dried	Material Type	-
Atterberg Preparation	Dry Sieved	Material Description	Red Brown Rocky CLAY

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
53.0		**100**	
19.0		**74**	
2.36		**65**	
0.425		**48**	
0.075		**36**	



Test Result	Specification Minimum	**Result**	Specification Maximum
Liquid Limit (%)		**68**	
Plastic Limit (%)		**32**	
Plastic Index (%)		**36**	
Linear Shrinkage (%)		**12.0**	

Test Result	Specification Minimum	**Result**	Specification Maximum
0.075/0.425 Fines Ratio		**0.75**	
PI x 0.425 Ratio (%)		**1735.2**	
LS x 0.425 Ratio (%)		**578.4**	
Linear Shrinkage Defects	-		

Remarks

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

Accreditation Number: 5029

Approved Signatory: Janine Fischer
Form ID: W85Rep Rev 1

Cardno Geotech Pty Ltd
ABN: 48 137 480 034
Address:
72 McCombe Road,
Davenport WA 6230

Laboratory: Geotech Bunbury
Phone: 08 9726 2187 Fax: 08 9721 2348
Email: paul.kent@cardno.com

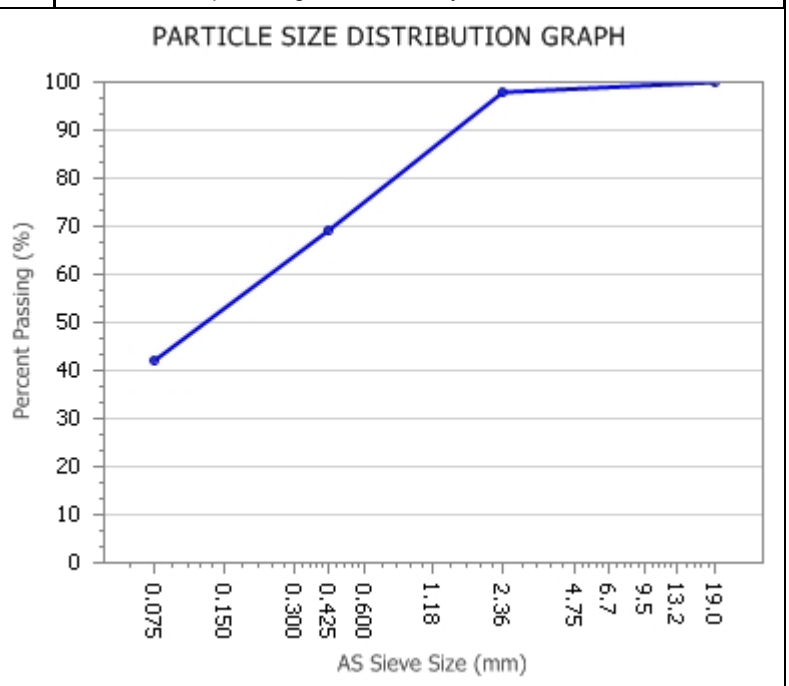
QUALITY OF MATERIALS REPORT

Client:	Civil/Structural Consulting Pty Ltd	Report Number:	5029/R/6483-1
Client Address:	41 Townview Tce , MARGARET RIVER	Project Number:	5029/P/451
Project:	Darch View, Margaret River	Lot Number:	TH 8
Location:	South West WA	Internal Test Request:	5029/T/2341
Component:		Client Reference/s:	
Area Description:		Report Date / Page:	20/05/2016 Page 1 of 1

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1

Sample Number	5029/S/13152	Test Request	
Sampling Method	Tested As Received	Area	
Date Sampled	4/05/2016		
Sampled By	Client Sampled		
Date Tested	16/05/2016	Material Source	-
Att. Drying Method	Oven Dried	Material Type	-
Atterberg Preparation	Dry Sieved	Material Description	Light Brown Sandy CLAY

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
2.36		**98**	
0.425		**69**	
0.075		**42**	



Test Result	Specification Minimum	**Result**	Specification Maximum	Test Result	Specification Minimum	**Result**	Specification Maximum
Liquid Limit (%)		**42**		0.075/0.425 Fines Ratio		**0.60**	
Plastic Limit (%)		**19**		PI x 0.425 Ratio (%)		**1580.1**	
Plastic Index (%)		**23**		LS x 0.425 Ratio (%)		**755.7**	
Linear Shrinkage (%)		**11.0**		Linear Shrinkage Defects	-		

Remarks

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Accreditation Number: 5029

Approved Signatory: Janine Fischer
Form ID: W85Rep Rev 1

Civil/Structural Consulting Pty Ltd

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Tel: 61 8 9757 2488
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Email: tim.csc@bigpond.com.au

APPENDIX D

EFFLUENT SITE AND SOIL EVALUATION REPORTS

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Engineers & Project Managers

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EFFLUENT SITE AND SOIL EVALUATION

NOTE: TEST HOLE LOCATIONS AND LANDFORM ARE SHOWN IN APPENDIX A

SITE Lot No.: 4 Street: Darch Road

Location: Margaret River

ALL SITES

SOIL CATEGORY – Upper Layers 1 to 2,

Mid Layers 3 to 4, Lower Layers 5 to 6

DESIGN LOAD RATE (Trenches & Beds) = 30mm/day

DESIGN IRRIGATION RATE = 4mm/day (LPED), 5mm/day (drip)

IN ACCORDANCE WITH AS/NZ1547:2012

CONCLUSIONS

All sites are suitable for onsite effluent disposal.

System of disposal and design of the system(s) is to have regard for:

- The large lot sizes.
- The moderate phosphate retention capacity of all the sites.
- The moderate permeability of the soil profiles, most areas underlain by low permeability clays.
- The likelihood of sub-surface water flows throughout the wet season, particularly after prolonged heavy rains.
- The proximity to the two seasonal creeklines.
- The proximity to the two dams and the detention basin.

COMMENTS

1) This report is based predominantly on the fieldwork carried out on 6/5/2016 and on the requirements of AS/NZS1547:2012.
2) The subject land is 5.4713 hectares in area and located approximately 2.2kms to the south east of Margaret River town centre, about 9km from the coast and in the extreme south catchment of Darch Brook, a tributary of the Margaret River. Current zoning is “General Agriculture”. It is bounded to the east by the Margaret River by-pass road, then State Forest. The northern third of the property, in the past was a functioning horse farm with residence, sheds, fenced yards and training areas.
3) This investigation was carried out shortly after the dry season, prior to the onset of the wet season. There was no sign of a water table, it is reasonable to assume that absence of ground water observed at the depth of field test holes is indicative that a high water table will not be an issue.

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COMMENTS (Cont)

4) There are no signs of subsurface water, however it is probable there would be subsurface flow in heavy rains and this would require appropriate management.
5) These reports are to be read in conjunction with the geotechnical test pits (see Appendix B) which were dug to varying depths up to 2.0m.
6) With regard to vegetation the northern third of the property is cleared. Of the southern two thirds, a half is covered with tuarts and blue gums (parkland cleared with minor undergrowth) and the other half is cleared. See photographs.
7) With regard to water sources there are two seasonal water courses (not running at the time of investigation) traversing the subject property (see Appendix G). One originates on the farm to the west of the subject site then traverses to the north with a small dam central on the property and a detention basin toward the north with a second dam near the northern boundary. The second water course originates on the eastern side of the Margaret River Bypass and traverses the north-eastern corner of the subject property before joining the other water course, exiting the property through the northern boundary and crossing Rosa Brook Road. It then continues north becoming a tributary of Darch Brook which is itself a tributary of the Margaret River.
8) Upper layers of soil profile (to about 800mm below GL) are sandy to silty/sand in nature and may be considered good to moderate permeability (Soil Category 1 to 2), Phosphate Retention Capacities are low to moderate. The mid-layers (generally approximately 800mm below natural GL) are mostly sandy clays/clayey sands (Soil Category 3 to 4), permeability may be considered moderate, Phosphate Retention Capacities are moderate to high. Once we enter the clay layer proper (below about 1200mm under GL in most areas) permeability can be expected to be low to very low (Soil Category 5 to 6), Phosphate Retention Capacities are moderate to high. Zone of disposal is anticipated at about 600mm below NGL. (Refer to AS/NZS1547:2012 Table 5.1 for Soil Categories and permeability). See Appendix E for Phosphate Retention Capacity laboratory results.
9) Low health risk, low environmental risk. The Design Loading Rate (DLR) for this area and soil profile is 30mm/day. (Refer to ASNZS1547:2012 Table L1), this is for a standard settling tanks and leach drain system. Design Irrigation Rate (DIR) is 4mm/day LPED and 5mm/day drip (refer to AS/NZS1547-2012 Table M1).
10) Design of effluent disposal system is to be in accordance with this report and the requirements of the Local Health Authority and Department of Health WA. Improvement of nutrient uptake is recommended by planting of the effluent disposal area with nutrient absorbing plants (such as Kikuyu grass).

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SOIL PROFILES and TEST RESULTS

TEST HOLE 1 (Soil Category in brackets)

0 to 200 – Dark brown silty/sandy topsoil, grass covered (1).
200 to 900 – Grey/light brown fine sand (1).

Phosphorous Retention Index – 8.4 (Sample from 600)

TEST HOLE 2 (Soil Category in brackets)

0 to 150 – Dark brown silty/sandy topsoil, grass covered (1).
150 to 450 – Light brown fine sand, small roots (1).
450 to 1200 – Light brown/orange clayey sand (2).

Phosphorous Retention Index – 83 (Sample from 600)

TEST HOLE 3 (Soil Category in brackets)

0 to 200 – Grey/brown sandy topsoil, grass covered (1).
200 to 1000 – Grey sand (1).

Phosphorous Retention Index – 2.7 (Sample from 600)

TEST HOLE 4 (Soil Category in brackets)

0 to 150 – Grey/brown sandy topsoil, grass covered (1).
150 to 1000 – Grey/brown sand (1).

Phosphorous Retention Index – 4.1 (Sample from 600)

TEST HOLE 5 (Soil Category in brackets)

0 to 150 – Dark brown silty topsoil, grass covered (1).
150 to 800 – Brown/yellow silty sand (1 to 2).

Phosphorous Retention Index – 480 (Sample from 600)

TEST HOLE 6 (Soil Category in brackets)

0 to 150 – Dark brown sandy topsoil, grass covered (1).
150 to 600 – Orange/brown gravelly/clayey/sand (2).
600 to 700 – Silty organic sludge (burnt roots/stumps).
700 to 1500 – Orange/grey/red gravelly (laterite) clay (4).

Phosphorous Retention Index – >500 (Sample from 600)

TEST HOLE 7 (Soil Category in brackets)

0 to 150 – Dark brown sandy topsoil, grass covered (1).
150 to 300 – Orange/brown gravelly sand (1).
300 to 1300 – Orange/brown gravelly/silty sand (laterite) (2).

Phosphorous Retention Index – 270 (Sample from 600)

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SOIL PROFILES and TEST RESULTS (Cont.)

TEST HOLE 8 (Soil Category in brackets)

0 to 120 – Dark brown/grey loamy topsoil, grass covered (1).
120 to 400 – Grey silty sand, moderately permeable (2).
400 to 900 – Grey sandy clay/clayey sand, low to moderate permeability (4).
900 to 1200 – Grey with minor orange flecks clay with minor grit, low permeability (5).

TEST HOLE 9 (Soil Category in brackets)

0 to 150 – Grey sandy topsoil, grass covered (1).
150 to 1000 – Yellow/orange sand with minor silt, firm, permeable (2).

Phosphorous Retention Index – 28 (Sample from 600)

TEST HOLE 10 (Soil Category in brackets)

0 to 200 – Dark brown sandy topsoil, grass covered (1).
200 to 1000 – Orange/brown sand, permeable (1).
1000 to 1700 – Orange/brown clayey sand, moderate permeability (3).

Phosphorous Retention Index – 5.7 (Sample from 600)

Signed:..... Date: 6/5/2016

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APPENDIX E

LABORATORY TEST RESULTS – EFFLUENT CAPACITY

(PHOSPHOROUS RETENTION INDICIES)

VINTESSENTIAL LABORATORIES

www.vintessential.com.au
ABN: 60 068 057 045

VIC (Site A)
32 Brasser Ave
Dromana VIC, 3936
T: 03 5987 2242
E: lab-vic@vintessential.com.au

WA (Site B)
15a Wrigglesworth Drive
Cowaramup WA, 6284
T: 08 9755 3622
E: lab-wa@vintessential.com.au

QLD (Site C)
22 Caves Road
Stanthorpe QLD, 4380
T: 07 4681 1522
E: lab-qld@vintessential.com.au

NSW (Site D)
Leeds Parade (CSU)
Orange NSW, 2800
T: 02 6361 3141
E: lab-nsw@vintessential.com.au

LABORATORY REPORT NUMBER: B1605059

Civil/Structural Consulting
PO Box 852
Margaret River WA 6285
Phone 08 97572488

Purchase Order
Sample(s) Received 13/05/2016
Report Type Final
Issue Preferences x2 tim.csc@bigpond.com; cc_fritch78@hotmail.com

Sample Number	Sample Details	Test	Result	Unit
B1605059/01	TH1	Phosphorous Retention Index (S06#)	8.4	
B1605059/02	TH2	Phosphorous Retention Index (S06#)	83	
B1605059/03	TH3	Phosphorous Retention Index (S06#)	2.7	
B1605059/04	TH4	Phosphorous Retention Index (S06#)	4.1	
B1605059/05	TH5	Phosphorous Retention Index (S06#)	480	
B1605059/06	TH6	Phosphorous Retention Index (S06#)	>500	
B1605059/07	TH7	Phosphorous Retention Index (S06#)	270	

Phoebe Norman
Approved Signatory
Vintessential Laboratories

Date Report Issued
18/05/2016

The above results relate only to the samples as received.

***Indicates determination by NATA accredited method.**

 # NATA accreditation does not cover the performance of this method.

NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025
Accreditation No. 11587
Site No. 11580 (VIC) 14527 (WA)

LABORATORY REPORT	NUMBER:	B1605059

Civil/Structural Consulting
PO Box 852
Margaret River WA 6285
Phone 08 97572488

Purchase Order
Sample(s) Received 13/05/2016
Report Type Final
Issue Preferences x2 tim.csc@bigpond.com; cc_fritch78@hotmail.com

Sample Number	Sample Details
B1605059/09	TH9

Test	Result	Unit
Phosphorous Retention Index (S06#)	28	

Sample Number	Sample Details
B1605059/10	TH10

Test	Result	Unit
Phosphorous Retention Index (S06#)	5.7	

Phoebe Norman
Approved Signatory
Vintessential Laboratories

Date Report Issued
18/05/2016

The above results relate only to the samples as received.

***Indicates determination by NATA accredited method.**

 # NATA accreditation does not cover the performance of this method.

Accredited for compliance with ISO/IEC 17025
Accreditation No. 11587
Site No. 11580 (VIC) 14527 (WA)

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APPENDIX F

ACID SULPHATE SOILS MAP

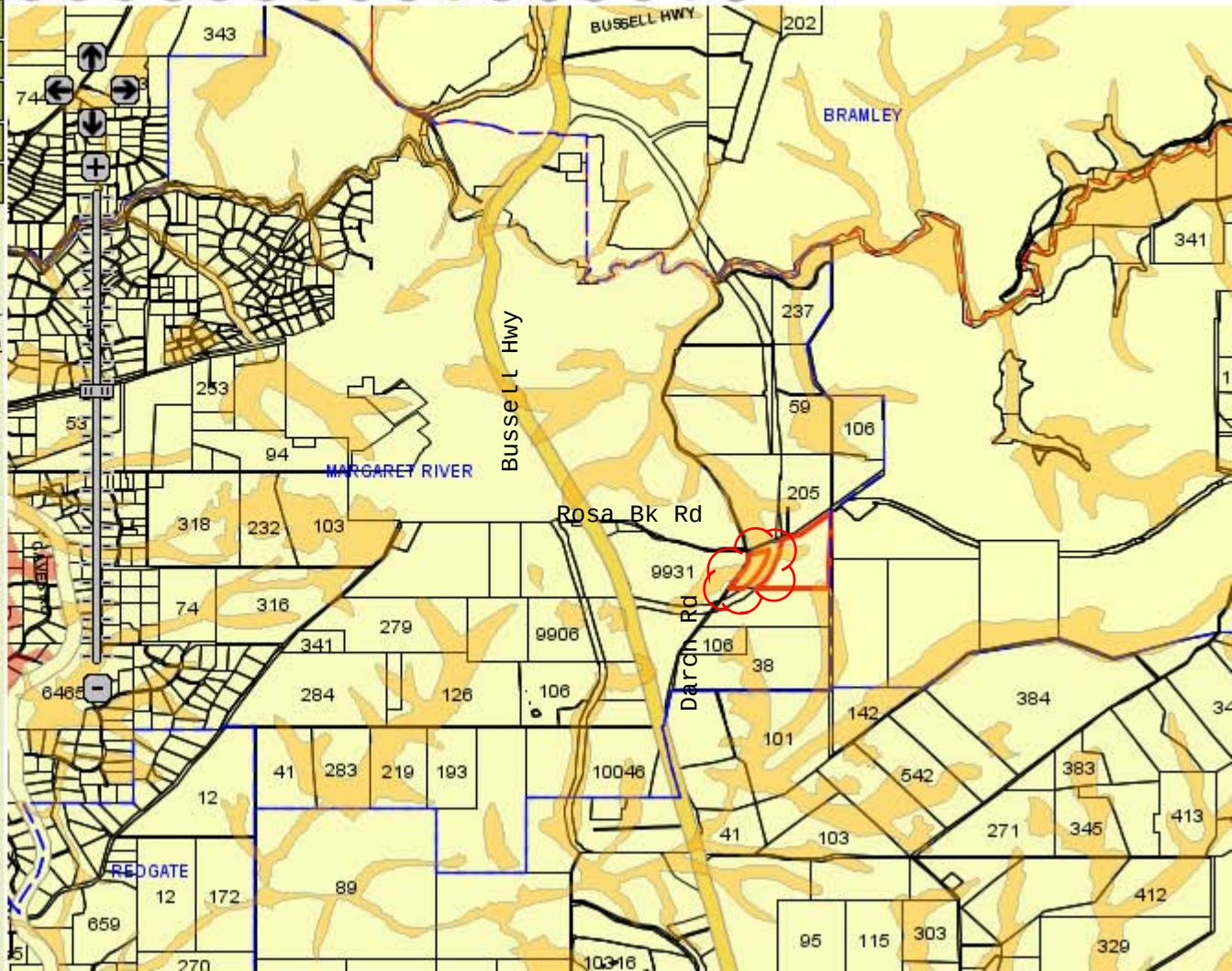
Home
Search
Layer Selector
Add Layers
Information

WMS Get Feature Information Tool
1 WMS feature(s) found in 1 layer(s)

Layers: DER-010

DER-010 Back to top

Attributes	Values
Box	
coordinates	114.988638,-34.244156 115.356088,-33.749996
createdate	2006-02-01
capture	Derived
risk_categ	Moderate to low risk
natcode	2g (p4)
riskclass	2



Civil/Structural Consulting Pty Ltd

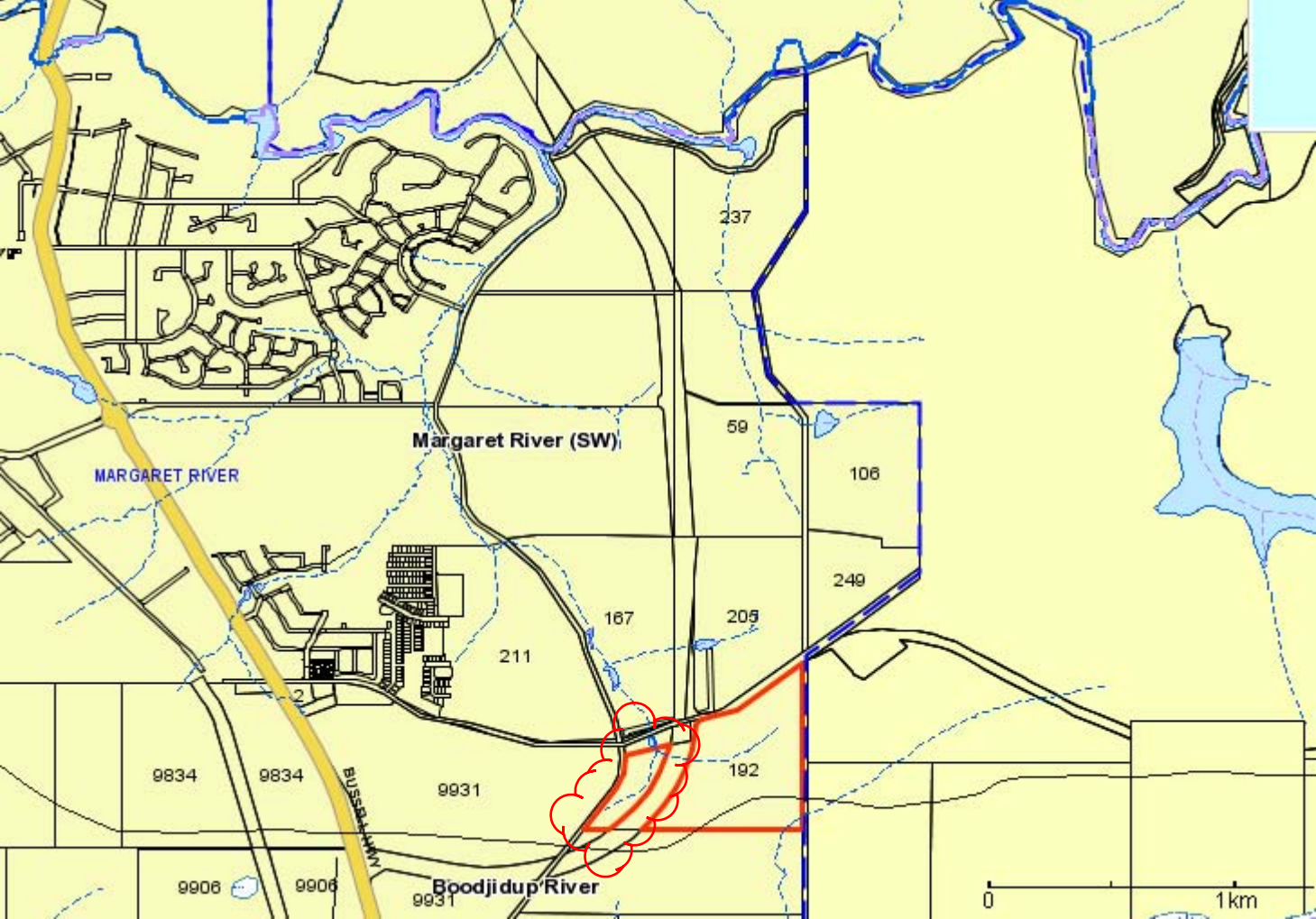
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APPENDIX G

WATER CATCHMENTS MAP


237
59
106
249
Margaret River (SW)
MARGARET RIVER
167
205
211
192
9834
9834
9931
BUSSELTON HWY
9906
9906
9931
Boodjidup River
0
1 km

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APPENDIX H

CSIRO INFORMATION SHEET –

GUIDE TO HOMEOWNERS ON FOUNDATION MAINTENANCE AND FOOTING PERFORMANCE

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

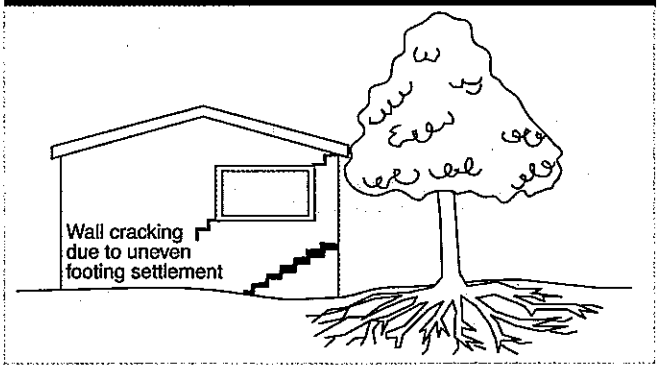
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

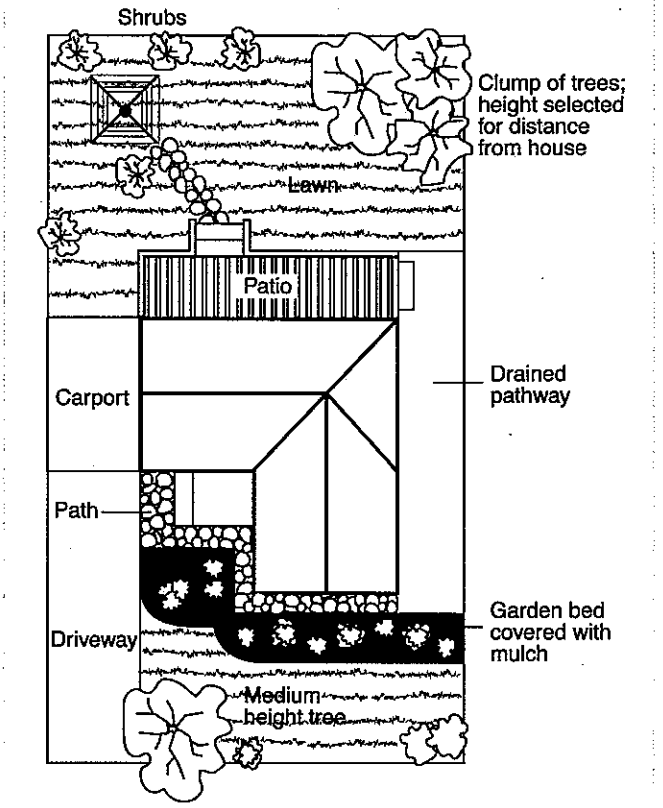
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

The information in this and other issues in the series was derived from various sources and was believed to be correct when published.

The information is advisory. It is provided in good faith and not claimed to be an exhaustive treatment of the relevant subject.

Further professional advice needs to be obtained before taking any action based on the information provided.

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8. Appendix C – Dial Before You Dig & DIP

Your Ref: KZLJ7H
Our Ref: SS011738
Enquiries: Robert Peacock
Telephone: 9411 7623

Western Power
Locked Bag 2520
PERTH,WA 6001
Electricity Networks Corporation
ABN 18 540 492 861

05 February 2020

Wood & Grieve Engineers
now part of Stantec
PO Box 634 ,
ALBANY WA 6330

Attention: Mr Matthew Hawkins

Dear Matthew,

LOTS 4 & 5 DARCH ROAD, MARGARET RIVER

WESTERN POWER REF: SS011738, WAPC No: TBA

In response to your request on 20 December 2019, please find enclosed information, enabling you to proceed with an Underground Distribution Scheme (UDS) design for the above subdivision development.

The information is valid for six months from the date on this letter and is also subject to the conditions approved by the Western Australian Planning Commission (WAPC) for this development. Any changes to the details you provided in the initial application may impact the requirements for your development, and a new project application may be necessary. If you wish to alter any of the details, you must send us your request in writing prior to submission for DCR.

The design information contains:

- Network Fault Levels
- Details of the HV system requirements, including cable sizes, entry and exit points, and position for connection to the existing HV system
- Details of the surrounding LV system for interconnection

Design requirements

Your design for this development must be based on this information and conform to Western Power's generic design requirements. These are set out in the *Underground Distribution Schemes* Manual (UDS) and *Western Australian Distribution Connections Manual* (WADCM).
The Underground Distribution Schemes Manual, Western Australian Distribution Connections Manual and various other guidelines and manuals are available from:

http://www.westernpower.com.au/ldd/guidelinesmanuals.html

Please ensure the designer forwards a draft copy of the UDS design to the developer for approval before submitting it to Western Power. This will avoid unnecessary costs and delays.

Important information to be included in your design submission for DCR

Details of what you will need to submit with your design are listed it Section 4.4.4 of the *Underground Distribution Schemes Manual*. An electronic submission of your design for conformance review is to be provided.

We would like to draw your attention to the following important points:

- Our reference number for this development is SS011738. Please ensure this number is quoted in all future correspondence with Western Power, and is clearly marked on your design drawing.

- Please also include in your subdivision design drawings the Latitude and Longitude information.

- Where there are interface works, such as cable joints or cable pole terminations, and/or other work to be carried out by Western Power, your design should indicate these works via blue notations but have no compatible units assigned to it.

- All multi stage developments must include a concept plan marked up to show the number and approximate locations of the required transformers, their capacity, and associated switchgear, and the HV circuitry throughout the development

- Please ensure your design submission includes a Bill of Materials, an LV Volt Drop Assessment Report, and if applicable, a Voltage Fluctuation Assessment Report.

- Civil consultants drawings detailing site levels, retaining wall and battered slope designs shall be submitted for DCR. A signed certificate of verification is required by a professional Civil Engineer registered on the National Professional Engineers Register (NER) verifying that the substation retaining walls are structural sound and/or battered slopes are suitable for their purpose.

- Where HV power lines, cables and earths are to be installed in proximity of metallic pipeline, the Designer must assess EPR and LFI on the pipeline in accordance with relevant Australian Standards and provide the assessment report and the pipeline owner's approval to WP.

- If Western Power supplied decorative streetlighting is included in the design, you will need to include a letter of acceptance from the local government authority.

- If non Western Power supplied (private) streetlighting is included in the design, you will need to include a letter from the local government authority, accepting that it will own, operate and maintain the streetlight system and pay the applicable tariff.

- Please ensure your design submission is accompanied by certification from the Engineer, appointed by the Developer, confirming that the UDS design meets all of Western Power's requirements.

What happens next

When we receive your design submission, we will carry out DCR to make sure that all design parameters are incorporated into the design process and all the required document and certificates are included. Western Power may or may not carry out conformance audit on your UDS design, however, Western Power reserves the right to carry out the conformance audit.

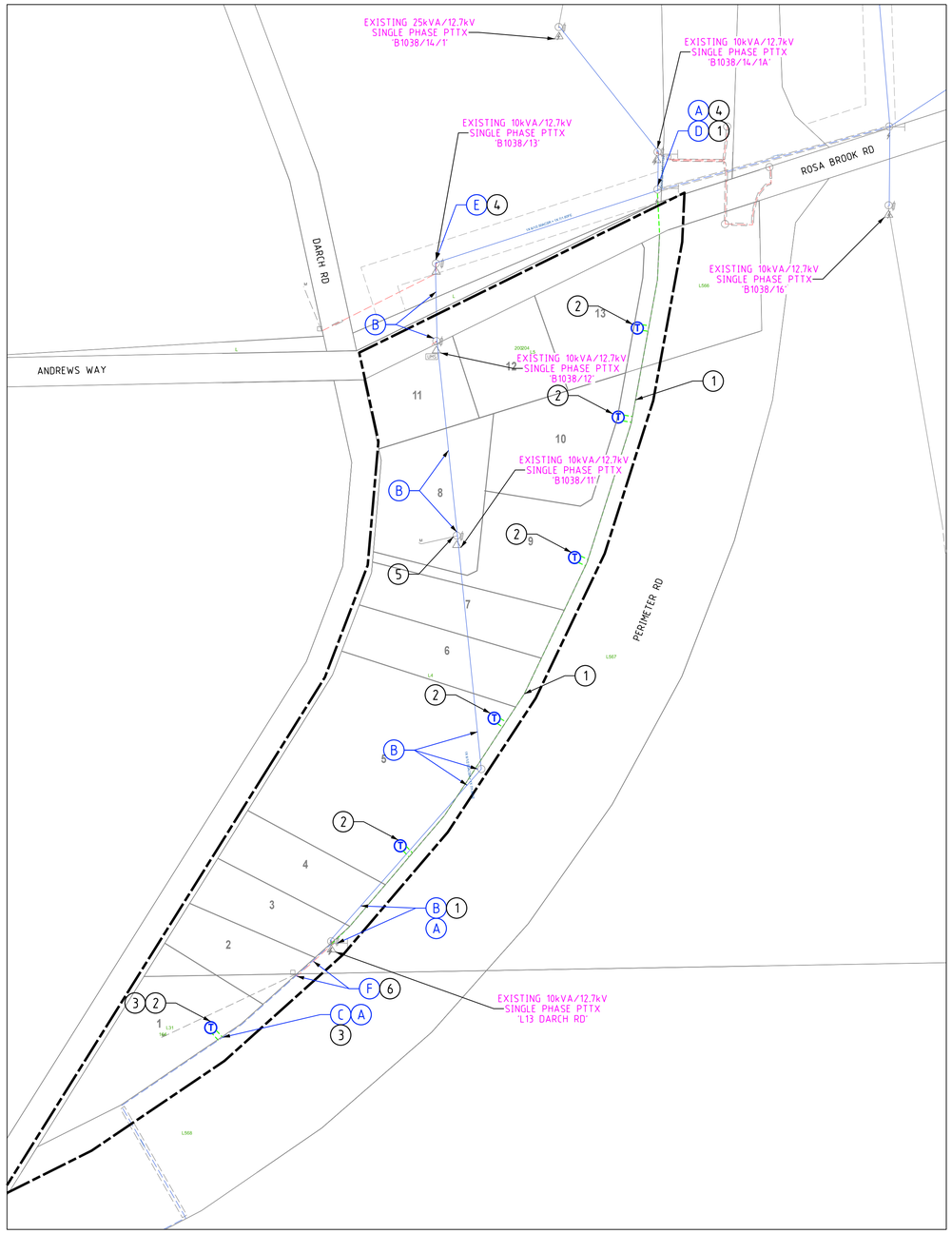
When the design submission for DCR has been accepted, we will issue a quote to the Developer, which will include DIP and conformance review fees. If the UDS design is rejected subsequent to a conformance audit we will provide reasons so it can be revised, however a re-conformance fee may be applied.

We look forward to receiving your UDS design. In the meantime, if you have any queries please phone your project manager on the above number, quoting our reference number for this development.

Yours sincerely,

Connections Manager
Customer Assist

SAFETY - MAKE IT YOUR PRIMARY VALUE



ALL WORKS ON EXISTING WESTERN POWER ASSETS ARE TO BE UNDERTAKEN BY WESTERN POWER

ALL WORKS IN THE VICINITY (WIV) OF EXISTING WESTERN POWER ASSETS ARE TO BE UNDERTAKEN IN ACCORDANCE WITH OCCUPATIONAL SAFETY AND HEALTH (OSH) AND WORKSAFE REQUIREMENTS AS PER WORKING NEAR ELECTRICITY SECTION OF THE WESTERN POWER WEBSITE.



IF WORKING IN THE VICINITY OF EXISTING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES.

REFER TO "WORKSAFE" REGULATION 3.64



THE LOCATION OF EXISTING SERVICES IS APPROXIMATE ONLY. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN. ALWAYS REFER TO CURRENT DBYD DRAWINGS. CONFIRM ASSET LOCATIONS ON SITE BEFORE COMMENCEMENT OF WORK.

REFER TO 'WORKSAFE' REGULATION 3.21

SCOPE OF WORK:

1. EXTEND 35HV SINGLE PHASE CABLE TO RETICULATE THROUGH SUBDIVISION BETWEEN EXISTING POLES S8200793 AND S802330.
2. INSTALL NEW 25kVA SINGLE PHASE TRANSFORMERS TO SERVICE FUTURE DEVELOPMENT. NOTE: LOCATION AND QUANTITY OF SUBSTATIONS ON DRAWING IS INDICATIVE ONLY.
3. CUT IN AND OUT OF EXISTING 35HV CABLE TO SERVICE NEW TRANSFORMER(S).
4. OBTAIN 3rd PARTY APPROVAL FOR RECONFIGURATION OF OVERHEAD ASSETS WITHIN PRIVATE PROPERTY.
5. REMOVE EXISTING OH CUST SERVICE POLES WITHIN LOTS.
6. DISCONNECT UNDERGROUNG CONSUMER MAINS IN CONJUNCTION WITH WP

WESTERN POWER SCOPE OF WORK:

- (A) CABLE JOINTS AND TERMINATIONS TO EXISTING WESTERN POWER ASSETS.
- (B) REMOVE EXISTING OH ASSETS: POLES, CONDUCTORS AND TRANSFORMERS. DISCONNECT & REMOVE EXISTING CUSTOMER OH SERVICE WIRE IN CONJUNCTION WITH DEVELOPERS ELECTRICAL CONTRACTOR.
- (C) CUT IN AND OUT OF EXISTING 35HV CABLE TO SERVICE NEW TRANSFORMER(S).
- (D) TERMINATE 35HV CABLE TO POLE S8200793. REPLACE/UPGRADE POLE AS REQUIRED.
- (E) RECONFIGURE STAYS AT POLE S1219461. REPLACE POLE IF REQUIRED.
- (F) DISCONNECT EXISTING UG CONSUMER MAINS. REMOVE EXISTING MINI PILLAR, CAP & ABANDON LV CABLE.

DESIGN NOTES:

A) DESIGN MUST COMPLY WITH THE ELECTRICITY (SUPPLY STANDARDS AND SYSTEM SAFETY) REGULATIONS 2001, WESTERN POWERS REQUIREMENTS. THE UNDERGROUND DISTRIBUTION SCHEMES (UDS) MANUAL, ANY OTHER RELEVANT STANDARDS AND INFORMATION GIVEN IN THIS DIP.

B) THE LOCATION OF TRANSFORMERS AND SWITCHGEAR ARE TO BE DETERMINED BY THE DESIGNER TO MAXIMISE EFFICIENCY AND RELIABILITY OF THE NETWORK.

C) EXISTING AERIAL SERVICES TO SUBDIVISION LOTS TO BE CONVERTED TO UNDERGROUND.

D) USE AN ADMD AS PER WESTERN POWER WEBSITE.

E) THE WORKING VOLTAGE OF THE NETWORK AT THIS SUBDIVISION IS 12.7kV SINGLE PHASE

F) IT IS RECOMMENDED THAT THE CONSULTANT UNDERTAKES A SITE SURVEY TO VERIFY THE LOCATION OF WP ASSETS AS SHOWN ON THE DRAWING.

LEGEND

SCHEME BDY.
RETAINING WALL
RESTRICTED ZONE
EASEMENT

HV CABLES

- CN53 - 400mm2 (3X1c)
- CN49 - 240mm2 (3X1c)
- CN48 - 185mm2 (3X1c)
- CN50 - 95mm2 (3X1c)
- CN51 - 50mm2 (3X1c)
- CN51 - 50mm2 (1c)
- CN46 - 35mm2 (3X1c)
- CN47 - 35mm2 (1c)
- EXISTING HV CABLES (SIZE AND TYPE INDICATED)

LV-SL CABLES

- CN45 - 240mm2 (1x3c)
- CN44 - 185mm2 (1x3c)
- CN43 - 120mm2 (1x3c)
- CN42 - 25mm2 (1x3c)
- CN41 - 16mm2 SL (1c)
- 40 C PILOT
- EXISTING LV CABLES (SIZE AND TYPE INDICATED)

STREET LIGHTS

42W CFL, 80W MV, 125W MV, 70W HPS, 150W HPS, 250W HPS, 250W HPS AERODROME

EXISTING

70W MH, 150W MH, 250W MH, 1L LED, 2L LED, 3L LED, 4L LED, 5L LED, 6L LED

LEGEND DEFINES TYPE & WATTAGE - NOT COLOUR

PILLARS / PITS / ETC

- MINI (WORKING END)
- UNIVERSAL
- MINI
- LINK
- CABLE MARKER U/G
- UMS PIT
- UTILITIES PIT
- BGSP PIT
- 100/200AMP CUTOUT
- CONDUIT/POLY PIPE
- SDL Serviced Uncleared De-energised Lot

TRANSFORMER (T) EXISTING SWITCHGEAR (S)

AERIAL CONDUCTORS AND POLES

- NEW POLE (ANY TYPE AS INDICATED)
- EXISTING POLE (ANY TYPE AS INDICATED)
- HV LV EXISTING AERIAL CONDUCTORS (SIZE AND TYPE INDICATED)

OH EQUIPMENT

- INTERMEDIATE
- DOF
- INLINE STRAIN
- PTT
- AERIAL STAY
- RECLOSER
- LOAD BREAK SWITCH
- CAPACITOR
- PTS
- HV ISOLATOR (150k)
- LV DISCONNECTOR
- ISOL TX
- OUTRIGGER STAY
- GROUND STAY
- SECTIONALISER
- LV ABC KRONE
- STREETLIGHT BOX (SLB)

FAULT LEVELS & PROTECTION CLEARING TIME

ITEM	DESCRIPTION
NEAREST UPSTREAM NETWORK NODE	N8186798
PROSPECTIVE FAULT LEVEL @ ABOVE NODE (1PH-EARTH)	CURRENT (AMPS): 2017.8 R (PU): 4.4673 X (PU): 5.0722
UPSTREAM PROTECTION DEVICE & TYPE	RELAY B1039/2
FAULT CLEARING TIME (S)	0.1 Second
CURRENT PICKUP (AMPS)	20
TIME MULTIPLIER SETTING (TMS)	0.2
TIME CURRENT CURVE (TCC)	V1
METALLIC FENCE ASSESSMENT EXEMPTION AS PER UDS MANUAL 6.2.8.25	-

LD CONSULTANT CONTACT DETAILS

COMPANY NAME: WOOD & GRIEVE ENG
REFERENCE NUMBER:
CONTACT: MATTHEW HAWKINS TEL: 9842 3700

Rev.	REVISIONS	DRN	CHKD	DESIGN	ENG	DATE
0	ISSUED TO CONSULTANT	R.P.	B.L.	R.P.	R.P.	01/20

DESIGN INFORMATION PACKAGE

LOT 3-4 ROSABROOK ROAD & LOT 5 DARCH ROAD

MARGARET RIVER, WA

LOT DETAILS
RESIDENTIAL LOTS: 13
GROUP HOUSING:
COMMERCIAL:
PUMPS:
OTHER:

westernpower

DESIGNER: ROBERT PEACOCK
TEL: 08 9411 7623
DATE: 01/20 SCALE: 1:2000 @ A1
GEO REF: Lat. - 33°58'37" S Long. - 115°06'00" E
W.A.P.C. REFERENCE No. N/A

DRAWING NUMBER
SS011738
SHEET 01 OF 01
REV: 0 ORIGINAL SIZE - A1

STREET LIGHTING

POLE TYPE	WATTAGE	SHT1/TOTAL
SL12 12.5m STEEL STANDARD	2x250W HPS	0/2
SL11 12.5m STEEL STANDARD	250W HPS	56/91
1.8 INSTALL SL 1.8m BEHIND FRONT OF KERB OR AS INDICATED ON DRAWING		

ROAD LIGHTING COMPLIES TO AS/NZS1158 LATEST ISSUE
ROAD LIGHTING STD'S UNLESS OTHERWISE INDICATED

CABLE		CONDUIT SIZE
400mm2	HV	150mm
240mm2	HV	150mm
185mm2	HV	150mm
95mm2	HV	150mm
50mm2	HV	150mm
35mm2 3c	HV	100mm
240mm2	LV	100mm
185mm2	LV	100mm
120mm2	LV	100mm
35mm2 1c	HV	50mm
25mm2	LV	50mm
16mm2	SL	50mm

STREET LIGHTS: 42w CFL; 125w MV; 70w HPS; 150w HPS; 250w HPS; EXISTING: 70/75w MH; 150w MH; 250w MH

PILLARS: UNIVERSAL; MINI; LIVE END SEAL; L LINK; UMS PIT; 100AMP CUTOUT; 200AMP CUTOUT

CCT DENOTES CIRCUIT FROM TRANSFORMER

TRANSFORMERS (T) SWITCHGEAR (S)

SCHEME BOUNDARY; PROPOSED WALLS; EXISTING WALLS; FUTURE WALLS

ARROW DENOTES DIRECTION TO PEG WITH WHICH DUCTS ARE TO BE ALIGNED

REFER TO LATEST UDS MANUAL & WADCM

DENOTES EXISTING DUCTS

POLE LOCATION GPS CO-ORDINATES (MRCG94)

POLE#	EASTING	NORTHING	POLE #	EASTING	NORTHING
P1	42036.152	194051.002	P29	42286.318	193739.709
P2	42050.919	194055.245	P30	42237.050	193711.403
P3	42049.861	194002.749	P31	42233.541	193735.504
P4	42066.893	194007.808	P32	42194.844	193697.957
P5	42062.489	193955.416	P33	42172.145	193705.549
P6	42085.471	193963.274	P34	42180.720	193726.618
P7	42074.959	193913.015	P35	42095.616	193733.154
P8	42102.011	193921.288	P36	42128.688	193736.555
P9	42085.367	193868.060	P37	42121.190	193716.559
P10	42119.360	193877.294	P38	42092.890	193690.068
P11	42092.090	193824.178	P39	42105.156	193670.823
P12	42116.502	193827.235	P40	42170.939	193661.294
P13	42140.704	193836.360	P41	42092.602	193640.504
P14	42095.665	193776.427	P42	42138.661	193641.944
P15	42120.070	193777.632	P43	42121.249	193617.304
P16	42165.345	193806.902	P44	42139.277	193608.453
P17	42196.230	193782.220	P45	42097.715	193597.609
P18	42232.520	193763.834	P46	42114.790	193564.566
P19	42278.503	193752.444	P47	42083.243	193551.334
P20	42335.727	193746.763	P48	42090.432	193520.927
P21	42385.888	193739.860	P49	42057.091	193504.467
P22	42437.569	193730.012	P50	42087.197	193480.583
P23	42486.241	193717.386	P51	42036.198	193467.049
P24	42481.150	193698.358	P52	42055.605	193458.539
P25	42432.811	193710.069	P53	42015.100	193422.273
P26	42383.110	193717.340	P54	42031.057	193414.824
P27	42335.532	193719.739	P55	42004.831	193370.807
P28	42287.799	193717.959	P56	41975.762	193326.484

POLE LOCATION GPS CO-ORDINATES (MGA94)

POLE #	EASTING	NORTHING	POLE #	EASTING	NORTHING
P1	322,584.167	6,243,918.188	P29	322,839.850	6,243,611.419
P2	322,598.856	6,243,922.694	P30	322,791.096	6,243,582.238
P3	322,598.736	6,243,870.188	P31	322,787.157	6,243,606.272
P4	322,615.674	6,243,875.550	P32	322,749.138	6,243,568.040
P5	322,612.207	6,243,823.089	P33	322,726.308	624,3575.226
P6	322,635.045	6,243,831.356	P34	322,734.505	6,243,596.444
P7	322,625.432	6,243,780.918	P35	322,649.299	6,243,601.458
P8	322,652.332	6,243,789.673	P36	322,682.304	6,243,605.450
P9	322,636.642	6,243,736.157	P37	322,675.165	624,3585.323
P10	322,670.464	6,243,745.997	P38	322,647.343	6,243,558.331
P11	322,644.148	6,243,692.403	P39	322,659.951	6,243,539.309
P12	322,668.501	6,243,695.896	P40	322,725.892	6,243,530.957
P13	322,692.535	6,243,705.452	P41	322,647.941	6,243,508.771
P14	322,648.575	6,243,644.725	P42	322,693.966	624,3511.033
P15	322,672.954	6,243,646.365	P43	322,676.997	6,243,486.087
P16	322,717.698	6,243,676.439	P44	322,695.180	6,243,477.560
P17	322,749.019	6,243,652.313	P45	322,653.819	6,243,465.975
P18	322,785.631	6,243,634.579	P46	322,671.482	6,243,433.243
P19	322,831.809	6,243,624.012	P47	322,640.177	6,243,419.450
P20	322,889.124	6,243,619.355	P48	322,647.908	6,243,389.177
P21	322,939.399	6,243,613.349	P49	322,614.867	6,243,372.124
P22	322,991.247	6,243,604.426	P50	322,645.394	6,243,348.782
P23	323,040.136	6,243,592.672	P51	322,594.646	6,243,334.339
P24	323,035.386	6,243,573.556	P52	322,614.201	6,243,326.177
P25	322,986.846	6,243,584.402	P53	322,574.352	6,243,289.194
P26	322,937.024	6,243,590.783	P54	322,590.439	6,243,282.032
P27	322,889.412	6,243,592.332	P55	322,565.004	6,243,237.554
P28	322,841.719	6,243,589.700	P56	322,536.732	6,243,192.719

POLE LOCATION CO ORDINATES APPROXIMATE ONLY .FINAL LOCATION TO BE CONFIRMED ON SITE PRIOR TO ERECTING OF SL POLES

SL POLE POSITION DESIGN
TO AS/NZS1158 CATEGORY V3
BY SAGE CONSULTING ENGINEERS
Pty.Ltd
REF NUMBER 2573

© SAGE CONSULTING ENGINEERS Pty. Ltd.
203 RAILWAY ROAD
SUBIACO W.A. 6008
TEL: (08) 9388 9745
FAX: (08) 9388 9256
Email: msage@iinet.net.au
A.C.N. 082 955 217

INSTALL SL CABLE IN 50mm CONDUIT 1.5m BEHIND BACK OF SHOULDER

INSTALL STREETLIGHT 1.5m BEHIND BACK OF KERB

INSTALL STREETLIGHT 1.5m BEHIND W-BEAM. INSTALL SL CABLE IN 50mm DUCT1.5m BEHIND W- BEAM

INSTALL STREETLIGHT 1.5m BEHIND W-BEAM. INSTALL SL CABLE IN 50mm DUCT 1.5m BEHIND W- BEAM

NORTH CCT

SOUTH CCT

EAST CCT

WEST CCT

BUSSELL HIGHWAY

MARGARET RIVER PERIMETER RD

CABLE CONTRACTOR TO NOTE: CONDUIT TO PASS BELOW 750mm FROM BASE OF DRAIN CROSSING

TOTAL 7kW OF STREETLIGHT NEW POLE PTT 25kVA 1 PHASE

WP TO REFER NOTE A + B CONTRACTOR REFER NOTE 6

WP TO REFER NOTE A + E CONTRACTOR REFER NOTE 6

W BEAM

INSTALL SL CABLE IN 50mmCONDUIT 1.8m BEHIND FRONT OF KERB

INSTALL DUCT 1.1m DEEP TO ALLOW FOR FUTURE ROAD WIDENING

ENLARGEMENT
NOT TO SCALE

STREETLIGHT CABLE INSTALLED ON 1.5m ALIGNMENT IN 50mm CONDUIT FROM FACE OF KERB FROM X-Y

WP REFER NOTE C

NOTE 8

RED PHASE

WHITE PHASE

BLUE PHASE

NOTE:
R - DENOTES RED PHASE
W - DENOTES WHITE PHASE
B - DENOTES BLUE PHASE

CONTRACTOR REFER NOTE 12 REFER DETAIL A INSTALL PILLAR 1m FROM BASE OF POLE ON SOUTH WESTERN SIDE

INSTALL SL CABLE IN 50mmCONDUIT 1.8m BEHIND FRONT OF KERB

INSTALL SL CABLE IN 50mm CONDUIT 1.8m BEHIND FRONT OF KERB

CABLE CONTRACTOR TO NOTE: CONDUIT TO PASS BELOW 750mm FROM BASE OF DRAIN CROSSING

WP REFER NOTE D

35HV EXIST

240LV

LU2

LU13

16SL

EXIST TX 22-63

CABLE CONTRACTOR TO INSTALL 2X20A FUSES IN PILLAR ON OUTGOING SL CABLES INSTALL PILLAR 1m FROM BASE OF POLE ON SOUTH WESTERN SIDE

WP TO REFER NOTE A
CONTRACTOR REFER NOTE 6 + 9

HAND TRENCH CAUTION EXISTING LIVE HV CABLES
CONTRACTOR REFER NOTE 9

WP TO REFER NOTE F FOR EXISTING 35HV CABLE
CONTRACTOR REFER NOTE 11

INSTALL SL CABLE IN 50mm CONDUIT 1.8m BEHIND FRONT OF KERB

INSTALL SL CABLE IN 50mm DUCT 1.8m BEHIND W- BEAM

INSTALL STREETLIGHT 1.5m BEHIND W-BEAM.

INSTALL SL CABLE IN 50mm DUCT 1.5m BEHIND W- BEAM

INSTALL STREETLIGHT 1.5m BEHIND BACK OF SHOULDER

JOINS A-A' SHEET 2

LOCATION MAP
NOT TO SCALE

SHEET 1
SHEET 2
SHEET 3
SHEET 4
PROPOSED ROSA BROOK ROAD

NOTES: DRAWING & CONSTRUCTION OF THIS PROJECT TO BE READ & BUILT IN CONJUNCTION WITH WESTERN POWER'S LATEST UDS MANUAL & WA DISTRIBUTION CONNECTION MANUAL
UPD TEXT FILES ARE TO BE USED AS A GUIDE ONLY ORDERING OF MATERIALS ARE THE RESPONSIBILITY OF THE CONTRACTOR FOR THE SUCCESSFUL COMPLETION OF THE PROJECT

1. CABLE PROTECTOR SLABBING IS REQUIRED WHERE THE CABLES LEAVE THE STANDARD WP ALIGNMENT
a.) TERMINATE AT STREETLIGHT POLE
b.) ENTER ROAD CROSSING CONDUIT
c.) TERMINATE AT CABLE POLE

2. STREET LIGHTS TO BE INSTALLED CLEAR OF FOOTPATHS AND PRAM RAMPS.LGA TO SURVEY & PEG POLE POSITION FOR CABLE CONTRACTOR. FINAL POSITIONS TO BE DETERMINED ON SITE SUBJECT TO WP APPROVAL

3. NOTE TO CABLE CONTRACTOR .POWER DRAWING TO BE READ IN CONJUNCTION WITH ALL CIVIL DRAWINGS TO DETERMINE SITE GROUND LEVELS AS SITE IS NOT FLAT.PART OF THE ROAD IS IN A DEEP CUT, THEREFORE ALL CABLES IN 0-500mm ALIGNMENT WILL NEED TO BE INSTALLLED IN CONDUITS

4. IF ACID SOILS OR ROCKS ARE PRESENT, CLEAN NEUTRAL BACK FILL IS TO BE USED AROUND THE CABLES.

5. NO OTHER UTILITY SERVICES SHALL PASS THROUGH OR BE LOCATED WITHIN THE SERVICE PILLAR EXCLUSION ZONE AS DEFINED IN AS/NZS 3000:2007 TABLE 3.7 REFER UDS MANUAL SECTION 5.3.5.2 ALL PILLARS TO BE INSTALLED 0.3m ABOVE 100 YEAR FLOOD LEVEL

6. CABLE CONTRACTOR TO CAP & BURY/COIL HV/LV/SL CABLES & LEAVE SUFFICIENT CABLE FOR WP TO JOINT/TERMINATE TO EXIST WP ASSET

7. CABLE CONTRACTOR TO ARRANGE WITH UPD ONLY TO COMPLETE AS CONSTRUCTED DWG FOR ELECTRONIC SUBMISSION TO WP. THIS DRAWING REMAINS THE PROPERTY OF UPD P/L NO UNAUTHORISED REVISIONS PERMITTED

8. STREET LIGHT CABLES IN MEDIAN STRIP TO BE INSTALLED IN 50mm CONDUIT AND WHERE CABLES ARE NOT INSTALLED ON 0-500mm ALIGNMENT

9. CABLE CONTRACTOR TO ENGAGE SUITABLY QUALIFIED ELECTRICAL PERSON DURING CONSTRUCTION WHEN INSTALLING NEW CABLES/ EQUIPMENT IN THE VICINITY OF EXISTING LIVE WP ASSETS IN ACCORDANCE WITH WORKSAFE POLICY

10. CIVIL CONTRACTOR TO ALLOW IN TENDER FEE FOR UPD TO ATTEND SITE TO CARRY OUT INSPECTION OF POLE SET OUT AS A PROVISIONAL ITEM .CIVIL CONTRACTOR TO CONTACT UPD FOR POLE INSPECTION PEGGING PRIOR TO ERECTION OF ANY SL POLE

11. CABLE CONTRACTOR TO SLAB EXISTING 35HV CABLE . COST OF INSTALLATION AND SUPPLY OF SLAB WILL BE REFUNDED IN THE WP QUOTE .WP WILL ALSO REFUND 50% OF COST OF TRENCHING BETWEEN A" AND B'

AS CONSTRUCTED

TRANSFORMER NAME AND LOCATION	CCT NO.	FUSE AMPS	CABLE mm²	CIRCUIT NAME	VOLT DROP	AMPS	TOTAL AMPS @ 4.7kVA/LOT
NEW 25kVA PTT 50A	1	63	16	NORTH	8.4	16	45
	2	63	16	EAST	10.4	14	
	3	63	16	SOUTH	6.95	14	

TRANSFORMER NAME AND LOCATION	CCT NO.	FUSE AMPS	CABLE mm²	CIRCUIT NAME	VOLT DROP	AMPS	TOTAL AMPS @ 4.7kVA/LOT
EXIST 63kVA GROUND MOUNT 87A	1	63	240	PERIMETER ROAD	9.74	16	78.8 INCLUDING EXIST CUSTOMER
	2	63	25	BUSSELL HIGHWAY PILLAR	10.25	19	

POLE LOCATION CO ORDINATES APPROXIMATE ONLY .FINAL LOCATION TO BE CONFIRMED ON SITE PRIOR TO ERECTING OF SL POLES

20m 0 20 40 60 80 100m
ALL DISTANCES ARE IN METRES
SCALE 1 : 1000

THIS DRAWING IS THE PROPERTY OF UPD PTY LTD. UNAUTHORISED USE OR COPYING OF THIS DRAWING IS PROHIBITED

DIAL1100 BEFORE YOU DIG

WARNING
BEWARE OF UNDERGROUND SERVICES
The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.

WARNING
IF WORKING IN THE VICINITY OF EXISTING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES CONTRACTOR TO COMPLY WITH "WORKSAFE" CLEARANCES DURING CONSTRUCTION

WP SCOPE OF WORKS

A). WP TO CARRY OUT CABLE TERMINATION INCLUDING EXCAVATION & REINSTATEMENT & SUPPLY ALL MATERIALS

B). WP TO COST TO INSTALL NEW 25kVA PTT ON EXIST POLE AND TERMINATE 25 LV CABLE INTO NEW PTT

C) WP TO NOTE EXISTING STAY WIRE + ANCHOR COVERED UNDER SEPARATE MP APPLICATION BY MRWA FOR THEIR REMOVAL

D). WP TO NOTE EXIST 35HV LOWERING COVERED UNDER SEPARATE MP APPLICATION BY MRWA

E). WP TO SUPPLY AND INSTALL MINIPILLAR FOR SL CONNECTION & TERMINATION AND TERMINATE THE 25mm + 16mm CABLES INTO THE MINIPILLAR

F). WP TO REFUND SLABBING OF EXISTING 35HV CABLE TO CABLE CONTRACTOR AND 50% COST OF TRENCHING FROM A' TO B'

REV	DESCRIPTION	DATE	DRAWN	CHKD	SENT WP	DCR. WP
14	AS CONSTRUCTED - CABLEFORCE	24-1-19	RM	BG	24-1-19	
13	SL POLE #53 NOW ON W CIRCUIT	31-10-18	RM	SS		
12	ISSUED FOR CONSTRUCTION	12-9-17	SBE	BE		
11	FURTHER CHANGES FROM WESTERN POWER SHEETS 2 & 3	6-9-17	RF	BE	6-9-17	12-9-17
10	CHANGES TO STREETLIGHT FEED FROM PILLARS SHEET 3	4-8-17	RF	BE	4-8-17	
REV	DIP RECEIVED 6-2-17 DESCRIPTION	DATE	DRAWN	CHKD	SENT WP	DCR. WP

MARGARET RIVER PERIMETER ROAD - SHEET 1
STREET LIGHTING

STREETLIGHTING
UNDERGROUND POWER DISTRIBUTION

DESIGNER RF | DRAWN RF | NPER ENGINEER KS | SCALE 1 : 1000 | Western Power Reference No SL010067 | WAPC No

UPD
Underground Power Development Pty. Ltd.
Suite 4, 47 Havelock Street
WEST PERTH WA 6005
ABN 53 094 593 067
TEL: (08) 9212 8777 EMAIL: team@upd.com.au

Drawing No SHEET 1 UPD8513 | Revision 14

SHEET 1 MRWA DRAWING NUMBER 201602-0661

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POLE LOCATION GPS CO-ORDINATES (MRCG94)

POLE #	EASTING	NORTHING
P1	42826.114	193425.178
P2	42863.343	193418.303
P3	42857.693	193374.536

POLE LOCATION GPS CO-ORDINATES (MGA94)

POLE #	EASTING	NORTHING
P1	323,385.168	6,243,306.589
P2	323,422.513	6,243,300.380
P3	323,417.646	6,243,256.520

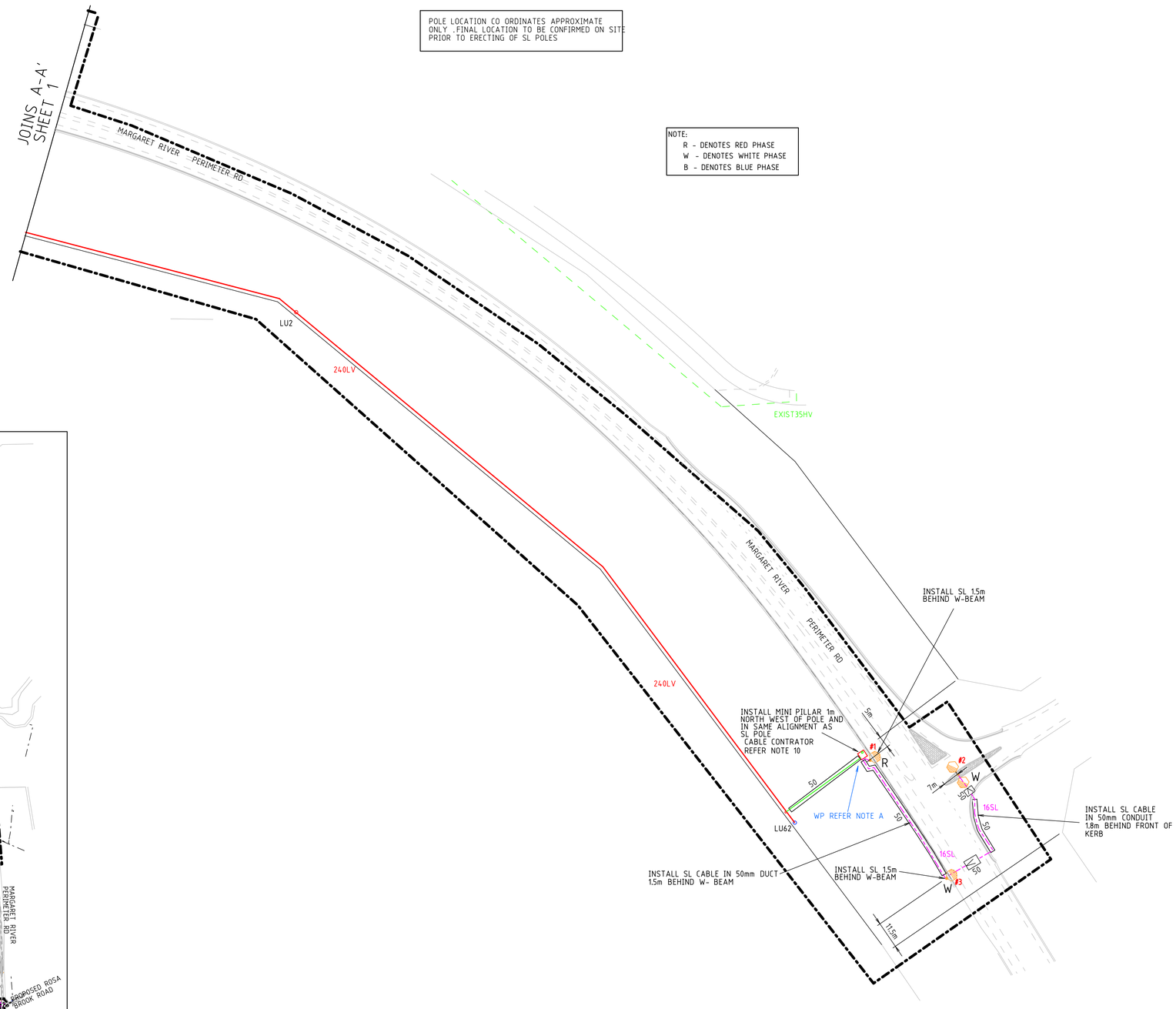
SL POLE POSITION DESIGN
TO AS/NZS1158 CATEGORY V3
BY SAGE CONSULTING ENGINEERS
Pty.Ltd
REF NUMBER 2573

© SAGE CONSULTING ENGINEERS Pty. Ltd.
203 RAILWAY ROAD
SUBIACO W.A. 6008
TEL: (08) 9388 9745
FAX: (08) 9388 9256
Email: msage@iinet.net.au
A.C.N. 082 955 217

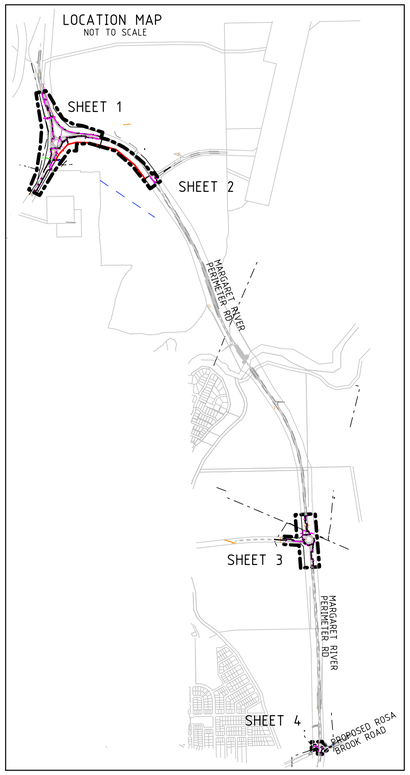
POLE LOCATION CO ORDINATES APPROXIMATE ONLY .FINAL LOCATION TO BE CONFIRMED ON SITE PRIOR TO ERECTING OF SL POLES

STREET LIGHTING

POLE TYPE	WATTAGE	SHT2/TOTAL
SL12 12.5m STEEL STANDARD	2x250W HPS	1/2
SL11 12.5m STEEL STANDARD	250W HPS	2/91
1.8 INSTALL SL 1.8m BEHIND FRONT OF KERB OR AS INDICATED ON DRAWING		
ROAD LIGHTING COMPLIES TO AS/NZS1158 LATEST ISSUE ROAD LIGHTING STD'S UNLESS OTHERWISE INDICATED		



NOTE:
R - DENOTES RED PHASE
W - DENOTES WHITE PHASE
B - DENOTES BLUE PHASE



CABLE		CONDUIT SIZE
400mm2	HV	150mm
240mm2	HV	150mm
185mm2	HV	150mm
95mm2	HV	150mm
50mm2	HV	150mm
35mm2 3c	HV	100mm
240mm2	LV	100mm
185mm2	LV	100mm
120mm2	LV	100mm
35mm2 1c	HV	50mm
25mm2	LV	50mm
16mm2	SL	50mm

STREET LIGHTS: 42W CFL; 125W MV; 70W HPS; 150W HPS; 250W HPS; EXISTING 70/75W MH; 150W MH; 250W MH

PILLARS: UNIVERSAL; MINI; LINK; LIVE END SEAL; UMS PIT; 100AMP CUTOUT; 200AMP CUTOUT

CCT DENOTES CIRCUIT FROM TRANSFORMER

TRANSFORMERS (T) SWITCHGEAR (S)

SCHEME BOUNDARY; PROPOSED WALLS; EXISTING WALLS; FUTURE WALLS

ARROW DENOTES DIRECTION TO PEG WITH WHICH DUCTS ARE TO BE ALIGNED

REFER TO LATEST UDS MANUAL & WADCM

DENOTES EXISTING DUCTS

NOTES: DRAWING & CONSTRUCTION OF THIS PROJECT TO BE READ & BUILT IN CONJUNCTION WITH WESTERN POWER'S LATEST UDS MANUAL & WA DISTRIBUTION CONNECTION MANUAL
UPD TEXT FILES ARE TO BE USED AS A GUIDE ONLY ORDERING OF MATERIALS ARE THE RESPONSIBILITY OF THE CONTRACTOR FOR THE SUCCESSFUL COMPLETION OF THE PROJECT

1. CABLE PROTECTOR SLABBING IS REQUIRED WHERE THE CABLES LEAVE THE STANDARD WP ALIGNMENT
a.) TERMINATE AT STREETLIGHT POLE
b.) ENTER ROAD CROSSING CONDUIT
c.) TERMINATE AT CABLE POLE

2. STREET LIGHTS TO BE INSTALLED CLEAR OF FOOTPATHS AND PRAM RAMPS.LGA TO SURVEY & PEG POLE POSITION FOR CABLE CONTRACTOR. FINAL POSITIONS TO BE DETERMINED ON SITE SUBJECT TO WP APPROVAL

3. NOTE TO CABLE CONTRACTOR .POWER DRAWING TO BE READ IN CONJUNCTION WITH ALL CIVIL DRAWINGS TO DETERMINE SITE GROUND LEVELS AS SITE IS NOT FLAT.PART OF THE ROAD IS IN A DEEP CUT.THEREFORE ALL CABLES IN 0-500mm ALIGNMENT WILL NEED TO BE INSTALLLED IN CONDUITS

4. IF ACID SOILS OR ROCKS ARE PRESENT.CLEAN NEUTRAL BACK FILL IS TO BE USED AROUND THE CABLES.

5. NO OTHER UTILITY SERVICES SHALL PASS THROUGH OR BE LOCATED WITHIN THE SERVICE PILLAR EXCLUSION ZONE AS DEFINED IN AS/NZS 3000:2007 TABLE 3.7 REFER UDS MANUAL SECTION 5.3.5.2 . ALL PILLARS TO BE INSTALLED 0.3m ABOVE 100 YEAR FLOOD LEVEL

6.CABLE CONTRACTOR TO CAP & BURY/COIL HV/LV/SL CABLES & LEAVE SUFFICIENT CABLE FOR WP TO JOINT/TERMINATE TO EXIST WP ASSET

7. CABLE CONTRACTOR TO ARRANGE WITH UPD ONLY TO COMPLETE AS CONSTRUCTED DWG FOR ELECTRONIC SUBMISSION TO WP. THIS DRAWING REMAINS THE PROPERTY OF UPD P/L NO UNAUTHORISED REVISIONS PERMITTED

8. STREET LIGHT CABLES IN MEDIAN STRIP TO BE INSTALLED IN 50mm CONDUIT AND WHERE CABLES ARE NOT INSTALLED ON 0-500mm ALIGNMENT

9. CABLE CONTRACTOR TO ENGAGE SUITABLY QUALIFIED ELECTRICAL PERSON DURING CONSTRUCTION WHEN INSTALLING NEW CABLES/ EQUIPMENT IN THE VICINITY OF EXISTING LIVE WP ASSETS IN ACCORDANCE WITH WORKSAFE POLICY

10.CABLE CONTRACTOR TO INSTALL 20AMP SL FUSE ON EACH OUTGOING 16mm SL CABLE.

11.CIVIL CONTRACTOR TO ALLOW IN TENDER FEE FOR UPD TO ATTEND SITE TO CARRY OUT INSPECTION OF POLE SET OUT AS A PROVISIONAL ITEM .CIVIL CONTRACTOR TO CONTACT UPD FOR POLE INSPECTION PEGGING PRIOR TO ERECTION OF ANY SL POLE

12..CABLE CONTRACTOR TO INSTALL 3x20A SL FUSES ON DIN RAIL IN PILLAR FOR OUTGOING SL CABLES

WP SCOPE OF WORKS

A). WP PERMIT 2 X 20A FUSE IN MINI PILLAR

AS CONSTRUCTED

SHEET 2 MRWA DRAWING NUMBER 201602-0662

GEO REFERENCE 33°58'28.3"S 115°06'06.3"E

REV	DESCRIPTION	DATE	DRAWN	CHKD	SENT WP	DCR. WP
14	AS CONSTRUCTED - CABLEFORCE	24-1-19	RM	BG	24-1-19	
13	SL POLE #53 NOW ON W CIRCUIT	31-10-18	RM	SS		
12	ISSUED FOR CONSTRUCTION	12-9-17	SBE	BE		
11	FURTHER CHANGES FROM WESTERN POWER SHEETS 2 & 3	6-9-17	RF	BE	6-9-17	12-9-17
10	CHANGES TO STREETLIGHT FEED FROM PILLARS SHEET 3	4-8-17	RF	BE	4-8-17	
	DIP RECEIVED 6-2-17					

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SCALE 1:1000
20m 0 20 40 60 80 100m
ALL DISTANCES ARE IN METRES

DIAL1100 BEFORE YOU DIG

WARNING
BEWARE OF UNDERGROUND SERVICES
The location of underground cables are approximate only and their exact position should be checked on site.No guarantee is given that all existing cables and services are shown.Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 321.

WARNING
IF WORKING IN THE VICINITY OF EXISTING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES CONTRACTOR TO COMPLY WITH "WORKSAFE" CLEARANCES DURING CONSTRUCTION

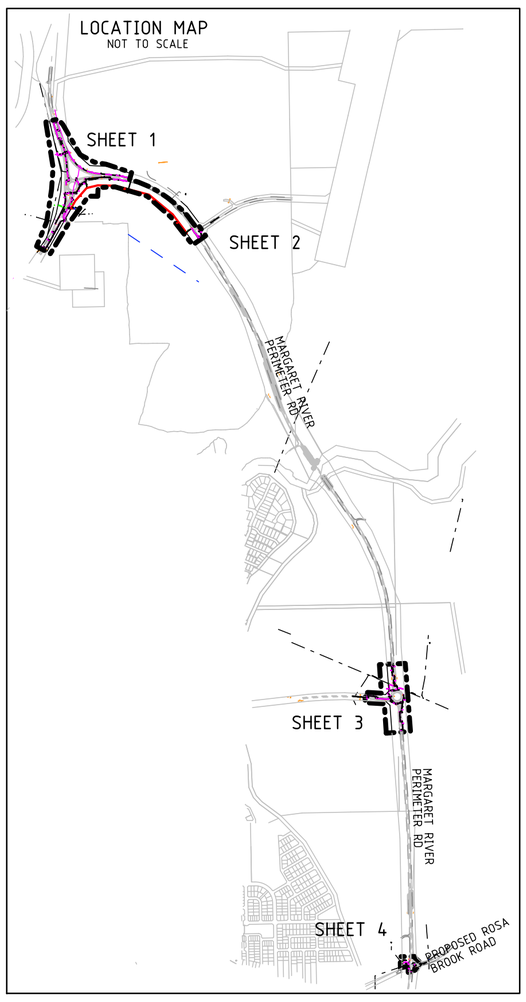
MARGARET RIVER PERIMETER ROAD- SHEET 2 STREET LIGHTING

STREETLIGHTING
UNDERGROUND POWER DISTRIBUTION

DESIGNER	DRAWN	SCALE	Western Power Reference No	Drawing No SHEET 2	Revision
B.ELLETT	RF	1:1000	SL010067	UPD8513	14
	NPER ENGINEER KS		WAPC No		

UPD
Underground Power Development Pty. Ltd.
Suite 4, 47 Havelock Street
WEST PERTH WA 6005
ABN 53 094 593 067
TEL. (08) 9212 8777 EMAIL: team@upd.com.au

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POLE LOCATION GPS CO-ORDINATES (MGA94)

POLE #	EASTING	NORTHING	POLE #	EASTING	NORTHING
P1	324,530.190	6,240,851.080	P17	324,393.634	6,240,595.943
P2	324,545.322	6,240,851.994	P18	324,447.421	6,240,589.410
P3	324,534.064	6,240,800.034	P19	324,499.589	6,240,582.999
P4	324,549.995	6,240,801.493	P20	324,528.743	6,240596.675
P5	324,537.920	6,240,748.574	P21	324,559.536	6,240,566.382
P6	324,557.254	6,240,750.413	P22	324,577.391	6,240,571.275
P7	324,540.933	6,240,696.920	P23	324,595.255	6,240,574.472
P8	324,559.515	6,240,697.183	P24	324,571.220	6,240,518.954
P9	324,536.018	6,240,643.104	P25	324,590.563	6,240,519.210
P10	324553.785	6240645.804	P26	324,574.381	6,240,465.701
P11	324,573.145	6,240,649.915	P27	324,593.702	6,240,467.091
P12	324,601.831	6,240,615.827	P28	324,581.807	6,240,413.893
P13	324,522.628	6,240,613.823	P29	324,597.601	6,240,414.979
P14	324,498.771	6,240,604.145	P30	324,586.182	6,240,364.842
P15	324,449.102	6,240,606.778	P31	324,601.286	6,240,365.758
P16	324,394.814	6,240,610.691			

POLE LOCATION GPS CO-ORDINATES (MRCG94)

POLE #	EASTING	NORTHING	POLE #	EASTING	NORTHING
P1	43927.094	190949.538	P17	43785.995	190696.876
P2	43942.240	190950.181	P18	43839.658	190689.383
P3	43930.055	190898.429	P19	43891.704	190682.040
P4	43946.010	190899.603	P20	43921.098	190695.193
P5	43932.990	190846.907	P21	43951.346	190664.353
P6	43952.355	190848.400	P22	43969.286	190668.926
P7	43935.080	190795.206	P23	43987.205	190671.803
P8	43953.664	190795.137	P24	43962.181	190616.723
P9	43929.203	190741.485	P25	43981.526	190616.633
P10	43947.016	190743.867	P26	43964.389	190563.420
P11	43966.447	190747.632	P27	43983.732	190564.465
P12	43994.520	190713.035	P28	43970.888	190511.486
P13	43915.291	190712.448	P29	43986.699	190512.290
P14	43891.264	190703.198	P30	43974.385	190462.364
P15	43841.649	190706.718	P31	43989.504	190463.009
P16	43787.438	190711.601			

POLE LOCATION CO ORDINATES APPROXIMATE ONLY .FINAL LOCATION TO BE CONFIRMED ON SITE PRIOR TO ERECTING OF SL POLES

STREET LIGHTING

POLE TYPE	WATTAGE	SHT3/TOTAL
SL12 12.5m STEEL STANDARD	2x250W HPS	0/2
SL11 12.5m STEEL STANDARD	250W HPS	31/91
1.8 INSTALL SL 1.8m BEHIND FRONT OF KERB OR AS INDICATED ON DRAWING		
ROAD LIGHTING COMPLIES TO AS/NZS1158 LATEST ISSUE ROAD LIGHTING STD'S UNLESS OTHERWISE INDICATED		

CABLE / CONDUIT SIZE

CABLE		CONDUIT SIZE
400mm2	HV	150mm
240mm2	HV	150mm
185mm2	HV	150mm
95mm2	HV	150mm
50mm2	HV	150mm
35mm2 3c	HV	100mm
240mm2	LV	100mm
185mm2	LV	100mm
120mm2	LV	100mm
35mm2 1c	HV	50mm
25mm2	LV	50mm
16mm2	SL	50mm

STREET LIGHTS (EXISTING): 42w CFL; 125w MV; 70w HPS; 150w HPS; 250w HPS; 70/75w MH; 150w MH; 250w MH

PILLARS: U UNIVERSAL; MINI; LIVE END SEAL; L LINK; UMS PIT; 100AMP CUTOUT; 200AMP CUTOUT

CCT DENOTES CIRCUIT FROM TRANSFORMER

TRANSFORMERS (T) SWITCHGEAR (S)

SCHEME BOUNDARY; PROPOSED WALLS; EXISTING WALLS; FUTURE WALLS

ARROW DENOTES DIRECTION TO PEG WITH WHICH DUCTS ARE TO BE ALIGNED

REFER TO LATEST UDS MANUAL & WADCM

DENOTES EXISTING DUCTS

NOTES: DRAWING & CONSTRUCTION OF THIS PROJECT TO BE READ & BUILT IN CONJUNCTION WITH WESTERN POWER'S LATEST UDS MANUAL & WA DISTRIBUTION CONNECTION MANUAL **UPD TEXT FILES ARE TO BE USED AS A GUIDE ONLY ORDERING OF MATERIALS ARE THE RESPONSIBILITY OF THE CONTRACTOR FOR THE SUCCESSFUL COMPLETION OF THE PROJECT**

1. CABLE PROTECTOR SLABBING IS REQUIRED WHERE THE CABLES LEAVE THE STANDARD WP ALIGNMENT
a.) TERMINATE AT STREETLIGHT POLE
b.) ENTER ROAD CROSSING CONDUIT
c.) TERMINATE AT CABLE POLE

2. STREET LIGHTS TO BE INSTALLED CLEAR OF FOOTPATHS AND PRAM RAMPS.LGA TO SURVEY & PEG POLE POSITION FOR CABLE CONTRACTOR. FINAL POSITIONS TO BE DETERMINED ON SITE SUBJECT TO WP APPROVAL

3. NOTE TO CABLE CONTRACTOR .POWER DRAWING TO BE READ IN CONJUNCTION WITH ALL CIVIL DRAWINGS TO DETERMINE SITE GROUND LEVELS AS SITE IS NOT FLAT.PART OF THE ROAD IS IN A DEEP CUT, THEREFORE ALL CABLES IN 0-500mm ALIGNMENT WILL NEED TO BE INSTALLLED IN CONDUITS

4. IF ACID SOILS OR ROCKS ARE PRESENT, CLEAN NEUTRAL BACK FILL IS TO BE USED AROUND THE CABLES.

5. NO OTHER UTILITY SERVICES SHALL PASS THROUGH OR BE LOCATED WITHIN THE SERVICE PILLAR EXCLUSION ZONE AS DEFINED IN AS/NZS 3000:2007 TABLE 3.7 REFER UDS MANUAL SECTION 5.3.5.2 ALL PILLARS TO BE INSTALLED 0.3m ABOVE 100 YEAR FLOOD LEVEL

6. CABLE CONTRACTOR TO CAP & BURY/COIL HV/LV/SL CABLES & LEAVE SUFFICIENT CABLE FOR WP TO JOINT/TERMINATE TO EXIST WP ASSET

7. CABLE CONTRACTOR TO ARRANGE WITH UPD ONLY TO COMPLETE AS CONSTRUCTED DWG FOR ELECTRONIC SUBMISSION TO WP. THIS DRAWING REMAINS THE PROPERTY OF UPD P/L NO UNAUTHORISED REVISIONS PERMITTED

8. STREET LIGHT CABLES IN MEDIAN STRIP TO BE INSTALLED IN 50mm CONDUIT AND WHERE CABLES ARE NOT INSTALLED ON 0-500mm ALIGNMENT

9. CABLE CONTRACTOR TO ENGAGE SUITABLY QUALIFIED ELECTRICAL PERSON DURING CONSTRUCTION WHEN INSTALLING NEW CABLES/ EQUIPMENT IN THE VICINITY OF EXISTING LIVE WP ASSETS IN ACCORDANCE WITH WORKSAFE POLICY

10. CABLE CONTRACTOR TO INSTALL 20AMP SL FUSE ON EACH OUTGOING 16mm SL CABLE. INSTALL MINIPILLAR 1m FROM BASE OF POLE ON SOUTH SIDE OF POLE

11. CIVIL CONTRACTOR TO ALLOW IN TENDER FEE FOR UPD TO ATTEND SITE TO CARRY OUT INSPECTION OF POLE SET OUT AS A PROVISIONAL ITEM .CIVIL CONTRACTOR TO CONTACT UPD FOR POLE INSPECTION PEGGING PRIOR TO ERECTION OF ANY SL POLE

12. CABLE CONTRACTOR TO INSTALL 3x20A SL FUSES ON DIN RAIL IN PILLAR FOR OUTGOING SL CABLES

WP SCOPE OF WORKS

A). WP TO CARRY OUT CABLE TERMINATION INCLUDING EXCAVATION & REINSTATEMENT & SUPPLY ALL MATERIALS

B). WP TO TERMINATE 25LV CABLE AS PER SPUDS SCHEME 5.1.4 DCSH-R29

SL CABLES PLACED IN 50mm CONDUITS 1.8m BEHIND FRONT OF KERB

POLE #AU1/14

EXIST 22kV 3 PHASE LINE

CABLE CONTRACTOR TO NOTE: CONDUIT TO PASS BELOW 750mm FROM BASE OF DRAIN CROSSING

EXIST POLE #AU1/15

HAND TRENCH CAUTION EXISTING LIVE HV CABLES CONTRACTOR REFER NOTE 7

400HV EXIST

POLE #AU1/16

EXIST 22kV LINE

WP REFER NOTE A + B CONTRACTOR REFER NOTE 6

SL CABLES PLACED IN 3-50mm CONDUIT 1.8m BEHIND FRONT OF KERB

Proposed John Archibald Dr

EXIST 25kVA TX

7.75kW OF SL LIGHT CONNECTED

3-25LV

16SL 2-25LV

INSTALL STREETLIGHT 3m BEHIND WHITE LINE

PILLAR 1 INSTALL MINIPILLAR IN 0-500mm ALIGNMENT

CABLE CONTRACTOR TO NOTE: CONDUIT TO PASS BELOW 750mm FROM BASE OF DRAIN CROSSING

INSTALL MINIPILLAR 1m FROM BASE OF POLE

INSTALL MINI PILLAR 1m NORTH WEST OF POLE AND IN SAME ALIGNMENT AS SL POLE

NOTE 8

PILLAR 2

25LV CABLE PLACED IN 50mm CONDUIT 1.8m BEHIND FRONT OF KERB

PILLAR 3

NOTE : CABLES CROSSING

SL CABLE PLACED IN 50mm CONDUIT 1.8m BEHIND FRONT OF KERB

MARGARET RIVER PERIMETER RD

LU13

AS CONSTRUCTED

SL POLE POSITION DESIGN
TO AS/NZS1158 CATEGORY V3
BY SAGE CONSULTING ENGINEERS
Pty.Ltd
REF NUMBER 2573

© SAGE CONSULTING ENGINEERS Pty. Ltd.
203 RAILWAY ROAD
SUBIACO W.A. 6008
TEL: (08) 9388 9745
FAX: (08) 9388 9256
Email: msage@iinet.net.au
A.C.N. 082 955 217

SHEET 3

MRWA DRAWING NUMBER 201602-0663

WARNING

BEWARE OF UNDERGROUND SERVICES

The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.

DIAL1100 BEFORE YOU DIG

WARNING

IF WORKING IN THE VICINITY OF EXISTING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES CONTRACTOR TO COMPLY WITH "WORKSAFE" CLEARANCES DURING CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	CHKD	SENT WP	DCR. WP
14	AS CONSTRUCTED - CABLEFORCE	24-1-19	RM	BG	24-1-19	
13	SL POLE #53 NOW ON W CIRCUIT	31-10-18	RM	SS		
12	ISSUED FOR CONSTRUCTION	12-9-17	SBE	BE		
11	FURTHER CHANGES FROM WESTERN POWER SHEETS 2 & 3	6-9-17	RF	BE	6-9-17	12-9-17
10	CHANGES TO STREETLIGHT FEED FROM PILLARS SHEET 3	4-8-17	RF	BE	4-8-17	

GEO REFERENCE 33°58'28.3"S 115°06'06.3"E

20m 0 20 40 60 80 100m

ALL DISTANCES ARE IN METRES

SCALE 1:1000

THIS DRAWING IS THE PROPERTY OF UPD PTY LTD. UNAUTHORISED USE OR COPYING OF THIS DRAWING IS PROHIBITED

MARGARET RIVER PERIMETER ROAD - SHEET 3 STREET LIGHTING

STREETLIGHTING
UNDERGROUND POWER DISTRIBUTION

DESIGNER	DRAWN	SCALE	Western Power Reference No	Drawing No SHEET 3	Revision
RF	RF	1:1000	SL010067	UPD8513	14
	NPER ENGINEER KS		WAPC No		

UPD Underground Power Development Pty. Ltd.
Suite 4, 47 Havelock Street
WEST PERTH WA 6005
ABN 53 094 593 067
TEL: (08) 9212 8777 EMAIL: team@upd.com.au

A1 ...\proj8500\8513\UPD8513.DGN 24/01/2019 2:14:49 PM

POLE LOCATION GPS CO-ORDINATES (MRCG94)

POLE #	EASTING	NORTHING
P1	44004.485	189192.712
P2	44032.082	189159.891
P3	44001.495	189122.063

POLE LOCATION GPS CO-ORDINATES (MGA94)

POLE #	EASTING	NORTHING
P1	324,638.979	6,239,095.966
P2	324,667.158	6,239,063.644
P3	324,637.254	6,239,025.276

POLE LOCATION CO ORDINATES APPROXIMATE ONLY .FINAL LOCATION TO BE CONFIRMED ON SITE PRIOR TO ERECTING OF SL POLES

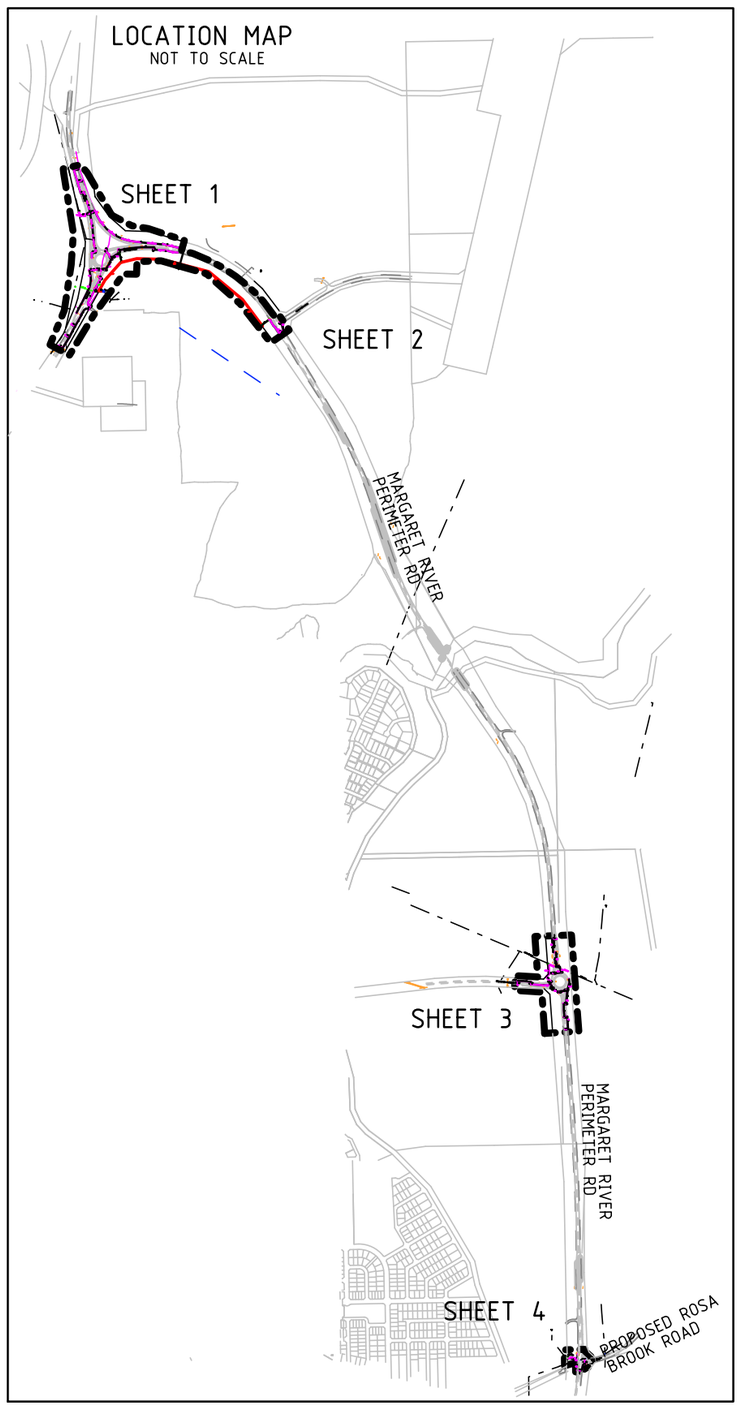
STREET LIGHTING

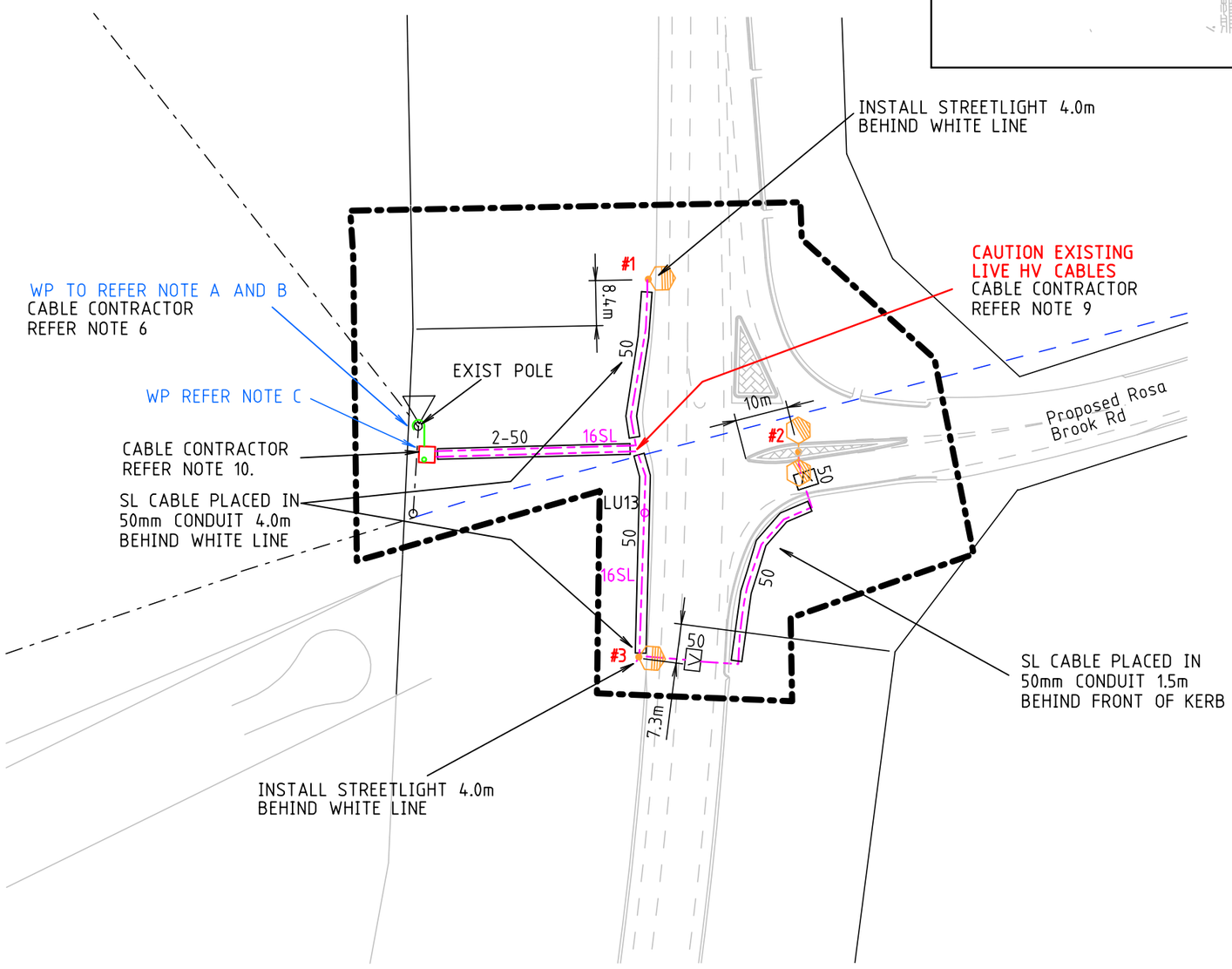
POLE TYPE	WATTAGE	SHT4/TOTAL
SL12 12.5m STEEL STANDARD	2x250W HPS	1/2
SL11 12.5m STEEL STANDARD	250W HPS	2/91
1.8 INSTALL SL 1.8m BEHIND FRONT OF KERB OR AS INDICATED ON DRAWING		
ROAD LIGHTING COMPLIES TO AS/NZS1158 LATEST ISSUE ROAD LIGHTING STD'S UNLESS OTHERWISE INDICATED		

SL POLE POSITION DESIGN
TO AS/NZS1158 CATEGORY V3
BY SAGE CONSULTING ENGINEERS
Pty.Ltd
REF NUMBER 2573

© SAGE CONSULTING ENGINEERS Pty. Ltd.
203 RAILWAY ROAD
SUBIACO W.A. 6008
TEL: (08) 9388 9745
FAX: (08) 9388 9256
Email: msage@iinet.net.au
A.C.N. 082 955 217

LOCATION MAP
NOT TO SCALE





CABLE		CONDUIT SIZE
400mm2	HV	150mm
240mm2	HV	150mm
185mm2	HV	150mm
95mm2	HV	150mm
50mm2	HV	150mm
35mm2 3c	HV	100mm
240mm2	LV	100mm
185mm2	LV	100mm
120mm2	LV	100mm
35mm2 1c	HV	50mm
25mm2	LV	50mm
16mm2	SL	50mm

STREET LIGHTS — EXISTING
42w CFL
125w MV
70w HPS
150w HPS
250w HPS
70/75w MH
150w MH
250w MH

PILLARS
U UNIVERSAL
MINI
LIVE END SEAL
L LINK
UMS PIT
100AMP CUTOUT
200AMP CUTOUT

CCT DENOTES CIRCUIT FROM TRANSFORMER

TRANSFORMERS (T)
SWITCHGEAR (S)

SCHEME BOUNDARY
PROPOSED WALLS
EXISTING WALLS
FUTURE WALLS

ARROW DENOTES DIRECTION TO PEG WITH WHICH DUCTS ARE TO BE ALIGNED

REFER TO LATEST UDS MANUAL & WADCM

DENOTES EXISTING DUCTS

NOTES: DRAWING & CONSTRUCTION OF THIS PROJECT TO BE READ & BUILT IN CONJUNCTION WITH WESTERN POWER'S LATEST UDS MANUAL & WA DISTRIBUTION CONNECTION MANUAL
UPD TEXT FILES ARE TO BE USED AS A GUIDE ONLY ORDERING OF MATERIALS ARE THE RESPONSIBILITY OF THE CONTRACTOR FOR THE SUCCESSFUL COMPLETION OF THE PROJECT

1. CABLE PROTECTOR SLABBING IS REQUIRED WHERE THE CABLES LEAVE THE STANDARD WP ALIGNMENT
a.) TERMINATE AT STREETLIGHT POLE
b.) ENTER ROAD CROSSING CONDUIT
c.) TERMINATE AT CABLE POLE

2. STREET LIGHTS TO BE INSTALLED CLEAR OF FOOTPATHS AND PRAM RAMPS.LGA TO SURVEY & PEG POLE POSITION FOR CABLE CONTRACTOR. FINAL POSITIONS TO BE DETERMINED ON SITE SUBJECT TO WP APPROVAL

3. NOTE TO CABLE CONTRACTOR .POWER DRAWING TO BE READ IN CONJUNCTION WITH ALL CIVIL DRAWINGS TO DETERMINE SITE GROUND LEVELS AS SITE IS NOT FLAT.PART OF THE ROAD IS IN A DEEP CUT, THEREFORE ALL CABLES IN 0-500mm ALIGNMENT WILL NEED TO BE INSTALLLED IN CONDUITS

4. IF ACID SOILS OR ROCKS ARE PRESENT, CLEAN NEUTRAL BACK FILL IS TO BE USED AROUND THE CABLES.

5. NO OTHER UTILITY SERVICES SHALL PASS THROUGH OR BE LOCATED WITHIN THE SERVICE PILLAR EXCLUSION ZONE AS DEFINED IN AS/NZS 3000:2007 TABLE 3.7 REFER UDS MANUAL SECTION 5.3.5.2 ALL PILLARS TO BE INSTALLED 0.3m ABOVE 100 YEAR FLOOD LEVEL

6. CABLE CONTRACTOR TO CAP & BURY/COIL HV/LV/SL CABLES & LEAVE SUFFICIENT CABLE FOR WP TO JOINT/TERMINATE TO EXIST WP ASSET

7. CABLE CONTRACTOR TO ARRANGE WITH UPD ONLY TO COMPLETE AS CONSTRUCTED DWG FOR ELECTRONIC SUBMISSION TO WP. THIS DRAWING REMAINS THE PROPERTY OF UPD P/L NO UNAUTHORISED REVISIONS PERMITTED

8. STREET LIGHT CABLES IN MEDIAN STRIP TO BE INSTALLED IN 50mm CONDUIT AND WHERE CABLES ARE NOT INSTALLED ON 0-500mm ALIGNMENT

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10. CABLE CONTRACTOR TO INSTALL 20AMP SL FUSE ON EACH OUTGOING 16mm SL CABLE. INSTALL MINIPILLAR 1m ON SOUTH SIDE OF POLE

11. CIVIL CONTRACTOR TO ALLOW IN TENDER FEE FOR UPD TO ATTEND SITE TO CARRY OUT INSPECTION OF POLE SET OUT AS A PROVISIONAL ITEM .CIVIL CONTRACTOR TO CONTACT UPD FOR POLE INSPECTION PEGGING PRIOR TO ERECTION OF ANY SL POLE

12. CABLE CONTRACTOR TO INSTALL 3x20A SL FUSES ON DIN RAIL IN PILLAR FOR OUTGOING SL CABLES

WP SCOPE OF WORKS

A). WP TO CARRY OUT CABLE TERMINATION INCLUDING EXCAVATION & REINSTATEMENT & SUPPLY ALL MATERIALS

B). WP TO COST TO INSTALL NEW 10kVA PTT AND TERMINATE 25 LV CABLE INTO NEW PTT.

C) WP PERMIT 2 X 20A FUSE IN MINI PILLAR

AS CONSTRUCTED

SHEET 4 MRWA DRAWING NUMBER 201602-0664

20m 0 20m 40m 60m 80m 100m
ALL DISTANCES ARE IN METRES

SCALE 1:1000

GEO REFERENCE 33°58'28.3"S 115°06'06.3"E

DIAL1100 BEFORE YOU DIG

WARNING

BEWARE OF UNDERGROUND SERVICES

The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.

WARNING
IF WORKING IN THE VICINITY OF EXISTING OVERHEAD DISTRIBUTION OR TRANSMISSION LINES CONTRACTOR TO COMPLY WITH "WORKSAFE" CLEARANCES DURING CONSTRUCTION

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REV	DESCRIPTION	DATE	DRAWN	CHKD	SENT WP	DCR. WP
14	AS CONSTRUCTED - CABLEFORCE	24-1-19	RM	BG	24-1-19	
13	SL POLE #53 NOW ON W CIRCUIT	31-10-18	RM	SS		
12	ISSUED FOR CONSTRUCTION	12-9-17	SBE	BE		
11	FURTHER CHANGES FROM WESTERN POWER SHEETS 2 & 3	6-9-17	RF	BE	6-9-17	12-9-17
10	CHANGES TO STREETLIGHT FEED FROM PILLARS SHEET 3	4-8-17	RF	BE	4-8-17	

MARGARET RIVER PERIMETER ROAD - SHEET 4
STREET LIGHTING

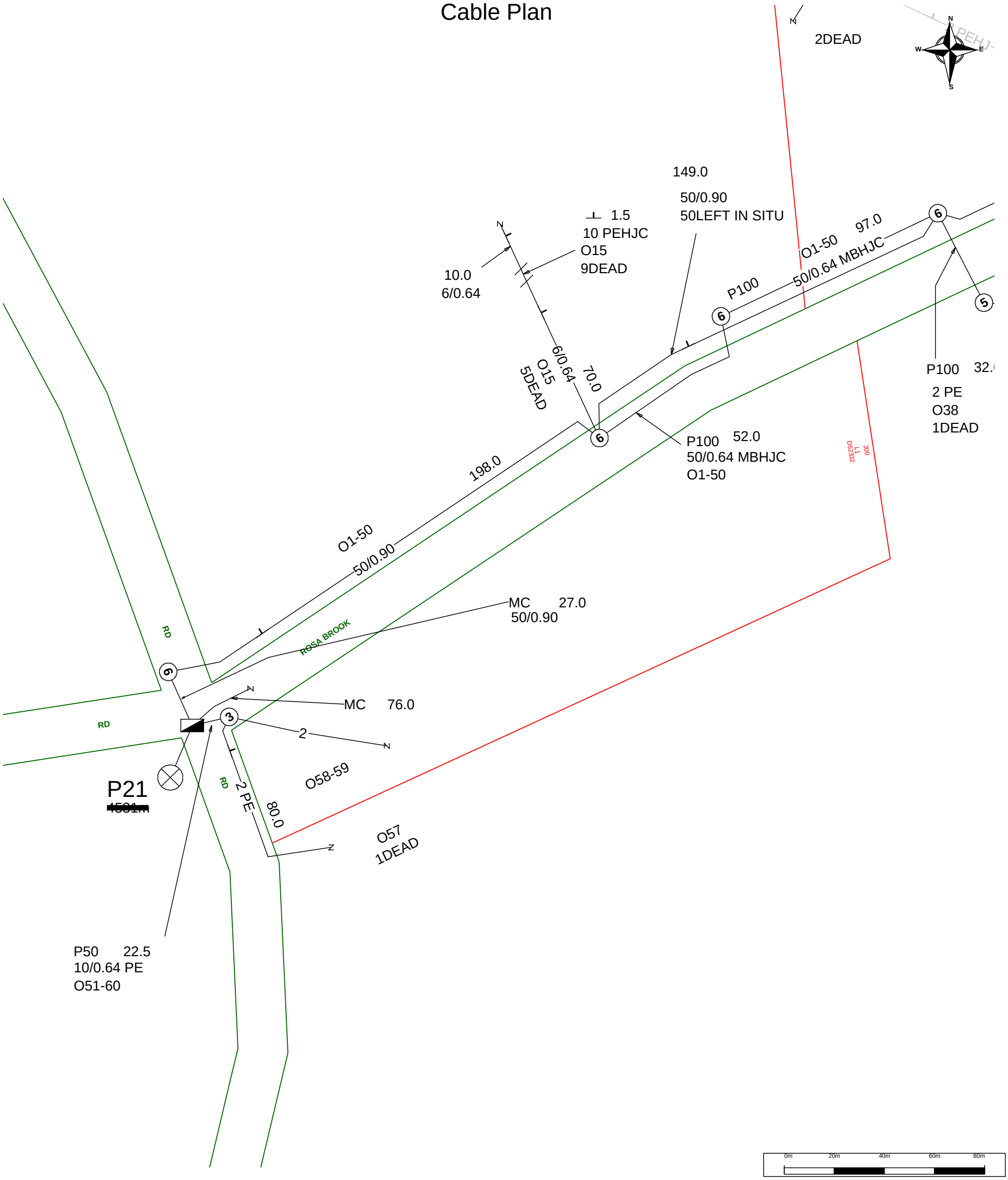
STREETLIGHTING
UNDERGROUND POWER DISTRIBUTION

DESIGNER B.ELLETT
DRAWN RF
NPER ENGINEER KS
SCALE 1:1000
Western Power Reference No SL010067
WAPC No
Drawing No SHEET 4 UPD8513
Rev 14

UPD Underground Power Development Pty. Ltd.
Suite 4, 47 Havelock Street
WEST PERTH WA 6005
ABN 53 094 593 067
TEL: (08) 9212 8777 EMAIL: team@upd.com.au

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Cable Plan



Telstra

For all Telstra DBYD plan enquiries -
email - Telstra.Plans@team.telstra.com
For urgent onsite contact only - ph 1800 653 935 (bus hrs)

TELSTRA CORPORATION LIMITED A.C.N. 051 775 556

Generated On 03/12/2019 12:00:25

Sequence Number: 92784859

CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.

The above plan must be viewed in conjunction with the Mains Cable Plan on the following page

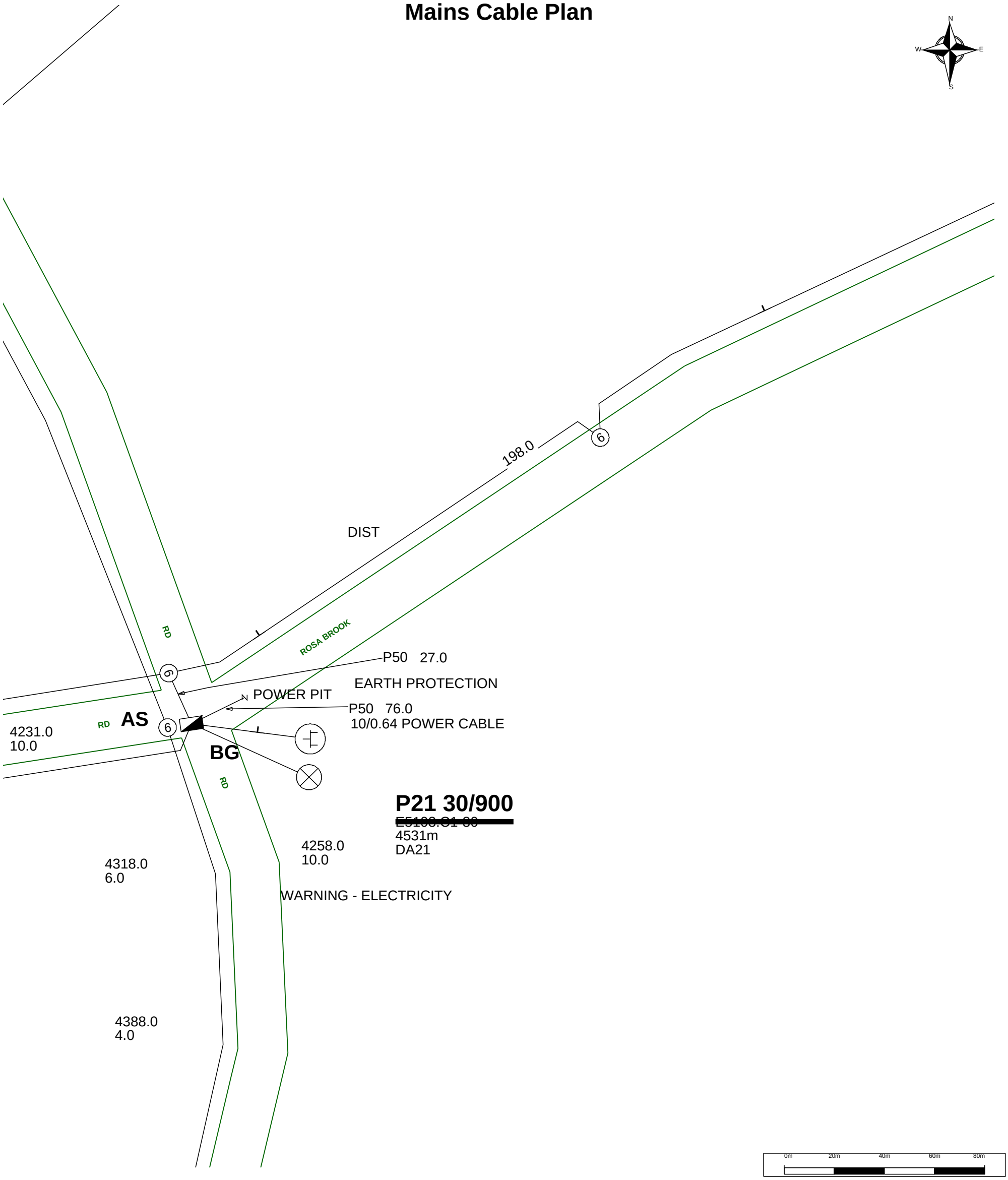
WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.

Mains Cable Plan



Telstra	For all Telstra DBYD plan enquiries - email - Telstra.Plans@team.telstra.com For urgent onsite contact only - ph 1800 653 935 (bus hrs)
TELSTRA CORPORATION LIMITED A.C.N. 051 775 556	
Generated On 03/12/2019 12:00:26	Sequence Number: 92784859
	CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

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WATER CORPORATION
UNDERGROUND ASSET DETAILS

629 Newcastle Street
Leederville, WA, 6007
PO Box 100
Leederville, WA, 6902
www.watercorporation.com.au
(08) 9424 8115

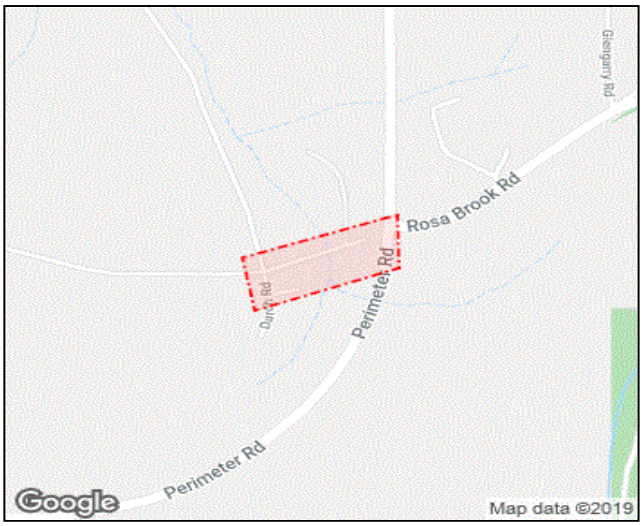
Requestor details

Mr Lachlan Sutherland
Wood and Grieve Engineers
PO Box 1276
Busselton WA 6280

Phone: 0897176107
Mobile: Not Supplied
Fax: Not Supplied
Email: lachlan.sutherland@wge.com.au

Sequence No: **92784860**
DBYD Job No: 18683784
Enquiry Date: 03/12/2019
Issue Date: 03/12/2019

Requested location details



Address Darch Road
Margaret River WA 6285
GPS X Coordinate
GPS Y Coordinate
Map Ref 15C1

Note: The response for this enquiry has been interpreted from details in the picture location only.

Water Corporation asset impact

NO PIPELINES FOUND
No underground pipes were identified. However be aware that pipes may still exist in your work area.
NOTE: For best results use the polygon function to define your work area. Point and line requests only generate a limited search of the surrounding area.

Important

1. Plans show approximate location only – verify location by potholing before using powered machinery.
2. Please read all information and attachments.
3. All documents must be kept together and retained on site by the work team.
4. This information is valid for 30 days from date of issue.

WATER CORPORATION
UNDERGROUND ASSET DETAILS

ABN 28 003 434 917
629 Newcastle Street
Leederville, WA, 6007
PO Box 100
Leederville, WA, 6902
www.watercorporation.com.au
(08) 9424 8115

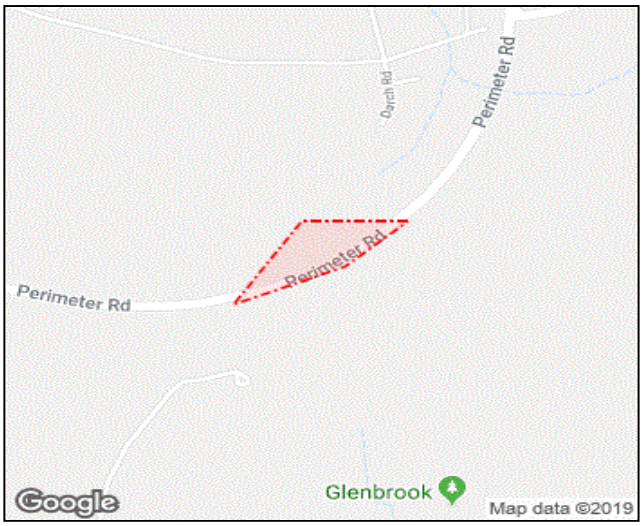
Requestor details

Mr Lachlan Sutherland
Wood and Grieve Engineers
PO Box 1276
Busselton WA 6280

Phone: 0897176107
Mobile: Not Supplied
Fax: Not Supplied
Email: lachlan.sutherland@wge.com.au

Sequence No: **92785022**
DBYD Job No: 18683811
Enquiry Date: 03/12/2019
Issue Date: 03/12/2019

Requested location details



Address Darch Road
Margaret River WA 6285
GPS X Coordinate
GPS Y Coordinate
Map Ref 15C1

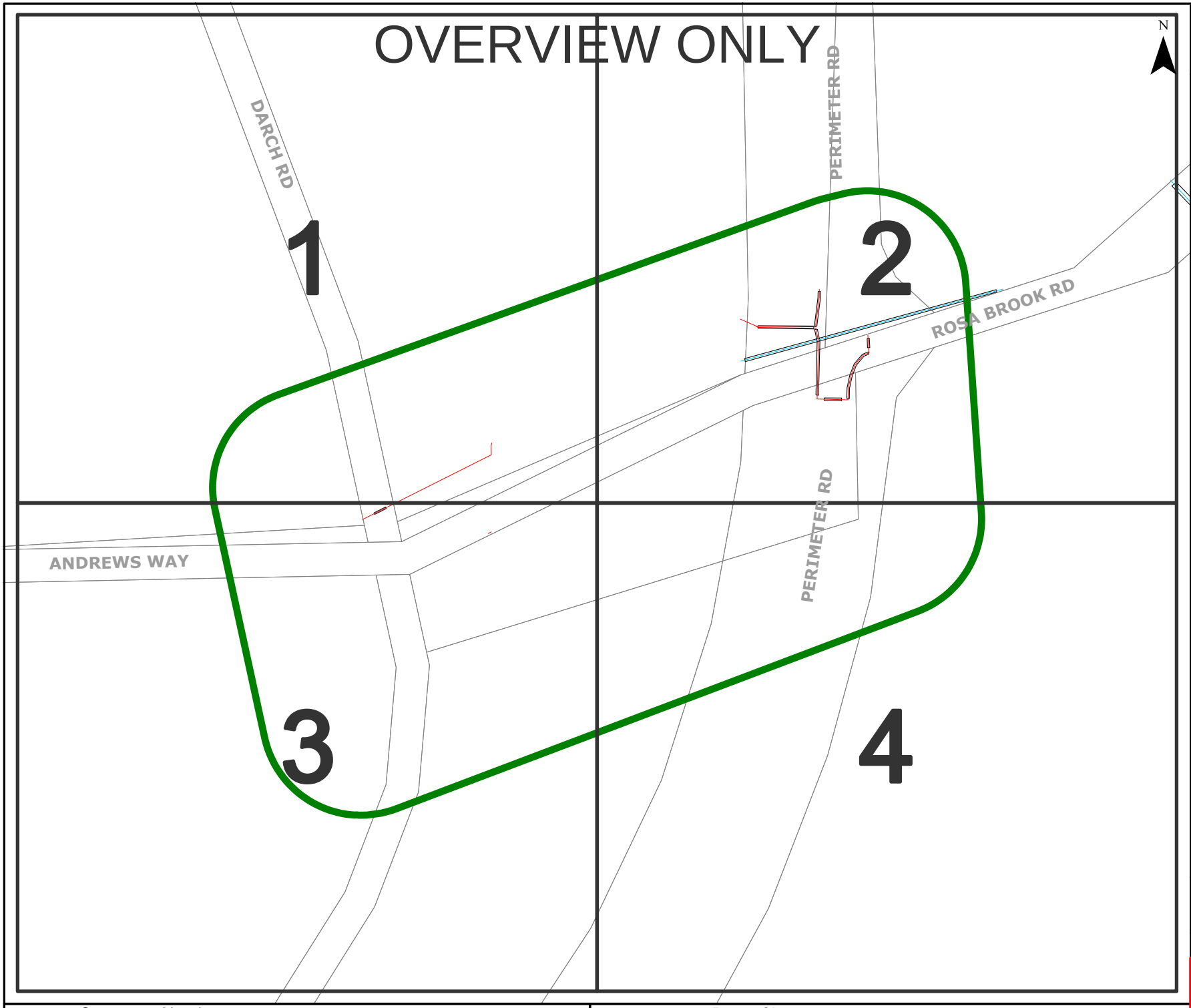
Note: The response for this enquiry has been interpreted from details in the picture location only.

Water Corporation asset impact

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NOTE: For best results use the polygon function to define your work area. Point and line requests only generate a limited search of the surrounding area.

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2. Please read all information and attachments.
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westernpower

UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

This map is INDICATIVE ONLY. Hand exposure via pothole method is MANDATORY.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

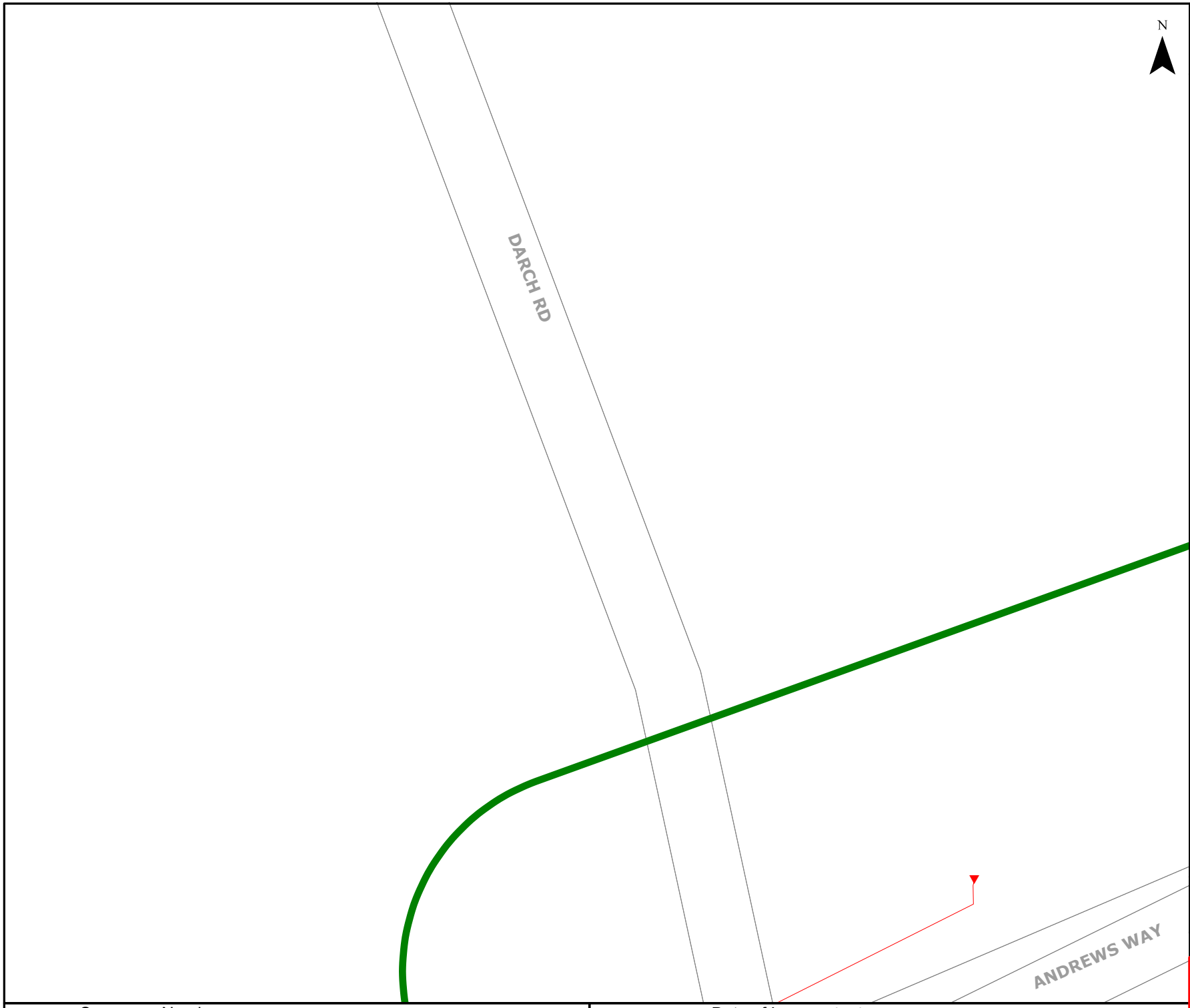
Information valid for 30 days from date of issue

A4	Scale : 1:3075

WARNING! Look out for overhead power lines

Sequence Number: 92784858

Date of Issue: 3/12/2019



westernpower

UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

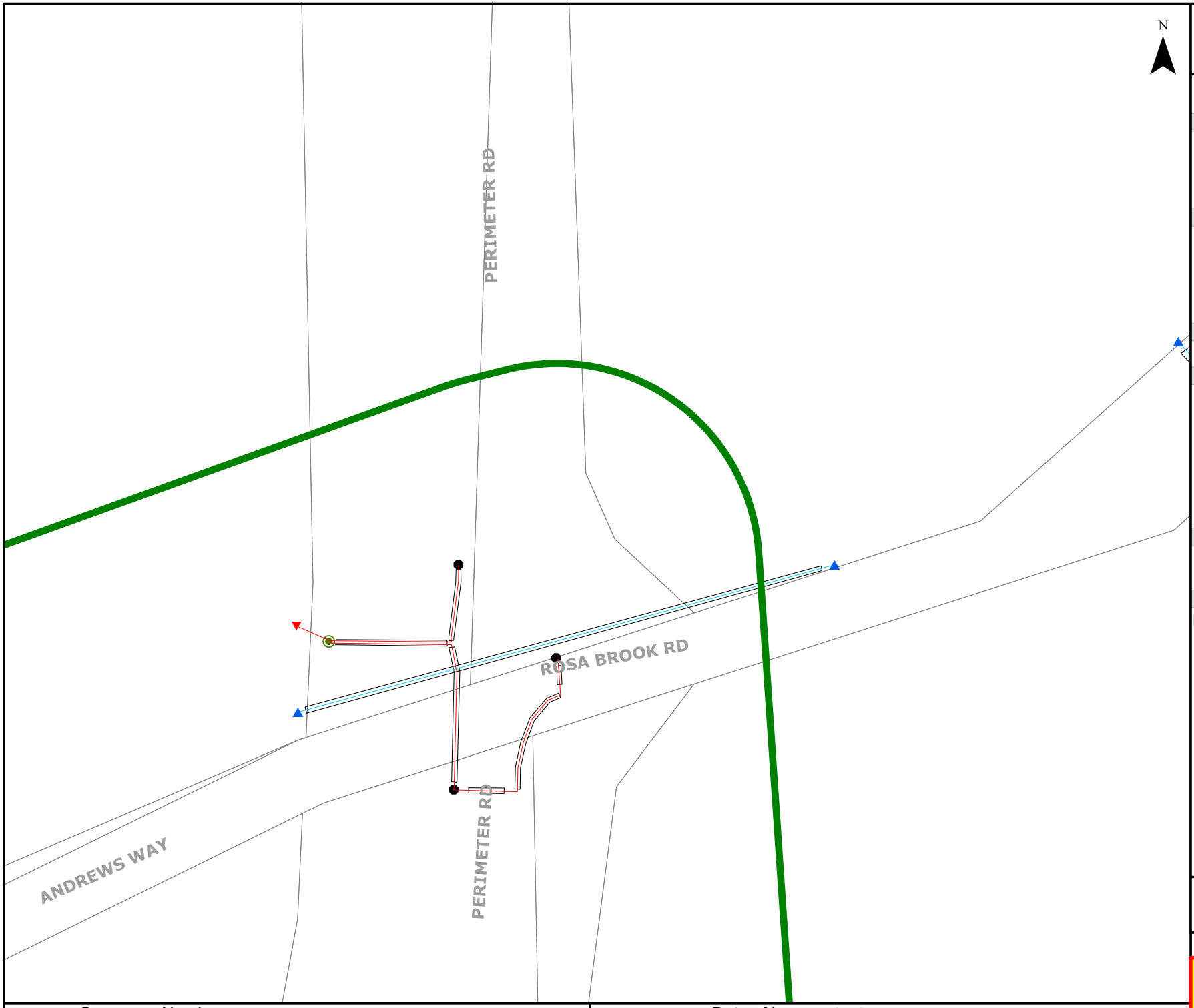
Information valid for 30 days from date of issue

A4	Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 92784858

Date of Issue: 3/12/2019



westernpower

UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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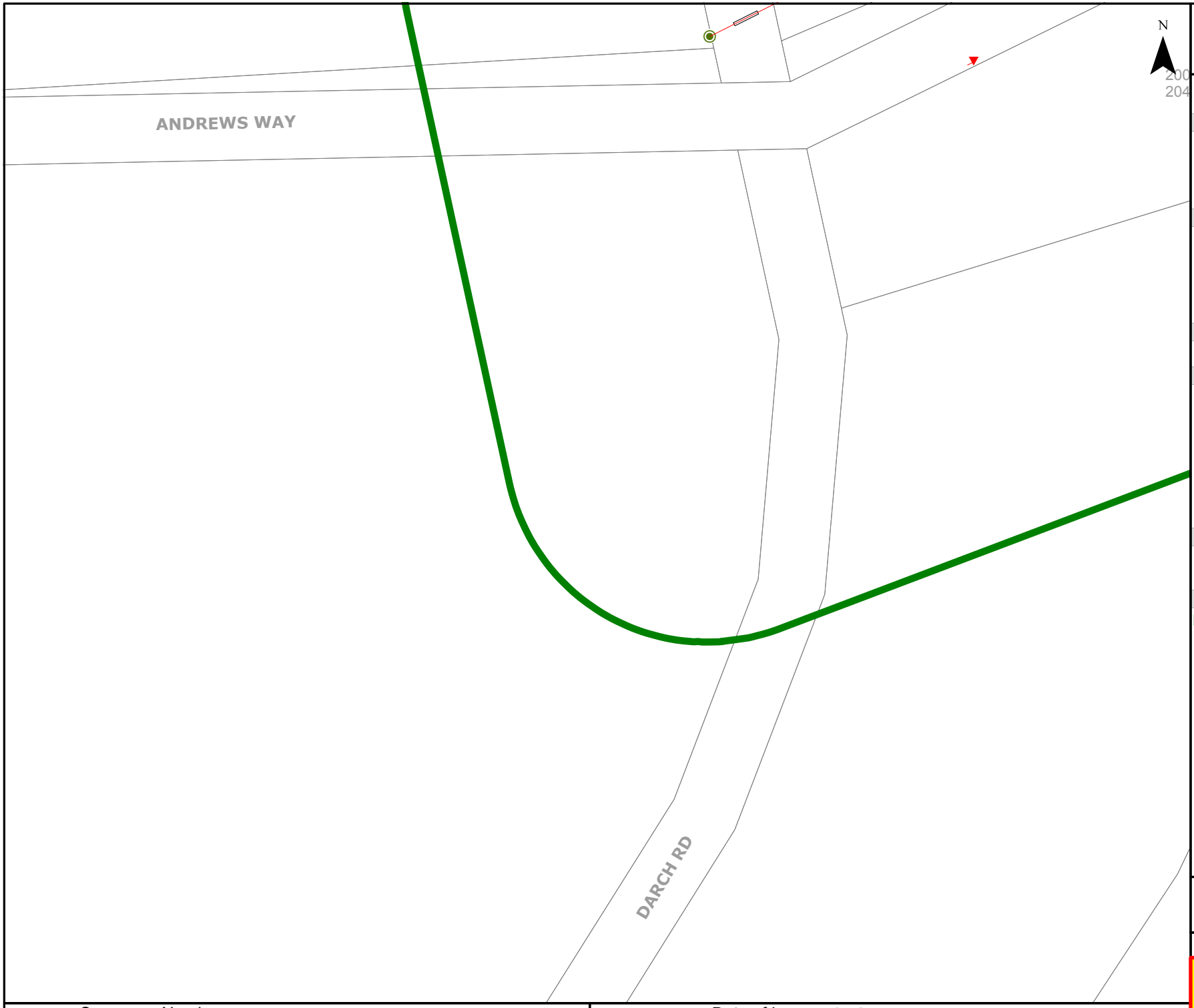
Information valid for 30 days from date of issue

A4	Scale : 1:1500

WARNING! Look out for overhead power lines

Sequence Number: 92784858

Date of Issue: 3/12/2019



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UNDERGROUND LEGEND

Structures

- Pillar
- Metal Pole
- Transformer Site
- UG Crossing *
- Ring Main Unit
- LV Distribution Frame

Distribution Cables

- High Voltage Cable (1kV - 33kV)
- Low Voltage Cable (< 1kV)
- Street Light Circuit (< 1kV)
- Street Light Pilot (< 1kV)
- Earth Wire

Cable Pole Terminations

- HV Termination
- LV Termination

Proposed Construction Assets

- Design Area *
- High Voltage Underground Cable
- Low Voltage Underground Cable
- Metal Pole
- Pillar
- Transformer site
- HV Termination
- LV Termination

State Underground Power Project

- CURRENT Work Area *
- COMPLETED Area *

Feature

- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

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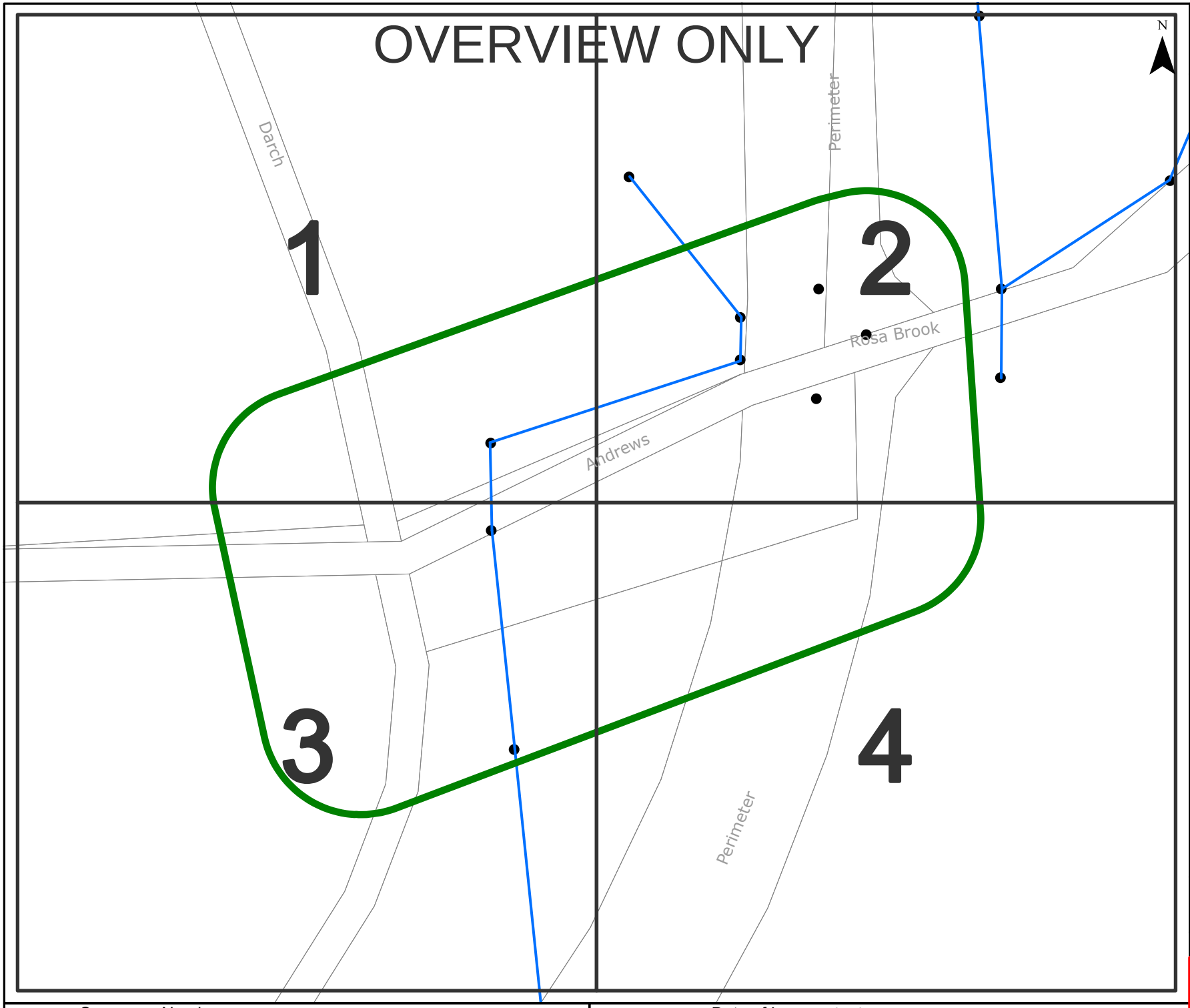
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OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

- High Voltage (1kV - 33kV)
- Low Voltage (< 1kV)

Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

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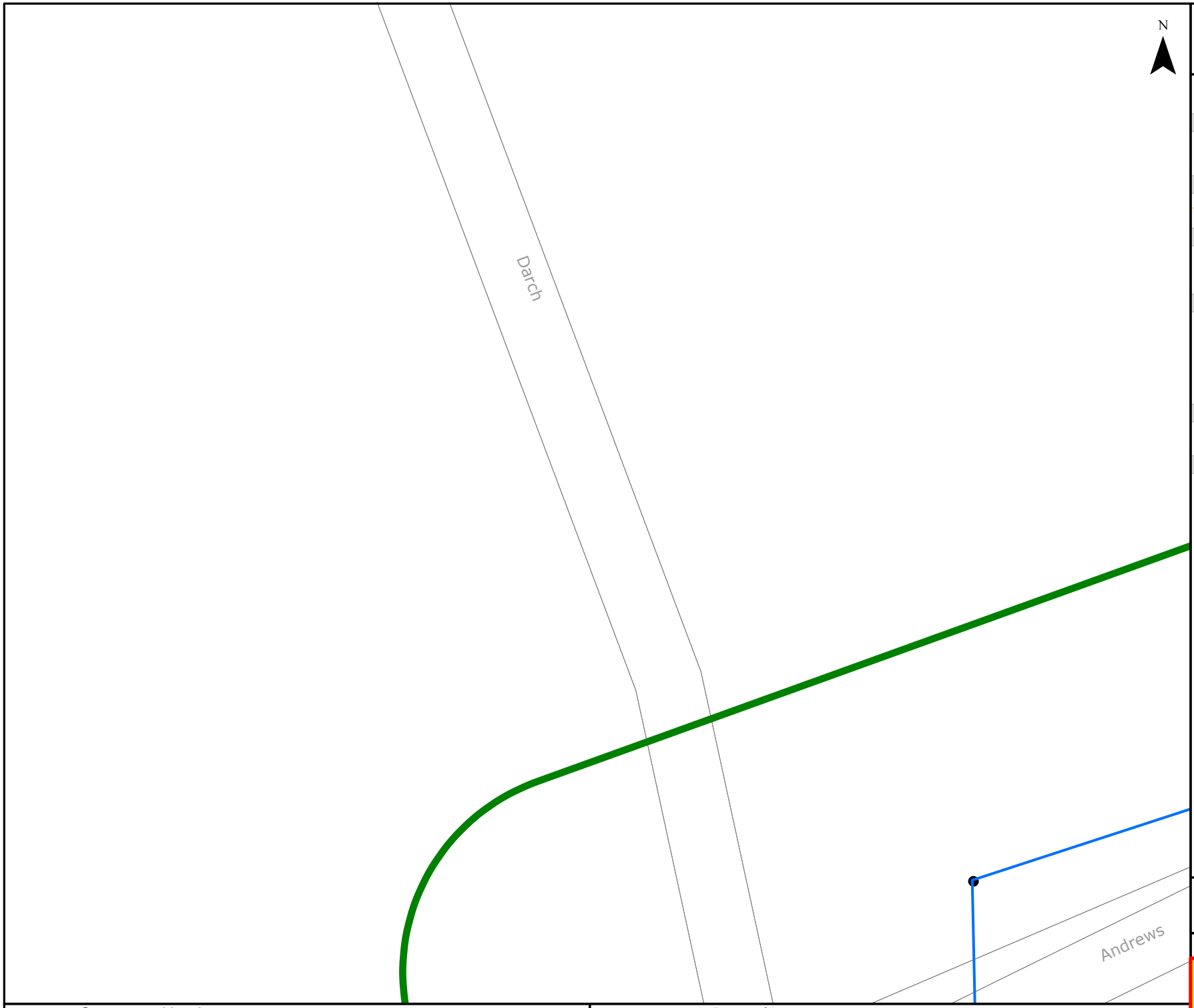
Information valid for 30 days from date of issue

A4	Scale : 1:3075

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OVERHEAD LEGEND

Structures

- Power Pole
- Transmission Poles

Transmission Overhead Powerline

- Transmission (33kV - 330kV)

Distribution Overhead Powerline

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Proposed Construction Assets

- Design Area *
- High Voltage Overhead Powerline
- Low Voltage Overhead Powerline
- Power Pole

Communications Assets

- Overhead Pilot Cable

Feature

- Area of Interest

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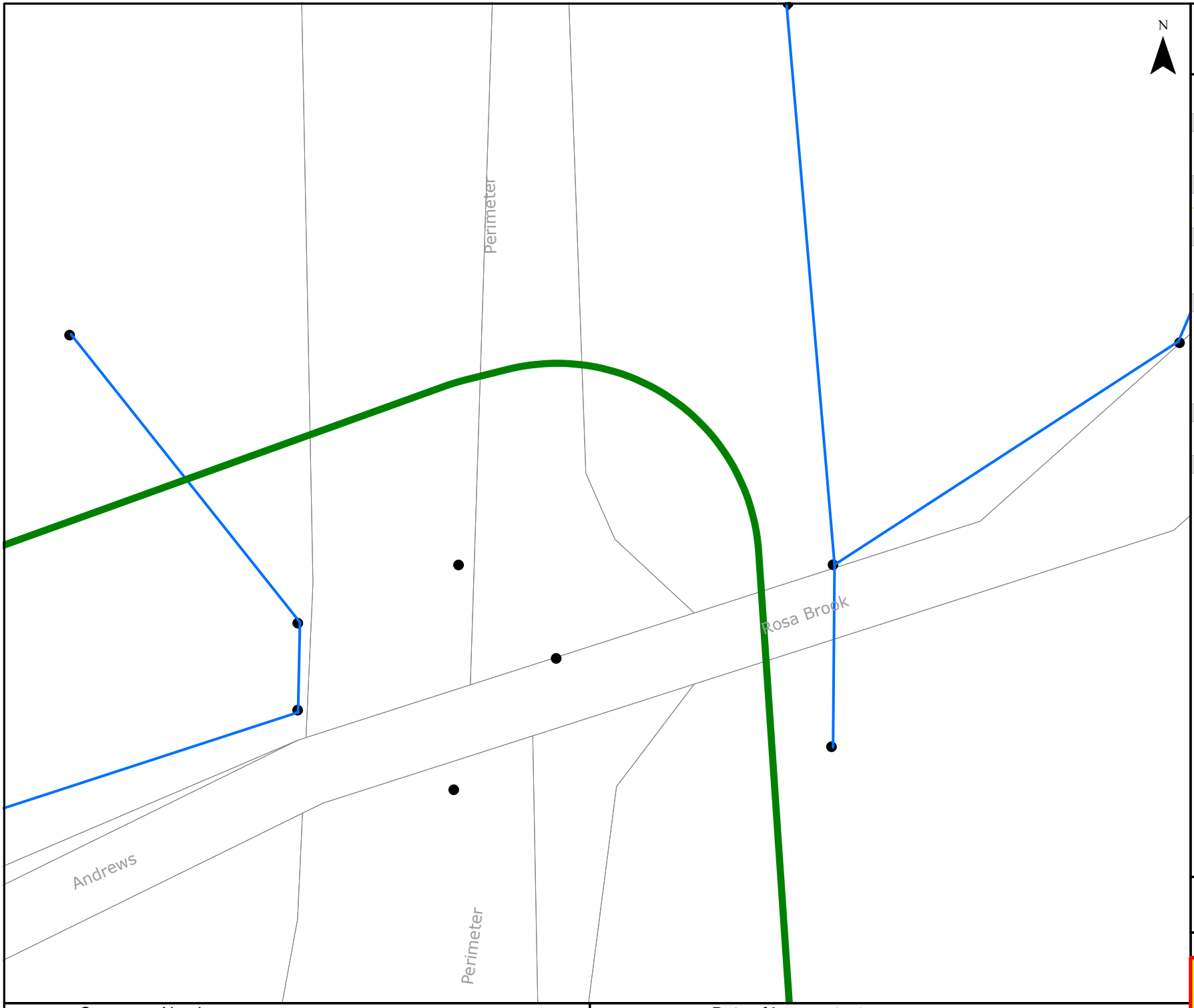
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- Low Voltage Overhead Powerline
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Communications Assets

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Feature

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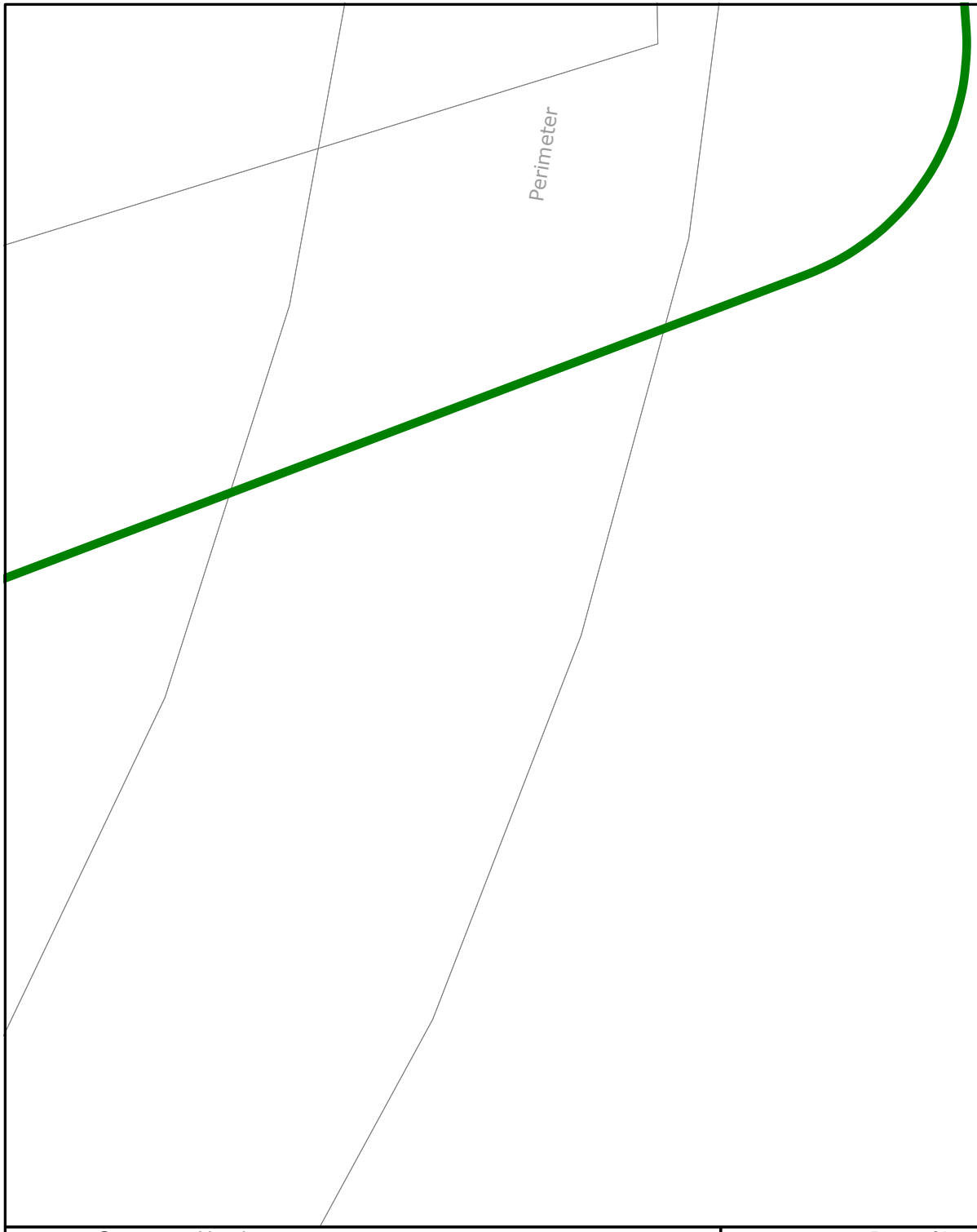
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Design with
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For more information please visit
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