157 Barfield Road, Hammond Park
Structure Plan

Prepared by

Michael Glendinning Property

Title:	157 Barfield Road, Hammond Park – Structure Plan
Project:	Lot 28 (#157) Barfield Road, Hammond Park
Prepared for:	Condor Nominees Pty Ltd
Date of Release:	January 2022 (Rev 0); April 2022 (Rev 1); June 2022 (Rev 2); December 2022 (Rev 3); October 2023 (Rev 4); December 2023 (Final)
Prepared by:	Michael Glendinning Property
Contributors:	Michael Glendinning Property, Coterra Environment, Development Engineering Services, Smith Bushfire Consultants, Transcore, Lloyd George Acoustics and Plan E Landscape Architects.
Approved by:	Michael Glendinning

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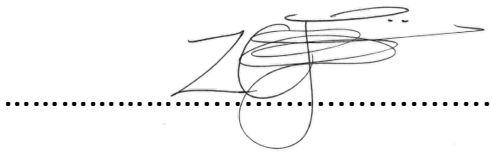
ENDORSEMENT PAGE

This Structure Plan is prepared under the provisions of the City of Cockburn Town Planning Scheme No.3

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

23 January 2024

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:

Witness: .....

Date: 24 January 2024

Date of Expiry: 24 January 2034

TABLE OF AMENDMENTS

Amendment No.	Summary of Amendment	Amendment Type	Date approved by WAPC

Executive Summary

Structure Plan – 157 Barfield Road, Hammond Park

This Structure Plan (SP) for Lot 28 (#157) Barfield Road, Hammond Park is prepared to facilitate and guide the subdivision and development for residential purposes of the Structure Plan area comprising Lot 28 Barfield Road, Hammond Park.

Lot 28 comprises a total area of 4.8166 hectares of which the western 2.4943ha fronting Barfield Road is zoned 'Development' and the remaining 2.3223ha abutting the Kwinana Freeway to the east is zoned 'Special Use', being subject to a 127m wide Western Power transmission easement to accommodate high voltage power lines which traverse this portion of Lot 28 from north to south parallel to the abutting Kwinana Freeway.

The City of Cockburn's Local Planning Scheme and Southern Suburbs District Structure Plan require a Structure Plan for the portion of Lot 28 zoned 'Development' but not the remainder of Lot 28 which is zoned 'Special Use'.

A homestead and outbuildings adjacent Barfield Road were removed prior to the current landowner's acquisition of Lot 28 in 2005. As such the land has been partially cleared, with remnant vegetation ranging in condition from 'Completely Degraded' to 'Very Good'. A proposal to clear remnant vegetation from Lot 28 was referred to the Federal Government's Department of Agriculture, Water and the Environment (DAWE) in November 2021 and was approved as "not a controlled action" on 1 December 2021, paving the way for the lodgement of this Structure Plan.

The Structure Plan is based upon a lot layout which conforms with State Government and City of Cockburn residential density targets, the latter responding to the City's Southern Suburbs District Structure Plan (DSP) which prescribes a minimum density of between 15 and 25 dwellings per hectare. As indicated on the Indicative Subdivision Layout at Figure 9 of this report, the development should comprise up to 46 lots for single dwellings at a density of 18.4 dwellings per hectare based on the gross urban zoned area, exclusive of the Special Use zoned powerline easement land.

The key statistics and planning outcomes of the Structure Plan are outlined in the following summary table. The Structure Plan Summary Table overleaf details the nature and key outcomes of the Structure Plan.

Structure Plan Summary Table

ITEM	DATA	Structure Plan Ref (section no.)
Total area covered by the Structure Plan	2.4943ha*	Exec Summary and Part One: Section 1.0
Area of each land use proposed: - Residential - Parks and Recreation	2.2449ha (90.0%) 0.2494ha (10.0%)**	Part One: Section 1.0 and Section 4.0
Total estimated lot yield	46 lots	Part One: Section 4.2
Estimated number of dwellings	46 dwellings	Part One: Section 4.2
Estimated population	120 persons	Part One: Section 4.2
Estimated residential site density	Approx 27 dwellings per residential site hectare	Part Two: Section 1.3.4 and Section 3.1
Estimated area and percentage of Public Open Space given over to: - Regional open space - Local parks	Nil 0.2494 hectares (10%)	Part One: Section 4.4; Part Two: Section 1.3.2 and Sections 3.0 and 3.2
Estimated percentage of natural area	est. 0.1200ha*** (4.9%)	Part Two: Section 3.1

* Western Power has agreed to accommodate a 20 metre road reserve within its powerline easement, as it did for the development of Lot 29 to the immediate north and for the development of Lot 15 to the immediate south which, in accordance with the City's Southern Suburbs DSP.

** The City's management and the proponent have reached consensus on the location of the POS in an area of the development in which the proponent can deliver a POS which combines retained native vegetation with recreational space where vegetation has been cleared in the past.

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6. Transportation Noise Assessment
7. Public Open Space Landscape Concept
8. Western Power Easement Revegetation Plan and Methodology Statement

Part One - Implementation

1.0 Structure Plan Area

This Structure Plan shall apply to the western portion of Lot 28 Barfield Road, Hammond Park comprising 2.4943 hectares of land which is zoned 'Development'. Outside the Structure Plan the eastern portion of Lot 28 comprises 2.3223ha abutting the Kwinana Freeway which is zoned 'Special Use'. The Structure Plan is identified as the 157 Barfield Road Structure Plan.

2.0 Operation

This Structure Plan shall come into effect on the date it is approved by the WAPC.

3.0 Staging

The Structure Plan area is likely to be developed in a single stage given the development requires fill to raise the natural ground level to a level which integrates with the adjoining developments to the immediate north (Lot 29) and to the immediate south (Lot 15) and which facilitates gravity sewerage to connect to existing infrastructure in Barfield Road.

The proposed source of fill material is the eastern portion of the property zoned 'Special Use' and subject to an easement in favour of Western Power for the protection of its overhead transmission line assets. Western Power has consented to the landowner excavating sand from the easement to provide fill for the proposed lots within the 'Development' zone, while re-contouring and revegetating the easement area for passive use by the local community as part of an emerging ecological corridor between Russell and Rowley Roads.

4.0 Subdivision and Development Requirements

Subdivision and development of the Structure Plan area shall generally be in accordance with the Structure Plan Map.

4.1 Applicable Standards

The land within the Structure Plan is zoned 'Development' under the City of Cockburn Town Planning Scheme No. 3 (TPS3) permitting residential subdivision and development with the expectation that, in accordance with WA Planning Commission policy, an area of Public Open Space of 10% of the developable area will be provided.

4.2 Residential Density

The proposed density for the Structure Plan area is R30 as per the Structure Plan Map, and, with a potential yield of up to 46 lots at 18.4 dwellings per hectare based on the gross urban zoned area, enables the proposed development to achieve the City's Southern Suburbs District Structure Plan's prescribed minimum density of between 15 and 25 dwellings per hectare.

4.3 Hazard Separation

The Structure Plan is subject to a Bushfire Management Plan attached as **Appendix 3**. Any land falling within a bushfire hazard identified in the Bushfire Management Plan is designated as a Bushfire Prone Area for the purpose of the Building Code of Australia.

4.4 Public Open Space

The Structure Plan proposes a Public Open Space which provides the development's future residents with 10% of the development area as required by the WA Planning Commission (refer to **Part Two: Section 3.2** for detail)

Having expressed a preference that the POS be located in a location within the development which would include remnant vegetation in good condition, the City's management joined the proponents in a site inspection which led to the location proposed on the Structure Plan map.

4.5 Landscaping and Revegetation

The City has agreed to the landscaping, revegetation and ceding of the Special Use 23 zoned Western Power easement land, which is to be imposed as a condition of any subdivision approval that seeks exemption to the requirement for native vegetation clearing permit under the State *Environmental Protection Act 1986.*

4.6 Notifications on Title

A requirement for Notifications to be imposed at the subdivision stage on all lots addressing the future disconnection of Barfield Road, mosquito-borne disease risk in the area, transport noise and bushfire prone areas as follows:

a) For all lots: "*The road network connectivity in this area linking Barfield Road to Rowley Road will be permanently closed in the future."*

b) For all lots: *"This lot is in close proximity to known mosquito breeding areas. The predominant mosquito species is known to carry viruses and other diseases."*

c) For all lots identified as requiring Quiet House Designs in the Transportation Noise Assessment: *"This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected by transport noise. Additional planning and building requirements may apply to development on this land to achieve an acceptable level of noise reduction."*

d) For all lots with a Bushfire Attack Level (BAL) rating of 12.5 or above advising the existence of a hazard or other factor: *"This land is within a bushfire prone areas designated by an Order made by the Fire and Emergency Services Commissioner and is/may be subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land."*

5.0 Local Development Plans

5.1 Local Development Plans are required to be prepared for lots comprising one or more of the following site attributes:

(i) Lots with direct boundary frontage to an area of Public Open Space.

(ii) Lots affected by vehicle noise associated with the Kwinana Freeway.

5.2 (i) In respect to 5.1(i) the Local Development Plan shall specifically address the interface between the POS and its interface with the two residential lots abutting its southern boundary.

6.0 Other Requirements

6.1 R Density Codes

Development of the proposed single residential lots will be governed by the standards outlined under the City's Local Planning Policy 1.16.

7.0 Additional Information

7.1 Environmental Management Requirements

In accordance with the recommendations of the Environmental Assessment Report (**Appendix 1**) the following management plans are required to be prepared and approved prior to the commencement of subdivisional works on-site:

- Fauna Management and Relocation Plan;
- Revegetation Plan; and
- Bushland Protection Management Plan

It is noted that there is potential for the Revegetation Plan and Bushland Protection Plan to be merged into one management plan at the time of preparation.

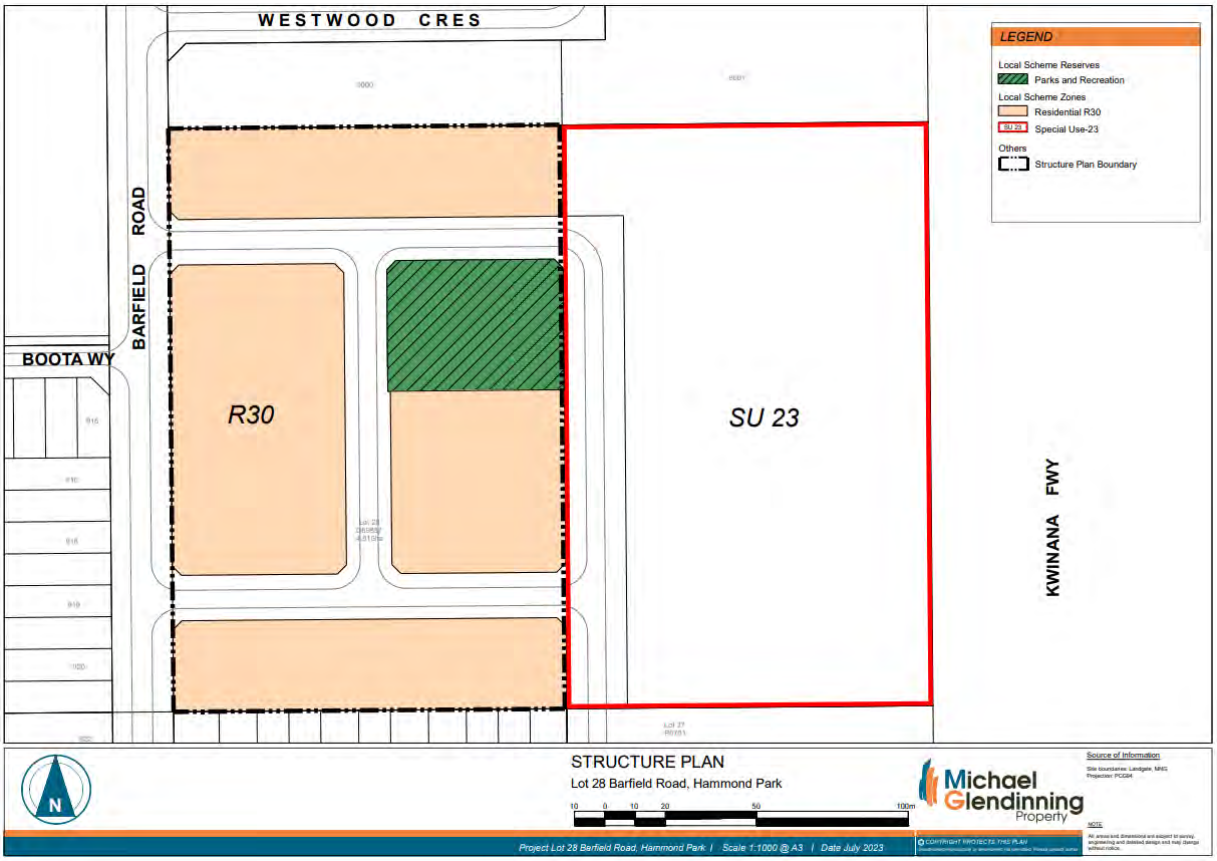
7.2 Land Contamination

The landowner Condor Nominees Pty Ltd acquired the site in 2005 and removed the abandoned improvements on site in 2018 with the intent of developing the land for housing lots. In March 2023 Condor engaged Environmental Risk Consultants (ERC) to conduct a site inspection. ERC summarised that "the potential for contamination to be present at the site is moderate and should be further assessed prior to site re-development" and recommended a Preliminary Site Investigation (PSI) "should be undertaken to further investigate the potential for contamination to be present".

Pursuant to approval of this Structure Plan, it is expected that a PSI will be a condition of Subdivision Approval.

7.3 Local Planning Policy 1.16

Dwellings built upon the residential lots within the Structure Plan area will be required to conform with the contents and requirements of Local Planning Policy 1.16 - Single House Standards for Medium Density Housing in the Development Zone.


WESTWOOD CRES
BARFIELD ROAD
BOOTA WY
R30
SU 23
KWINANA FWY
LEGEND
Local Scheme Reserves
Parks and Recreation
Local Scheme Zones
Residential R30
SU 23
Special Use-23
Others
Structure Plan Boundary
N
STRUCTURE PLAN
Lot 28 Barfield Road, Hammond Park
10 0 10 20 50 100m
Michael Glendinning Property
Source of Information
NOTE
Project Lot 28 Barfield Road, Hammond Park | Scale 1:1000 @ A3 | Date July 2023

Part Two - Explanatory Report

1.0 Planning background

1.1 Introduction and Purpose

This Structure Plan for 157 Barfield Road, Hammond Park has been prepared by planning consultant Michael Glendinning Property on behalf of the landowner, Condor Nominees Pty Ltd.

It is lodged in accordance with clause 6.2.4 in the City of Cockburn Town Planning Scheme No. 3 (TPS3) which requires a structure plan to be approved for land zoned 'Development' under TPS3 and provides the statutory planning framework to guide the future subdivision and development of the subject land contained within the Structure Plan boundaries.

The Structure Plan has been prepared in accordance with the City of Cockburn's procedure which specifies compliance with Schedule 2, Part 4 of the deemed provisions in the Planning and Development (Local Planning Schemes) Regulations 2015.

It comprises three parts as follows:

Part 1 – Implementation Section contains the Structure Plan Map and the statutory planning provisions and requirements applicable to future subdivision and development of the subject land pursuant to clause 6.2.4 of TPS3.

Part 2 – Explanatory Section (this Part) provides an assessment of all relevant matters including the applicable planning framework, the site context and characteristics.

Part 3 – Structure Plan provides an explanation of the Structure Plan.

Appended are eight (8) Technical Appendices being those technical reports and supporting documentation as required.

1.2 Land Description

1.2.1 Location

157 Barfield Road, Hammond Park is located between Barfield Road and the Kwinana Freeway, approximately 730m north of Rowley Road which facilitates access to the Freeway, and approximately 430m south of Gaebler Road, which crosses the Freeway. Further access to the Kwinana Freeway and the Aubin Grove railway station on the Perth-Mandurah railway is less than 2km north of 157 Barfield Road.

The suburb of Hammond Park is well served by educational facilities, which include Hammond Park Secondary College (approx. 200m west of Barfield Road), Hammond Park Catholic School (approx. 350m to the west, opposite the Secondary College, and Hammond Park Primary School (approx. 1.5km to the north-west).

Figure 1: Location Map

1.2.2 Area and Land Use

Lot 28 has a total area of 4.8166ha with a frontage of 192m to Barfield Road in the west and a 192m boundary to the Kwinana Freeway in the east. The rectangular Lot 28 has northern and southern boundaries of 250m. The Structure Plan occupies the western portion of Lot 28 and has an area of 2.4943ha. The subject land has been partially cleared and the site is undeveloped. The eastern half of the property is affected by an easement in favour of Western Power associated with 330Kv power line infrastructure which traverses this portion of the site and is outside the Structure Plan area.

Figure 2: Cadastral Plan

1.2.3 Legal Description and Ownership

The subject land comprises 157 Barfield Road, Hammond Park, being Lot 28 on Diagram 69857, Certificate of Title Volume 1754 Folio 135. As noted on the Title, portion of the site is subject to an easement to the State Electricity Commission of Western Australia for the purposes of clearing the land subject to the easement and to maintain in, upon, along and across the land in a proper manner, towers, poles, wires and other necessary apparatus in connection with its transmission, distribution and telephones lines for the purpose of transmitting and distributing power by electricity. The easement also provides Western Power the right to enter upon the land for the purpose of inspecting electrical equipment and making necessary repairs and alterations thereto. Under the conditions of the easement the landowner may not increase the height of the natural surface of the land but can lower the natural surface, construct structures, buildings and improvements within the easement area with the written approval of Western Power.

1.3 Planning Framework

1.3.1 Zoning and Reservations

Lot 28 Barfield Road is zoned 'Urban' under the Metropolitan Region Scheme (MRS). Figure 3 below indicates the Structure Plan boundary via a broken black line on an extract of the MRS Map.

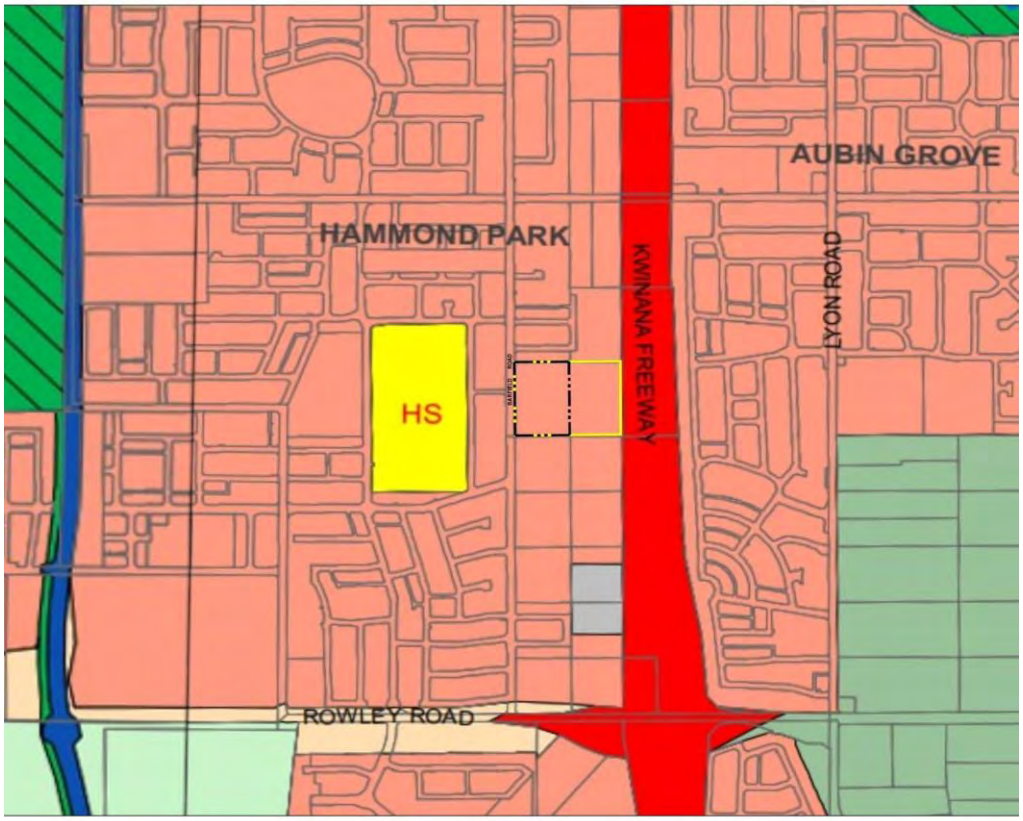


Figure 3: Metropolitan Region Scheme

Under the City of Cockburn Town Planning Scheme No. 3 (TPS3) the western half of the subject land is zoned 'Development' and is therefore included in Development Contribution Plan 13, which requires developers to contribute to City-wide community infrastructure, and Development Contribution Plan 9, which requires developers within Hammond Park to contribute to hard infrastructure (regional drainage and the widening and upgrade of Hammond Road, between Gaebler and Rowley Roads). The eastern half, being that portion of the property affected by the Western Power easement is zoned 'Special Use 23'. Clause 6.2 of TPS3 sets out the statutory requirements for the preparation and adoption of a Structure Plan within the 'Development' zone. This Structure Plan has been prepared in accordance with the requirements of clause 6.2.

Figure 4: City of Cockburn TPS No.3

1.3.2 Regional and Sub-Regional Structure Plans

Reflecting its 'Urban' zoning under the MRS, the subject land is identified for urban purposes in relevant regional strategic documentation, being designated as 'Urban' within the South Metropolitan Peel Sub-Regional Planning Framework. The subject land is located within the City of Cockburn Southern Suburbs District Structure Plan - Hammond Park where it is identified as medium density residential.

Figure 5 overleaf confirms the location of Lot 28 in relation to the District Structure Plan

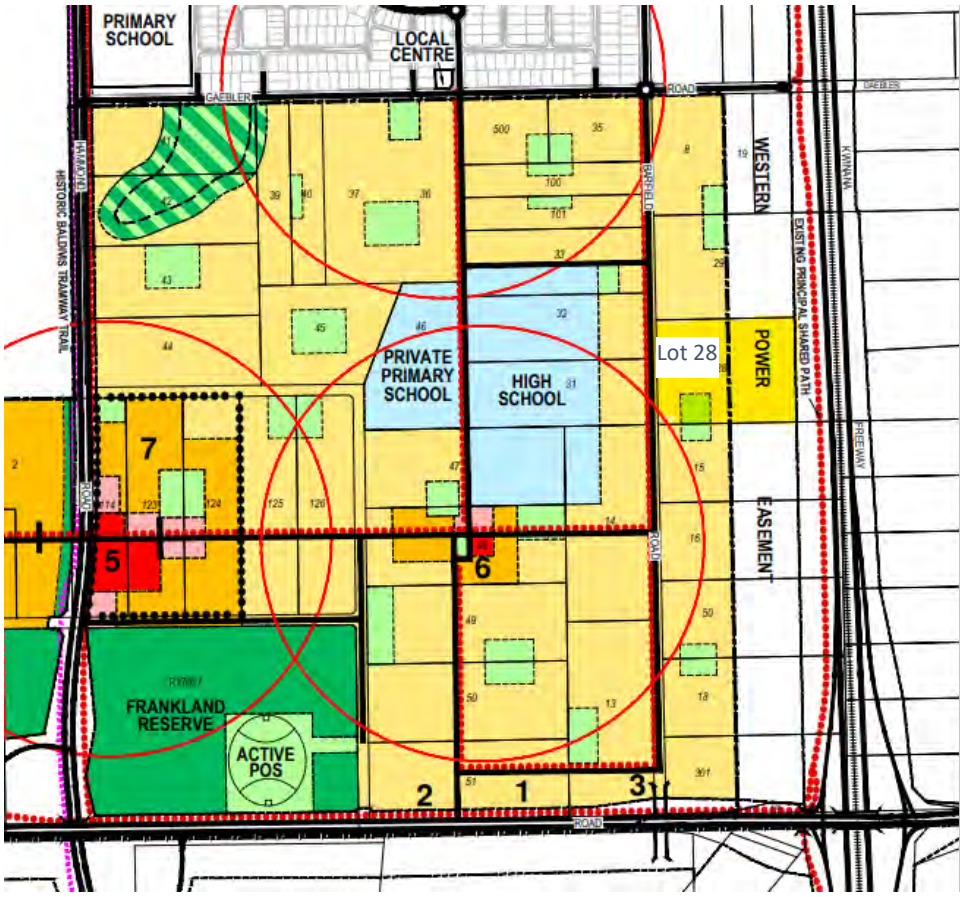


Figure 5: Southern Suburbs District Structure Plan - Hammond Park

The DSP plan locates an indicative public open space straddling Lot 28's common boundary with Lot 15 to the immediate south, however the owner/developer of Lot 15 has consolidated its POS obligations into larger scale POS elsewhere in its Vivente Estate. The relocation of Lot 15's POS provision compromises the options for an appropriate location within the Structure Plan. The location of the POS on the Structure Plan responds to the topography, which falls from south to north, and the opportunity to include native vegetation in good condition within the POS.

1.3.3 Planning Strategies

The relevant operational Planning Strategies are, as referred to in Section 1.3.2,

- Regional: South Metropolitan Peel Sub-Regional Planning Framework (WAPC, 2018)
- District: Southern Suburbs District Structure Plan - Hammond Park (City of Cockburn

Furthermore, it is understood that the City is in the process of reviewing its Local Planning Strategy, however this is not expected to impact on the Structure Plan nor any subsequent subdivision application.

1.3.4 Planning Policies

The Structure Plan has been prepared within the context of the wider State and Local Planning Policy Framework including where relevant applicable State Planning Policy and Development Control Policies. A number of items are particularly noted including

SPP 7.3 Residential Design Codes, Liveable Neighbourhoods and Planning Bulletin 112/2016 R-MD Codes:

- **State Planning Policy 7.3 – Residential Design Codes Volume 1 (WAPC 2021)**

  SPP 7.3 controls residential development throughout Western Australia. The R-Codes are the agreed mechanism to control density within residential zones, through the application of R-Code densities in local planning schemes.

  The R-Code density primarily controls the allowable average and minimum lot size, with built form performance standards and 'deemed-to-comply' examples, specific to the nominated density, described within Parts 5 & 6 of the R-Codes. The Structure Plan Map designates a proposed R-Code density of R30. Further discussion in regard to R-Codes density is provided in **Part Two: Section 3.1** of this report.

- **Liveable Neighbourhoods (WAPC 2009)**

  Liveable Neighbourhoods is the WAPC's operational policy guiding the design of structure plans. The objective of Liveable Neighbourhoods is the delivery of a high quality residential environment. The Structure Plan responds to the requirements of Liveable Neighbourhoods by promoting an interconnected, safe and walkable neighbourhood, providing a variety of lot sizes and housing types, responding to the diverse housing needs of the community, maximising land efficiency and securing a residential density of 18.4 dwellings per gross hectare and 26.9 dwellings per residential site hectare, exceeding the upper threshold of the Liveable Neighbourhoods target. Further discussion regarding density targets is provided in **Part Two: Section 3.0** of this report.

- **State Planning Policy 3.7 Planning in Bushfire Prone Areas**

  SPP 3.7 addresses the requirements to be met where development is proposed in a bushfire prone area. This requires a detailed bushfire risk assessment to be undertaken and preparation of a Bushfire Management Plan (BMP) outlining how the identified bushfire risk can be managed. A BMP for the Structure Plan is appended as **Appendix 3** and bushfire implications for the Structure Plan area discussed in section 2.8 of this report.

- **State Planning policy 5.4 Road and Rail Transport Noise and Freight**

  SPP 5.4 addresses transport noise from within major transport corridors, such as the Kwinana Freeway, and outlines criteria to be used to assess noise impacts. It also outlines possible noise management and mitigation measures available to meet the noise level criteria identified in the policy. A specific acoustic report has been prepared addressing the requirements of SPP 5.4 and is appended as **Appendix 6**. The implications of SPP 5.4 for the Structure Plan is discussed in Part Two: Section 3.5 of this report.

- **Planning Bulletin 112/2016 – Medium Density Single House Development Standards – Structure Plan Areas (R-MD Codes)**

  PB 112/2016 outlines the WAPC position in relation to a consistent set of R-Code variations within new Structure Plan areas. The basis for implementation of the R-MD provisions within the City of Cockburn is the City's Local Planning Policy 1.16 'Single House Standards for Medium Density Housing in the Development Zone'.

- **Local Planning Policies**

  At a Local Authority level, in addition to relevant planning procedure outlined by the City of Cockburn to guide preparation and assessment of local structure plans, applicable local policies include:

  - LPP 1.12: Noise Attenuation Policy and Guidelines
  - LPP 1.13: Bushfire Prone Areas
  - LPP 1.16: Single House Standards for Medium Density Housing
  - LPP 5.1: Public Open Space
  - LPP 5.4: Location of High Voltage Overhead Power Lines
  - LPP 5.5: Local Development Plans
  - LPP 5.11 Filling of Land
  - LPP 5.12: Retaining Walls
  - LPP 5.15: Access Street- Road Reserve and Pavement Standards
  - LPP 5.18: Subdivision and Development – Street Trees
  - LPP 5.19: Structure Plans & Telecommunications

The Structure Plan has been prepared with relevant requirements of these policies taken into consideration as/where appropriate.

1.3.5 Other approvals and decisions

In November 2021, a proposed action to clear vegetation to construct a residential development on the site was referred to the Department of Agriculture, Water and the Environment (DAWE) in accordance with the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

In December 2021, DAWE issued its decision that the proposed action is "not a controlled action", thereby allowing the clearing and development to proceed.

1.3.6 Pre lodgement consultation

Pre lodgement consultation has been undertaken with a range of relevant stakeholders including officers from the City of Cockburn, Western Power, Federal and State Environmental Agencies, servicing agencies and adjoining landowners.

2.0 Site Conditions and Constraints

This section summarises content from the technical reports appended to this report which address pre-development conditions and constraints affecting the subject land as follows.

2.1 Biodiversity and natural area assets

Biodiversity and natural area assets are detailed in Coterra Environment's Environmental Assessment Report (EAR) appended as **Appendix 1**. The City's Natural Area Management Strategy 2021-2022 recognises the importance of the Western Power easement as an important local ecological corridor. Given that Lots 29 and 15 to the immediate north and south have earthworked the easement in a similar manner as is proposed for Lot 28, post-earthworks revegetation will maintain the integrity of the corridor. Figure 6 below is an aerial view of the subject property which evidences the site's natural assets and the findings of the EAR are summarised overleaf.

Figure 6: Aerial view of the subject property

2.1.1 Vegetation and Flora

A detailed vegetation and flora survey was undertaken on the site (Coterra 2017) in accordance with relevant EPA guidance (2016). Vegetation conditions ranged from very good to completely degraded. While 2.3ha considered in good or better condition was identified within the subject land, approximately half of the 'Development' zoned area is degraded, having been cleared where a house and outbuildings were previously located along with firebreaks.

Furthermore, proximity to Barfield Road and access to Western Power infrastructure within their easement has resulted in extensive weed infestation.

Vegetation condition ranged from 'Completely Degraded' to 'Very Good' according to the Keighery (1994) scale. Vegetation in the eastern portion of the site (within the Western Power transmission line easement) was predominantly in 'Degraded' to

'Completely Degraded' condition, and patches of 'Good' to 'Very Good' condition vegetation were identified in the western portion of the site.

A targeted search for threatened and priority flora identified under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and the Western Australian Biodiversity Conservation Act 2016, was undertaken and no flora species of conservation significance were recorded on site.

2.1.2 Fauna

A fauna habitat survey was undertaken on site in accordance with relevant government guidance (EPA, 2002, 2016b; EPA & DEC, 2010). Banksia Woodland was identified across the majority of the site as representing fauna habitat, noting variable condition of vegetation.

Dominant trees and shrub species identified on site that present potential foraging habitat for black cockatoos (Carnaby's Black Cockatoo, Baudin's Black Cockatoo, Forest Red-tailed Black Cockatoo) and an assessment of foraging value was undertaken on site, based on habitat density and canopy cover (averaging 10-30% canopy cover).

Habitat at the site represents low to moderate foraging value for black cockatoos. No black cockatoo breeding or roosting habitat trees were identified on site.

Whilst database searches identified numerous fauna species as potentially occurring on the site, within the broader context of the Swan Coastal Plain bioregion, only four birds and one mammal, of which none are conservation-significant, were recorded on site.

Of the EPBC conservation-significant species identified as potentially occurring on site, three black cockatoo species and Rainbow Bee-eater, none of these species were recorded on site.

2.1.3 Environmental Management

In accordance with Clause 7.1 of Part One of this report, a Fauna Management and Relocation Plan, a Revegetation Plan and a Bushland Protection Management Plan will be prepared and approved prior to the commencement of subdivisional works on-site.

It is noted that there is potential for the Revegetation Plan and Bushland Protection Plan to be merged into one management plan at the time of preparation.

2.2 Landform and soils

Topography of the site is gently sloping, with the lowest point occurring on the north western boundary at approximately 24 metres Australian Height Datum (mAHD), reaching a high point of 34 mAHD in the south eastern corner of the site. The aspect of the site is generally west.

The site is located within the Bassendean Dune system of the Swan Coastal Plain. The primary soil type across the subject area is S8, which is described as: SAND – very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of Aeolian origin (Gozzard, 1983).

The subject area is mapped as having a Moderate to Low Risk of Acid Sulfate Soils (ASS) occurring within 3 m of the soil surface (DWER, 2017). None of these soil systems present any impediment to development of the subject land.

2.3 Groundwater and surface water

Estimated maximum groundwater levels across the site range from approximately 21 to 22 mAHD, flowing in a general westerly direction. Groundwater is likely to occur between 5 to 7 metres below ground level (mbgl) (DWER, 2017b).

Groundwater monitoring was undertaken across three bores within the site between September 2017 and November 2018 to capture two winter peak periods (Emerge Associates, 2018). Groundwater levels in these locations fluctuated between 21.813 mAHD (E-MBO3) to 23.099 mAHD (E-MB02) (refer Figure 5 of **Appendix 1**). This equates to groundwater levels across the site occurring between 3.050 to 4.829 m below ground level (mbgl), with approximately 1 m difference across the three bores at any one time.

There are no wetlands or watercourses recorded within the site (DBCA, 2020). No signs of water pooling or flowing across the site were noted during the ecological surveys (Coterra, 2017). The water characteristics of the subject land, both surface and groundwater, are addressed in **Appendix 1** and detailed in the Local Water Management Strategy (LWMS) prepared by Development Engineering Consultants (DEC) and attached as **Appendix 2**.

2.4 Bushfire hazard

Due to the bushfire threat to the Structure Plan area emanating from the existing vegetation and proposed revegetation within the Western Power easement, a detailed Bushfire Management Plan for the whole of Lot 28 has been prepared by Smith Bushfire Consultants and is appended as **Appendix 3**.

The most significant bushfire hazard pre-development is the extensive native vegetation associated with the Banksia scrub across the site. Following the subdivision the vegetation within the Kwinana Freeway road reserve abutting the eastern boundary of the subject property will become the primary bushfire hazard. The revegetation of the vegetation below the powerline within the easement will modify the vegetation to AS 3959: 2018 vegetation classification of shrubland. Western Power have increased their standard easement condition which previously restricted vegetation height to 2 metres above natural ground level but has been increased to 3 metres in height, which facilitates a broader species of shrubs within the easement.

The proposed clearing and filling of the development site will reduce an existing bushfire hazard as the existing vegetation is upslope of the proposed lots and the south-west wind is the most common wind in the afternoon in summer.

The native vegetation within the Western Power easement will be sufficiently separated from any future dwelling pursuant to the proposed excavation of sand and selective revegetation, including grasslands within the easement the potential bushfire, with further protection of future dwellings, if required, enhanced by house construction to the appropriate standard.

The planned public open space (POS) vegetation has been designed to not impact on the bushfire attack level of the neighbouring dwellings while maintaining biological, aesthetic and

recreational opportunities. By maximising the bushfire protection of the future residents and dwellings, and simultaneously achieving multiple of community values and assets ensures the optimum outcome for the POS.

Figure 7 below confirms that the great majority of the "Development' zoned land will have a Bushfire Attack Level of either 'BAL Low' or BAL 12.5, with higher BALs only where future dwellings are located close to the areas of remnant vegetation in the easement area.

Consultation with environmental and planning officers from the City of Cockburn in November 2023 resulted in a mutually agreeable outcome whereby the portion of the Western Power easement which, having obtained Western Power's consent, will be excavated for fill for the development of the Structure Plan. The City has agreed that the revegetation will be classified as "Scrub".

Further detail is provided in Technical Appendix 3 "Bushfire Management Plan" and Technical Appendix 8 "Western Power Easement Revegetation Plan and Methodology Statement".

Figure 7 overleaf is an extract from the appended Bushfire Management Plan's Bushfire Attack Level (BAL) Contour Map, which confirms that only two houses in this 46 lot Structure Plan will be rated higher than BAL 12.5, with up to 16 of the 46 lots rated BAL Low.

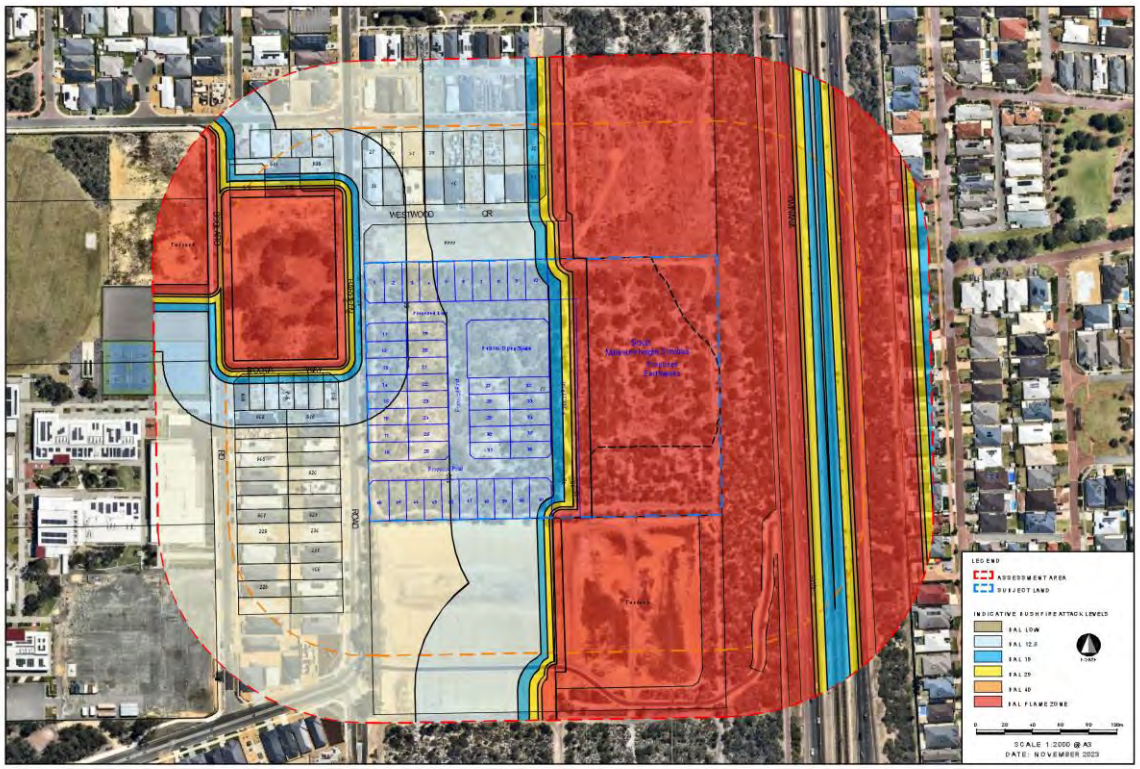


Figure 7: BAL Contour Map

2.5 Heritage

While a homestead and outbuildings existed on the site prior to Condor Nominees' acquisition of the property in 2005, there are no known sites or items of European heritage located in the structure plan area. In addition, the structure plan area contains no known Aboriginal heritage site(s). This notwithstanding, it is noted that Aboriginal heritage sites are protected under

legislation whether known and recorded, or not, and it is the landowner's responsibility to comply with legislative requirements.

2.6 Context and other land use constraints and opportunities

As evidenced by Figure 8 overleaf, the subject land is located immediately west of the Kwinana Freeway and forms part of the Hammond Park development area which has been progressively developed by various landowners over recent years.

The abutting property to the north (formerly Lot 29 Barfield Road) is substantially developed and the property to the south (Lot 15 Barfield Road) is partially constructed as a latter stage of the Vivente residential estate. The majority of properties on the western side of Barfield Road are fully developed.

Figure 8: Local Context

Lot 28 Barfield Road is located within comfortable walking distance of the recently opened Hammond Park Secondary College at the western side of Figure 8 and within 300m of a Transperth bus route on Irvine Drive on the western side of the College. Lot 28 is also within 400m of a proposed Local Centre immediately south of the College and the Hammond Park Catholic Primary School immediately west of the College. The Hammond Park Primary School is located approximately 1km to the north-west.

Lot 28 is somewhat exposed to traffic noise from the Kwinana Freeway to the immediate east, but the noise is mitigated to a degree by the height of eastern edge of the property and the lower level of the Freeway.

Lot 28 comprises two components, being the 'Development' zoned Structure Plan area which contains a mix of cleared land and remnant vegetation, on relatively flat terrain with a slight fall to the northern boundary, and the 'Special Use' zoned eastern portion consists of degraded vegetation on terrain which falls from east to west, accommodating Western Power transmission infrastructure running parallel to the Kwinana Freeway. The difference in terrain between the two components provide an opportunity to minimise the importation of fill by excavating surplus soil in the eastern portion to meet fill requirements for the development planned within the Structure Plan area.

Western Power's easement over the eastern portion of Lot 28 and its neighbours prohibits residential development but can, with Western Power's consent, be occupied by a subdivisional road servicing the proposed residential development, which assists the Structure Plan to address the traffic noise from the Freeway and potential bushfire threat from the vegetation (and proposed revegetation) within the easement.

3.0 Structure Plan

The Structure Plan area will predominantly facilitate residential development of the western portion of the subject area which is zoned 'Development' under the City's TPS No.3. The regular shape of the available residential development area enables a simple and legible subdivision layout, based upon two east-west access roads which intersect with Barfield Road, a central north-south access road and an eastern access road proposed within the western margin of the Western Power easement which will connect with a road on the same alignment within the development to the immediate south which forms part of Noble & Co's 'Vivente' estate. The development on the property to the immediate north also has an access road on the same alignment but does not provide for a connection with Lot 28.

The indicative Subdivision Plan which informs the Structure Plan's road layout is capable of delivering up to 46 front loaded residential lots, of which 28 have 12.5m street frontages, 10 have 12m street frontages and the remaining corner lots with lot widths of between 13.6m to 15.7m. North and south facing lots will have 30m lot depth to maximise solar access, whereas due to the Structure Plan area having an east-west dimension of 129.8m, the east and west facing lots will have a 28.6 to 28.7m lot depth.

Lot areas are expected to range from 344m^2 to 472m^2 and average around 370m^2 due to the predominance of the smaller lots. While this average exceeds the R-Code average of 300m^2, the range of lot sizes reflects the prevailing market demand for lot widths of 12m and 12.5m and ideally lot depth of 30m, the average is inflated by the eight corner lots which have additional width to facilitate side setbacks for the secondary street or, in the case of the two lots affected by BALs emanating from the easement vegetation, further width to mitigate the BAL impact.

Relevant components of the Structure Plan are discussed under Section 3.1 onwards and the "Indicative Subdivision Plan" which informs the Structure Plan is shown below as **Figure 9**.

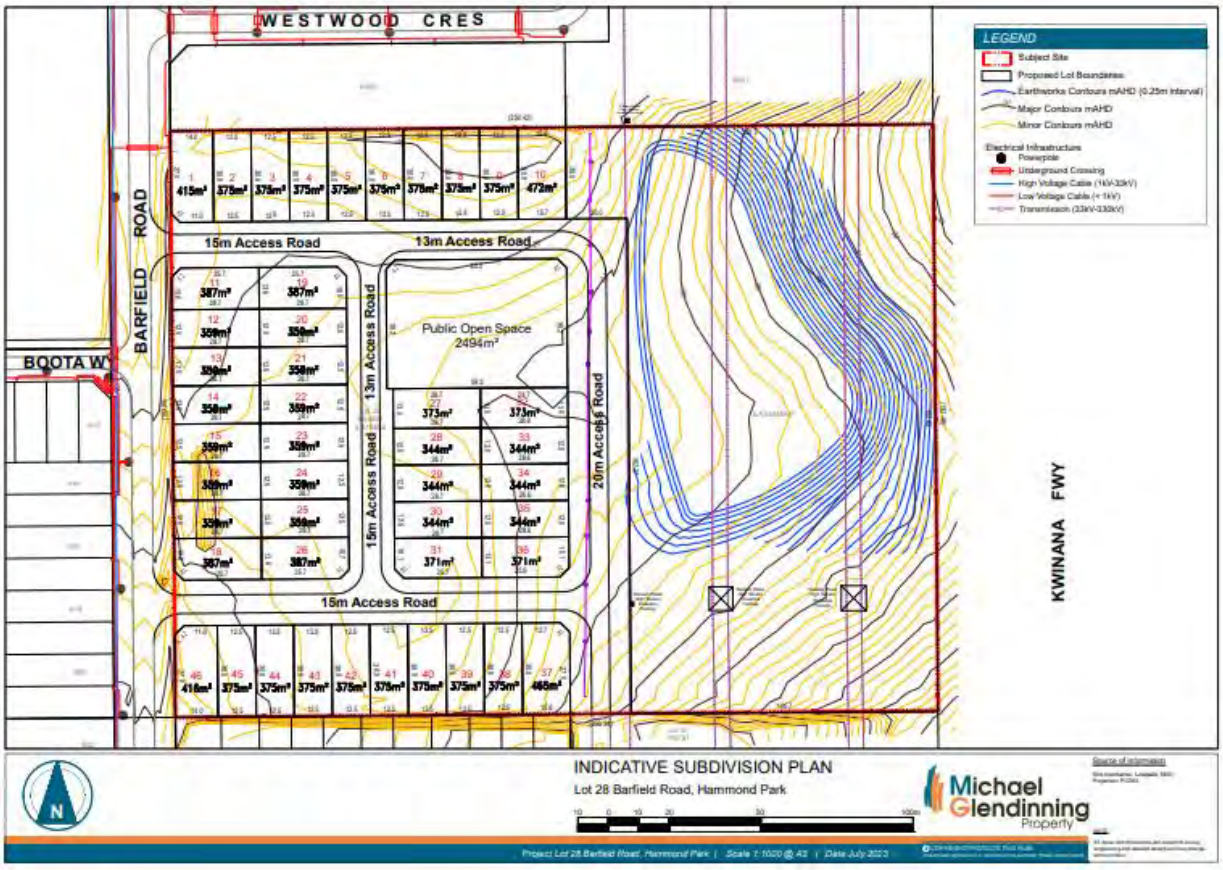


Figure 9: Indicative Subdivision Plan

3.1 Residential

The Structure Plan area will predominantly be developed for Residential purposes. The Structure Plan proposes a residential density code of R30 over the site.

The requirement to achieve a minimum density of 15 dwellings per gross hectare of residential land as outlined in Directions 2031 and Beyond is acknowledged. The target of 26 dwellings per residential site hectare as per the 'Perth and Peel @3.5 Million' strategy released by the WAPC in 2015 is also noted.

The Structure Plan has a gross area of 2.4943ha. Based on a minimum dwelling target of 15 dwellings per gross urban zoned hectare as set out in Directions 2031 and Beyond, the Structure Plan could yield 37 dwellings.

The Structure Plan has a residential area of 1.7064ha. Based on a maximum density target of 26 dwellings per residential site hectare (excluding access roads and POS) as set out in Perth and Peel @ 3.5 Million, the Structure Plan could yield 44 dwellings.

The indicative Subdivision Plan which underpins the Structure Plan achieves a yield of 46 lots/dwellings (refer Figure 9) and therefore satisfies the minimum density targets in Directions 2031 and Beyond, and Perth and Peel @3.5 Million. Based on Greater Perth's average household size of 2.6 persons per dwelling (2016 Census) the estimated population of the Structure Plan area is 120 persons.

3.2 Public Open Space

The proponents of the Structure Plan engaged with the City of Cockburn to explore several options for the location of the POS within the Structure Plan. The City expressed a desire that the POS would contain an area of good quality native vegetation near the north-eastern corner of the Structure Plan area. The proponents and the City met on site and agreed the POS location now evidenced on the Structure Plan and the underlying indicative Subdivision Plan. This location provides a balance of retained vegetation and passive open space for the future residents.

Having reached this bilateral decision, the proponents commissioned a POS concept from Plan E Landscape Architects in October 2023, included as Technical Appendix 7 "Public Open Space Landscape Concept". Element 4 (Public Parkland) of Liveable Neighbourhoods requires a POS Schedule, provided below:

PUBLIC OPEN SPACE SCHEDULE	
ITEM	**DATA**
Structure Plan Area	2.4943ha
Area of each land use proposed: • Residential • Public Open Space	 2.2449ha (90.0%) 0.2494ha (10.0%)
Public Open Space components • Passive/Active Open Space • Retained Vegetation	 0.1482ha (59% of 10%) 0.1012ha (41% of 10%)

3.3 Movement Network

The Structure Plan has direct road frontage on Barfield Road with two proposed full movement priority-controlled access intersections on Barfield Road and a connection to Lot 15 to the immediate south. The traffic analysis undertaken by Transcore and appended as **Appendix 4** shows that the traffic generation of the Structure Plan is relatively low and would not have any significant impact on the surrounding road network. The traffic modelling and analysis undertaken indicates that the projected traffic volumes on all SP internal roads would be less than 1,000 vehicles per day (vpd) and therefore the internal roads of would be classified as Access Street D in line with the Liveable Neighbourhoods guidelines.

The basic standard for Access Street D roads is a 6m wide carriageway in a 15m road reserve in accordance with Liveable Neighbourhoods' requirement for an Access Street D serving less than 1000 vpd.

Currently there is a shared path and a footpath to the west and east side of Barfield Road respectively immediately north of the subject site which has been constructed as part of the development of Lot 29 (the northern Lot). It is expected that similar paths would be provided along Barfield Road fronting the subject site. In accordance with the requirements of Liveable Neighbourhoods, footpaths will be provided on at least one side of every street within the development.

South of the Structure Plan area is the Vivente Dual Use Path through Lot 15 which connects to the commuter PSP on the western side of the Kwinana Freeway. The proponent anticipates providing footpaths on either side of our internal roads, including the 20m road planned within the WP easement which will connect the two developments to provide access to cyclists and pedestrians with access to the Dual Use Path connecting Lot 15 to the Kwinana Freeway PSP.

3.4 Infrastructure and Servicing

The report on Engineering Services provided by DEC (appended as **Appendix 5**) addresses the following:

- Site conditions
- Earthworks and Retaining Walls
- Roads
- Drainage
- Groundwater
- Power
- Water Supply
- Sewer
- Telecommunications Infrastructure; and
- Gas

In summary, DEC's report confirms that all the above services are available to Lot 28 subject to improvements to the property, in particular the filling of the Structure Plan area to facilitate gravity sewer reticulation to connect to existing infrastructure to the west. This and the need to integrate lot levels with Lot 29 to the immediate north and Lot 15 to the immediate south (both of which have excavated sand from the Western Power easement area to fill their lots) is the rationale for the earthworks within the easement indicated on our indicative Subdivision Plan (**Figure 9**) which have been approved by Western Power subject to our compliance with their standard easement conditions.

All roads within the development will be designed and constructed to the City's specifications and it is noted that Barfield Road, which abuts the site on its western boundary, is currently unkerbed on its eastern side and on both sides north of Boota Way and has been kerbed on its western side as part of the adjoining "Vivente" development. Although it is in good condition it will required to be upgraded, kerbed on its eastern side and "urbanized" as part of the development works.

No drainage function is proposed, as the Lot 29 development to the immediate north has a large drainage basin and significant unused area occupied by the power lines which, according to the City's subdivision engineer, has spare capacity to accommodate stormwater drainage from Lot 28.

Groundwater level at the site generally has a peak level at RL23.3m AHD at Barfield Road rising to around RL23.7m AHD at the western side of the power easement. The site levels rise from RL25.5m AHD in the north-west corner of the site to around RL34m AHD in the south-eastern corner of the site abutting the Kwinana Freeway providing a minimum clearance to peak groundwater of some 2.1m.

The land can be connected to all services, either by extension and upgrading from existing infrastructure in Barfield Road. Power, telephone, gas, sewer, water and telecommunications infrastructure already pass along the site frontage, therefore consultation with infrastructure providers has not been necessary.

Telstra, however, has advised that its network has the capacity to absorb the likely incremental customers from this proposal, there are no current known quality issues at the site with the Telstra network, and that there are no identified Telstra Wireless infrastructure upgrade needs in the immediate area.

All residential development along Barfield Road to date has included lots with direct frontage to Barfield Road and, therefore, the opportunity for lots to have direct frontage and access to Barfield Road has also been taken for the Lot 28 Structure Plan.

3.5 Noise Mitigation

The Transportation Noise Assessment provided by Lloyd George Acoustics and appended as **Appendix 6** assesses the noise emanating from the Kwinana Freeway, plots the expected noise levels as they relate to the potential need for affected lots (primarily the easternmost lots facing east toward the Freeway) and considers noise mitigation requirements and response options, which include:

- Package A or B requirements for houses on lots where noise levels exceed 51dB;
- A noise wall at the eastern end of the property, being its boundary with the Kwinana Freeway road reserve; or
- House specific assessment based on the specific design of the house.

These options are addressed in detail in **Appendix 6** and a decision on one or more of the options will be made through the ensuing Subdivision Application process and it is acknowledged that a Local Development Plan or Plans may be required to ensure adequate mitigation measures.

Part Three - Appendices

Technical Appendices Index

Appendix	Content	Prepared by:
1	Environmental Assessment Report	Coterra Environment
2	Local Water Management Strategy	Development Engineering Consultants
3	Bushfire Management Plan	Smith Bushfire Consultants
4	Transport Impact Statement	Transcore
5	Engineering Services Report	Development Engineering Consultants
6	Transportation Noise Assessment	Lloyd George Acoustics
7	Public Open Space Landscape Concept	Plan E Landscape Architects
8	Western Power Easement Revegetation Plan and Methodology Statement	Coterra Environment

Appendix 1: Environmental Assessment Report

Coterra Environment

COTERRA ENVIRONMENT

Environmental Assessment Report

Lot 28 (157) Barfield Road, Hammond Park

Rev 2 November 2022

CALIBRE | COMMITMENT | COLLABORATION

This report was prepared by: Coterra Pty Ltd trading as COTERRA ENVIRONMENT
ABN: ABN: 92 143 411 456
Our Ref: MGPBAR05
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Reviewer: K. Choo
Report Version: Rev 2
Date: November 2022

This report was prepared for:

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1 Introduction

Having purchased the property in 2005, Condor Nominees is proposing to develop Lot 28 (157) Barfield Road, Hammond Park (the site) for residential purposes. The site is located within the City of Cockburn, approximately 25 kilometres (km) south of Perth Central Business District (Figure 1).

The site covers approximately 4.81 hectares (ha) and is surrounded by residential development to the north, south and west (Figure 2). A Western Power transmission line easement (2.33 ha) is located on the eastern portion of the site, between the proposed residential development and the Kwinana Freeway (Figure 2).

The site is currently unoccupied (buildings previously present have been demolished) and is approximately 80% vegetated, with some tracks and cleared areas located throughout.

In November 2021, a proposed action to clear vegetation to construct a residential development on the site was referred to the Department of Agriculture, Water and the Environment (DAWE) in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In December 2021, DAWE issued its decision that the proposed action is "not a controlled action", thereby allowing the clearing and development to proceed.

1.1 Planning Context

The site is zoned 'Urban' under the Metropolitan Region Scheme (DoP, 1984) and is zoned partially 'Development Zone' and partially 'Special Use' under the City of Cockburn Town Planning Scheme (TPS) No. 3 (DPLH, 2002).

1.2 Land Use History

The site is currently undeveloped, although tracks/firebreaks have been historically constructed around the perimeter and throughout the site.

A brief assessment of historical aerial photography (Landgate, 2021a) is detailed below:

- **1953**: site is undeveloped. Vegetation is present on site, likely representative of remnant vegetation.
- **1965**: eastern portion of site is cleared in association with rural land uses. Western portion of site remains vegetated.
- **1970**: vegetation has regenerated through eastern portion of the site. Clearing has been undertaken to dissect the western and eastern portions of the site.
- **1974 - 1985**: the eastern portion of the site is again cleared in its entirety in association with power line infrastructure, which is visible on site. The western portion of the site remains vegetated.
- **1989**: a house and access roads (from Barfield Road) has been constructed in the western portion of the site. The eastern portion of the site remains cleared.
- **1995**: further clearing and construction has been undertaken in the western portion of the site. Some vegetation has regenerated in the eastern portion of the site. Kwinana Freeway has been constructed adjacent to the site by this point in time.
- **2000 - 2015**: no changes evident to the western or eastern portion of the site.
- **2018**: constructed buildings have been removed from the western portion of the site. The eastern portion of the site remains vegetated but partially cleared. Firebreaks are visible around the perimeter of the site.

1.3 Site Development Actions

The development of the 4.81 ha site encompasses the following:

1. 3.44 ha of vegetation clearing, comprising 2.35 ha for residential development and 1.09 ha within the Western Power easement for the excavation of sand to fill the residential development to integrate with those developments to the north and south of the site, thereby allowing the site to be gravity-sewered and drained. The proponent has, as did their neighbours, obtained Western Power's consent to excavate within their easement for the fill required for the proposed residential development
2. Subdivision of 2.48 ha of the site including construction of internal public roads, installation of services (power, gas, water, telecommunications), establishment of residential lots and public open space. A Structure Plan has been prepared for the site to facilitate development for residential purposes (Figure 3), under the City of Cockburn TPS No. 3 (DPLH, 2002)
3. The remaining 2.33 ha of the site is encumbered by a Western Power high voltage transmission line easement traversing mostly degraded vegetation. No residential lots will be located within this portion of the site, although a road reserve, earthworks and revegetation have been planned for inclusion within the easement (Figure 3).

1.4 Purpose of this Report

This report is being prepared in support of a Structure Plan, which will facilitate future residential subdivision and development of the site.

2 Key Guidance and Policies

2.1 Town Planning

2.1.1 Liveable Neighbourhoods

Liveable Neighbourhoods is the Western Australian Planning Commission's (WAPC) operational guidelines for the design and assessment of structure plans and subdivision to guide the future development of Perth and Peel and the State's regional centres (WAPC, 2015a).

Liveable Neighbourhoods is aligned to the following strategic policies:

- State Planning Strategy 2050 (WAPC, 2014)
- Perth and Peel @ 3.5 million (WAPC, 2018)
- Directions 2031 and Beyond (WAPC, 2010)
- State Planning Policy 3: Urban Growth and Settlement (WAPC, 2006).

In addition, it is supported by local planning strategies, local planning schemes, local planning policies and local development plans (WAPC, 2015a).

2.1.2 City of Cockburn Town Planning Scheme No. 3

The City of Cockburn TPS No 3 details provisions for development within the City of Cockburn. TPS No. 3 details objectives for 'Development' zones as follows:

"To provide for future residential, industrial or commercial development to be guided by a comprehensive Structure Plan prepared under the Scheme." (DPLH, 2002).

The site is with Development Area 26, which requires future development to adhere to the following scheme provisions:

- An approved Structure Plan together with all approved amendments shall be given due regard in the assessment of applications for subdivision, land use and development in accordance with clause 27(1) of the Deemed Provisions
- To provide for residential development and compatible land uses

2.1.3 City of Cockburn Local Planning Policies

The City of Cockburn has multiple local planning policies relevant to residential development, including but not limited to the following:

- Local Planning Policy (LPP) 1.12 Noise Attenuation Policy and Guidelines – provides guidance on noise management and reporting process within the City of Cockburn and requirements for different acoustic reports in support of Structure Plans and Development Applications
- LPP 5.1 Public Open Space – outlines public open space requirements in accordance with Liveable Neighbourhoods, Development Control Policy 2.3 (WAPC, 2002) and State Planning Policy 3.7 Planning for Bushfire Risk. Identifies areas that are not acceptable public open areas within a development.
- LPP 5.4 Location of High Voltage Overhead Power Lines Microwave Towers – this policy provides details on determining setback requirements from overhead power lines and residential development.
- LPP 5.11 Filling of Land – details procedure for engineering certification in relation to filled sites for subdivision and/or development.

- LPP 5.12 Retaining Walls – details development retaining wall requirements and City approvals process
- LPP 5.15 Access Street - Road Reserve & Pavement Standards – details guidance on street design and construction based on Liveable Neighbourhoods
- LPP 5.18 Subdivision and Development – Street Trees – details street tree requirements and quantities to be provided within a development, noting no specification as to species, only that they mature to a sufficient size and canopy, and provide sufficient street verge shading.

2.2 Land Use Planning

2.2.1 Guidance Statement No. 33

Environmental Protection Authority (EPA) Guidance Statement No. 33 – *Environmental Guidance for Planning and Development* (EPA, 2008) provides an overview of environmental protection processes and information, to assist land use planning and development in Western Australia. It provides specific information on (EPA, 2008):

- Environmental protection processes in Western Australia including referral and environmental impact assessment procedures that apply to land use planning and development under the *Environmental Protection Act 1986*
- EPA's advice on protecting a range of biophysical factors, to assist land use planning, including:
  - Biodiversity and significant natural areas
  - Native terrestrial vegetation
  - Native terrestrial fauna
  - Wetlands
  - Waterways
  - Public drinking water source areas
  - Land degradation
  - Landscape and landforms
  - Karst, subterranean wetlands and fauna
- EPA's advice on managing potential pollutants, waste and water (pollution management factors), to assist land use planning, including:
  - Pollution management
  - Air quality
  - Water management
  - Noise and vibration
  - Light, radiation and electromagnetic fields
  - Contaminated sites
  - Waste management.
- EPA's advice on protecting aspects of the biophysical environment of cultural and social significance to the community (social surroundings factors), and the EPA's position on risk.

2.2.2 Draft State Planning Policy 2.9 Planning for Water Policy and Guidelines

2.2.2.1 Draft State Planning Policy 2.9 Planning for Water Policy

The intent of draft State Planning Policy 2.9 (SPP 2.9) is to ensure planning and development considers water resource management, including appropriate management measures to achieve optimal water resource outcomes (WAPC, 2021).

Draft SPP 2.9 consolidates multiple water-related policies and guidelines, with the overall objectives to:

- Protect and improve the environmental, social, cultural and economic values of the State's water resources
- Protect public health and the long-term supply of good quality and affordable drinking water
- Manage the risk of riverine flooding to people, property and infrastructure
- Ensure the secure and sustainable supply, use and re-use of water resources
- Ensure future development is resilient to the water related impacts of climate change
- Minimise future costs and protect public health by ensuring that appropriate wastewater infrastructure is provided.

Draft SPP 2.9 details specific management measures in relation to the Swan Canning river system are detailed as follows:

- Maintain and enhance the natural ecosystem and hydrological functions of the river system, and demonstrate detrimental impacts have been mitigated
- Demonstrate a benefit to the community and a functional need to be located within the river and/or foreshore reserves, where the proposal is located on public land
- Maintain and enhance public access to and along the rivers and its foreshores, including through the establishment of foreshore reserves
- Consider the importance of the river as a strategic water transport network for commercial and recreational use
- Maintain and enhance the natural landscape character and sense of place of the river system
- Maintain and enhance views to or from the Swan Canning river system from public places
- Identify and protect Noongar and other cultural heritage places and values
- Protect, maintain or increase vegetation coverage (preferably with endemic species)
- Maintain or establish ecological and public open space linkages to the Swan Canning river system for wildlife habitat and movement and natural water flows (WAPC, 2021).

2.2.2.2 Draft State Planning Policy 2.9 Planning for Water Guidelines

Draft SPP 2.9 guidelines provide information relevant to the implementation of the draft SPP 2.9 policy (Section 2.2.2.1). The guidelines provide advice in:

- Determining appropriate land use planning practices in relation to water resources across Western Australia
- Specifying the requirements to be met at each stage of the planning process
- Ensuring that necessary water resource management measures are incorporated into land development.

The guidelines detail what information is required at different stages of the planning and development approvals process, including:

- Addressing climate change
- Addressing cumulative impact
- Water management plans
- Environmental, social and cultural values
- Riverine flooding
- Infrastructure and supply
- Public drinking water source areas
- Peel-Harvey Coastal Plain catchment
- Swan Canning river system.

Specific to the Swan Canning river system, draft SPP 2.9 states that proposals around the Swan Canning river system should protect and enhance the ecological heal, community benefits, amenity and heritage value of the Swan Canning river system for the public benefit of Western Australia (WAPC, 2021b).

2.2.3 State Planning Policy 3.7: Planning in Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas

State Planning Policy 3.7 (SPP 3.7) – Planning in Bushfire Prone Areas (WAPC, 2015b) and the associated Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017) have been developed to implement effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure (WAPC, 2015b).

SPP 3.7 applies to all strategic planning, subdivision and development applications in bushfire prone areas, and aims to support development through an assessment of bushfire hazard. The aims of SPP 3.7 are to:

- Avoid increases in the threat of bushfire to people, property and infrastructure
- Reduce vulnerability to bushfire through identification and consideration of bushfire risks
- Ensure higher order strategic planning documents, proposals, subdivision and development applications take into account bushfire protection requirements
- Achieve an appropriate balance between bushfire risk management measures, biodiversity conservation values, environmental protection and biodiversity management and landscape amenity, with consideration to climate change (WAPC, 2015b).

The Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017) provides guidance on the implementation of SPP 3.7, and assist in:

- Determining appropriate land use planning in relation to bushfire prone areas across Western Australia
- Specifying the requirements to be met at each stage of the planning process
- Ensuring that necessary bushfire protection measures are incorporated into development (WAPC, 2017).

3 Existing Environment

3.1 Climate

The site is located in the Perth metropolitan area, which experiences a typical Mediterranean climate, with hot, dry summers and cool, wet winters. Jandakot Aero weather station, located 8.1 km from the site, reports an annual mean rainfall of approximately 816 millimetres (mm) (BOM, 2021). Temperature ranges from 18 C (July) to 31.5 C (February) (BOM, 2021).

3.2 Landforms, Soils and Topography

Topography of the site is gently sloping, with the lowest point occurring on the north western boundary at approximately 24 metres Australian Height Datum (mAHD), reaching a high point of 34 mAHD in the south eastern corner of the site (Figure 4). The aspect of the site is generally west.

The site is located within the Bassendean Dune system of the Swan Coastal Plain. The primary soil type across the subject area is S_8, which is described as: SAND – very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of Aeolian origin (Gozzard, 1983; Figure 4).

The subject area is mapped as having a Moderate to Low Risk of Acid Sulfate Soils (ASS) occurring within 3 m of the soil surface (DWER, 2017a; Figure 4).

3.3 Hydrology

3.3.1 Groundwater

Estimated maximum groundwater levels across the site range from approximately 21 to 22 mAHD, flowing in a general westerly direction (DWER, 2017b). Groundwater is likely to occur between 5 – 7 metres below ground level (mbgl) (DWER, 2017b).

Groundwater monitoring was undertaken across three bores within the site between September 2017 and November 2018 to capture two winter peak periods (Emerge Associates, 2018). Groundwater levels in these locations fluctuated between 21.813 mAHD (E-MBO3) to 23.099 mAHD (E-MB02) (Figure 5; Appendix 1). This equates to groundwater levels across the site occurring between 3.050 to 4.829 m below ground level (mbgl), with approximately 1 m difference across the three bores at any one time.

3.3.2 Surface Water and Wetlands

There are no wetlands or watercourses recorded within the site (DBCA, 2020). No signs of water pooling or flowing across the site were noted during the ecological surveys (Coterra, 2017).

3.4 Vegetation and Flora

3.4.1 Vegetation Associations and Complexes

The site is historically representative of Beard Vegetation Association 1001, which is described as 'medium very sparse woodland; Jarrah, with low woodland; Banksia or Casuarina' (Beard et al, 2005) and the Bassendean Complex – Central and South (Figure 6; Heddle et al, 1980). The Bassendean Complex – Central and south is described as "woodland of jarrah (*Eucalyptus marginata*), *Allocasuarina fraseriana, Banksia attenuata, B. grandis* and *B. menziesii* on the sand dunes to low woodland of *Melaleuca preissiana, B. ilicifolia* and *B. littoralis* and sedgelands on the low-lying moister sites. This area includes the transition of jarrah to coastal blackbutt (*E. todtiana*) in the Perth vicinity and jarrah to marri (*Corymbia calophylla*) on the moister

soils. Other plant species include *Kunzea ericifolia, Hypocalymma angustifolium, Adenanthos obovatus* and Verticordia species (Heddle et al, 1980).

3.4.2 Vegetation Type

A detailed vegetation and flora survey was undertaken on the site (Coterra, 2017). The survey was done in accordance with relevant government guidance (EPA, 2016a). Two vegetation types were observed on the site, as follows:

- An Open Low Forest of *Banksia attenuata, B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* over Open Tall Shrubland to Tall Shrubland of *Xanthorrhoea preissii*, with occasional pockets of *Kunzea glabrescens* tall shrubs, over Open Shrubland to Shrubland of *Stirlingia latifolia* over Open Low Shrubland of *Hibbertia hypericoides* or *Hypocalymma robustum* and *Bossiaea eriocarpa* or over a mixed Sedgeland/Herbland including *Phlebocarya ciliata*, and/or *Desmocladus flexuosus* and *Lepidosperma squamatum* on midslope flats, on loamy sands, was recorded predominantly in the western portion of the subject area.
- Scattered *Banksia menziesii* and *B. ilicifolia* over Shrubland to tall Shrubland of *Adenanthos cygnorum* over Open Grassland of introduced species **Ehrharta calycina* with scattered native low shrubs, on midslope sandy flats was recorded predominantly in the eastern portion of the subject area.

3.4.3 Vegetation Condition

Vegetation condition ranged from 'Completely Degraded' to 'Very Good' according to the Keighery (1994) scale (Coterra, 2017). Vegetation in the eastern portion of the site (in association with the Western Power transmission line easement) was predominantly in 'Degraded' to 'Completely Degraded' condition, and patches of 'Good' to 'Very Good' condition vegetation were identified in the western portion of the site (Coterra, 2017).

3.4.4 Threatened and Priority Flora

A targeted search for threatened and priority flora identified under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016*, was undertaken and no flora species of conservation significance were recorded on site (Coterra, 2017). The survey was conducted during the peak Spring flowering period, within optimum search times for conservation-significant orchid species such as *Caladenia huegelii* (Coterra, 2017).

3.4.5 Threatened and Priority Ecological Communities

3.4.5.1 Banksia Woodlands of the Swan Coastal Plain ecological community

Vegetation within the western portion of the site was assessed and determined to be representative of the Banksia Woodlands of the Swan Coastal Plain ecological community (Banksia Woodlands Threatened Ecological Community (TEC)), as defined by DEE (2016a, 2016b). In summary, the key diagnostic criteria used in identifying the Banksia Woodlands TEC are addressed as follows:

- The criteria of vegetation condition is met, with the Banksia woodland in the western portion of the subject area in Very Good and Good Condition (Figure 6).
- The criteria of patch size is met, with the areas of Very Good and Good Condition mapped as 1.16 ha and 0.23 ha in size respectively.
- The criteria of an upper layer of trees of Banksia dominated or co-dominated species is met, with the tree canopy layer dominated by *Banksia attenuata*, *B. menziesii* and *B. ilicifolia*.
- The criteria of a species-rich and diverse understory is met, with 75 native understorey species recorded in this floristic community within the subject area.

- Key species in the sclerophyllous shrub layer of the ecological community including *Bossiaea eriocarpa* (common brown pea), *Daviesia* spp., *Daviesia triflora*, *Eremaea pauciflora*, *Gompholobium tomentosum* (hairy yellow pea), *Hibbertia hypericoides* (yellow buttercups), *Kunzea glabrescens*, *Petrophile linearis* (pixie mops), *Philotheca spicata* (pepper and salt), *Stirlingia latifolia* (blueboy), *Phlebocarya ciliata*, *Hypolaena exsulca* and *Xanthorrhoea preissii* (balga) were recorded (Coterra, 2017).
- Key species in the herbaceous ground layer including *Amphipogon turbinatus* (tufted beard grass), *Burchardia congesta* (milkmaids), Caladenia spp. (spider orchids), *Dasypogon bromeliifolius* (pineapple bush), *Desmocladus flexuosus*, *Drosera erythrorhiza* (red ink sun dew), *Lepidosperma squamatum* (a tufted sedge), *Lomandra hermaphrodita*, *Lyginia imberbis*, *Mesomelaena pseudostygia* (semaphore sedge), *Patersonia occidentalis* (purple flag), *Stylidium brunonianum* (pink fountain trigger plant), *Stylidium piliferum* (common butterfly trigger plant), *Trachymene pilosa* (dwarf parsnip), and *Xanthosia huegelii* (heath xanthosia) were recorded (Coterra, 2017).

Of the developable 2.48 ha portion of the site, the Threatened Ecological Community (TEC) comprises 1.38 ha in 'Good' (0.23 ha) to 'Very Good' (1.16 ha) vegetation (Coterra, 2017). The remaining 1.1 ha of banksia woodland in 'Degraded' to 'Completely Degraded' condition cannot be defined as Banksia Woodland TEC due to its poor condition.

3.4.5.2 Tuart (*Ecualyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community

A patch, in respect of the Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community is defined as containing at least three established Tuart trees, with no more than 40 metres between their canopies (DEE, 2017a). Only two Tuart trees were recorded on site, approximately 8 m apart (Coterra Environment, 2017).

Whilst the Tuart Woodlands TEC can co-occur with the Banksia Woodlands TEC, in cases where Tuart occurs as an occasional emergent above a stratum dominated or co-dominated by Banksia species, the patch is likely to be the Banksia Woodlands TEC (DEE, 2017a), as demonstrated through an assessment of key diagnostic characteristics (Coterra, 2017). As such, no further assessment was made as to the possible occurrence of the vegetation belonging to the Tuart Woodlands TEC.

3.4.6 Bush Forever and Ecological Linkages

3.4.6.1 Bush Forever

Multiple Bush Forever sites are located in the vicinity of the site within State-managed conservation reserves (Figure 8), including:

- Bush Forever (BF) Site 392 (Harry Waring Marsupial Reserve, Wattleup)

  Located approximately 1.3 km west of the site (Landgate, 2021b). BF Site 392 contains approximately 271 ha of bushland on Bassendean and Spearwood Dunes (DEP, 2000). Vegetation includes Floristic Community Type (FCT) 21a, 23a and 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 492 (Lyon Road Bushland, Banjup)

  Located approximately 1.3 km northeast of the site (Landgate, 2021b). BF Site 492 contains approximately 25 h of bushland on Bassendean Dunes (DEP, 2000). Vegetation includes FCT 21a, 21c and 23a, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 268 – Mandogalup Road Bushland, Mandogalup

  Located approximately 2.2 km southwest of the site (Landgate, 2021b). BF Site 268 contains approximately 96 ha of bushland on Bassendean and Spearwood Dunes (DEP, 2000). Vegetation

includes FCT 25 and 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 391 (Thomsons Lake Nature Reserve and Adjacent Bushland, Beeliar)

  Located approximately 2.6 km northwest of the site (Landgate, 2021b). BF Site 391 contains approximately 366 ha of bushland on Bassendean and Spearwood Dunes (DEP, 2000). Vegetation includes FCT 24 and 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 263 – Banjup Bushland, Banjup

  Located approximately 2.8 km northeast of the site (Landgate, 2021b). BF Site 263 contains approximately 104 ha of bushland on Bassendean Dunes (DEP, 2000). Vegetation includes FCT 21c, 22 and 23a, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 267 – Mandogalup Road Bushland, Hope Valley

  Located approximately 3.2 km southwest of the site (Landgate, 2021b). BF Site 267 contains approximately 15 ha of bushland on Spearwood Dunes (DEP, 2000). Vegetation includes FCT 28, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 347 – Wandi Nature Reserve and Anketell Road Bushland, Wandi/Oakford

  Located approximately 3.2 km southeast of the site (Landgate, 2021b). BF Site 347 contains approximately 412 ha of bushland on Pinjarra Plains and Bassendean Dunes. Vegetation includes FCT 22 and 23a, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

- Bush Forever Site 344 – Denis De Young Reserve and Gibbs Road Swamp Bushland, Banjup/Forrestdale

  Located approximately 3.3 km northeast of the site (Landgate, 2021b). BF Site 344 contains approximately 289 ha of bushland on Bassendean Dunes (DEP, 2000). Vegetation includes FCT 21c and 22, which can be attributed to the Banksia Woodlands TEC (DEP, 2000; DEE, 2016a).

3.4.6.2 Ecological linkages

The portion of the site contained within the Western Power easement is identified by the City of Cockburn as a local ecological linkage. Local ecological linkages aim to link protected locally significant patches to each other, regionally significant patches and regional ecological linkages (Molloy et al., 2009).

3.4.7 Bush Fire Risk

The site is located in a mapped bushfire prone area, as defined by the Department of Fire and Emergency Services (Landgate, 2021). These areas are defined as being subject to, or likely to be subject to, bush fire attack, and are identified by the presence of and proximity to bush fire prone vegetation and includes both the area containing the bush fire prone vegetation and a 100 m buffer zone immediately surrounding it (Landgate, 2021).

3.5 Fauna Habitat and Fauna

3.5.1 Fauna Habitat

A fauna habitat survey was undertaken on site in accordance with relevant government guidance (EPA, 2002, 2016b; EPA & DEC, 2010). Banksia Woodland was identified across the majority of the site as representing fauna habitat (Figure 6), noting variable condition of vegetation (Coterra, 2017).

3.5.1.1 Black Cockatoo Habitat

The following dominant trees and shrub species identified on site that present potential foraging habitat for black cockatoos (Carnaby's Black Cockatoo, Baudin's Black Cockatoo, Forest Red-tailed Black Cockatoo):

- *Banksia attenuata*
- *Banksia menziesii*
- *Banksia ilicifolia*
- *Eucalyptus marginata* (Jarrah)
- *Allocasuarina fraseriana* (Sheoak)
- *Xanthorrhoea preissii* (Balga) (Coterra, 2017).

An assessment of foraging value was undertaken on site, based on habitat density and canopy cover (averaging 10-30% canopy cover). Habitat at the site represents low to moderate foraging value for black cockatoos (Coterra, 2017).

No black cockatoo breeding or roosting habitat trees were identified on site (Coterra, 2017).

3.5.2 Fauna Occurrence

Whilst database searches identified numerous fauna species as potentially occurring on the site, within the broader context of the Swan Coastal Plain bioregion, only four birds and one mammal, of which none are conservation-significant, were recorded on site (Coterra, 2017).

3.5.3 Significant Fauna Species

Of the EPBC conservation-significant species identified as potentially occurring on site, three black cockatoo species and Rainbow Bee-eater, none of these species were recorded on site (Coterra, 2017).

4 Potential Environmental Impacts and Proposed Management

4.1 Soils and Topography

4.1.1 Potential Impacts

The site is mapped in a 'moderate to low' risk ASS area (Section 3.2). Disturbance to ASS has the potential to create an acidic environment, which may impact groundwater if not appropriately managed.

4.1.2 Management Measures

Once detailed engineering and construction details are available, an ASS self-assessment form (WAPC, 2020; Appendix 2) should be completed, and if there is potential for ASS to be impacted by the development, an ASS investigation should be undertaken. The ASS investigation and management plan should be undertaken in accordance with the following:

- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER, 2015a)
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER, 2015b).

These investigations and management plans could be undertaken as a condition of subdivision approval.

4.2 Groundwater and Stormwater

4.2.1 Potential Impacts

The development will be managed to avoid adverse impacts to groundwater which could then have an impact on nearby waterbodies.

4.2.2 Management Measures

A Local Water Management Strategy (LWMS) has been prepared for the site by Development Engineering Consultants (December 2021), to outline groundwater and stormwater management initiatives in respect of the development.

4.2.2.1 Stormwater Management

Stormwater management on the site post development will be based on the principles of water sensitive urban design and use best management practices consistent with draft SPP 2.9 (WAPC, 2021). Stormwater management will also be required to be consistent with local government requirements.

The LWMS demonstrates that stormwater is able to be appropriately managed. The following approach is proposed for the site (DEC, 2021):

- Drainage will be directed to the existing POS/Drainage area located in Lot 8001 which is east of Westwood Crescent in the development of former Lot 29 Barfield Road, and immediately north of Lot 28. The swale will be designed to ensure all events up to the major 1% AEP storm is infiltrated on site.
- Bio Retention areas will be constructed at the proposed drainage outlet to provide nutrient uptake during the infiltration process.
- The 1% AEP storm will be wholly contained within POS area
- All roads within the estate will be designed to accommodate and direct extreme event flows towards each POS and drainage basin
- The development is proposed to be filled a minimum of 300mm above the top water level of drainage basins to ensure conveyance for major storms will be along the roadways without flooding homes.

4.2.2.2 Water Quality Management

The following water quality management measures are proposed for the site (DEC, 2021):

- Construction activities will be managed to ensure stormwater pollution is minimised (see section 6.8 of LWMS for further detail)
- Surface water will be routed to swale basins and retained on site
- To achieve significant reductions of total suspended solids, total phosphorus and total nitrogen and gross pollutants, the following best management measures are proposed (DEC, 2021):
  - Non structural measures will be implemented to reduce applied nutrient loading
  - On site retention of 63.22% AEP 1 hour storm

4.2.2.3 Groundwater Management

Required groundwater clearances will be achieved at the site through design measures.

Fill is required on site to integrate the development with existing residential developments to the north and south of the site, allow the site to be gravity-sewered and drained.

In general, the groundwater levels are several metres below the site levels. Therefore, development levels are generally at a minimum of RL25.6mAHD, which is above the maximum likely groundwater level. Subsequently, there is no further need for controls of groundwater levels and all drainage pipework will be laid well above the controlled groundwater levels (DEC, 2021).

4.3 Vegetation and Flora

4.3.1 Potential Impacts

With exception to the Public Open Space, future residential development of the site will result in clearing of native vegetation within the western portion of the site. Within the powerline easement, retention of 0.72 ha of vegetation is proposed with the remaining area proposed for bulk earthworks and a road reserve which will connect with the development to the south, this arrangement having been accepted by Western Power. The potential for bushfire risks associated with retained and planted vegetation should also be considered.

4.3.2 Management Measures

4.3.2.1 Vegetation Retention

Existing vegetation will be retained within the easement (0.72 ha) and within the Public Open Space (0.13 ha) (Figure 3). The vegetation proposed for retention within the easement is comprised of degraded shrubland, which contains scattered *Banksia menziesii* and *B. ilicifolia* but is dominated by *Adenanthos cygnorum*. Within the Public Open Space the vegetation proposed for retention is comprised of an open low forest of *Banksia attenuata, B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana*.

The vegetation proposed for retention within the easement is predominantly in 'Degraded-Completely Degraded' condition, or existing cleared tracks, with the vegetation proposed for retention in the Public Open Space being predominantly in 'Very Good' condition (Figure 7).

The banksia species present, as well as some scattered jarrah (*Eucalyptus marginata*), sheoak (*Allocasuarina fraseriana*) and grasstree (*Xanthorrhoea preissii*) provide potential foraging habitat to some or all of the protected black cockatoo species possibly present in the area (Table 1).

Table 1 Dominant tree and shrub species that may provide Black Cockatoo foraging species

Tree/Shrub Species	Carnaby's Black Cockatoo	Baudin's Black Cockatoo	Forest Red-Tailed Black Cockatoo
Banksia attenuata	X	X	
Banksia ilicifolia	X	X	
Banksia menziesii	X	X	
Allocasuarina fraseriana		X	X
Xanthorrhoea preissii	X	X	
Eucalyptus marginata	X	X	X

Sources: (DEE, 2017b; Groom, 2011)

To protect vegetation retention areas, the following management measures will be implemented:

- vegetation retention areas will be fenced prior to, and during construction to prevent inadvertent access and/or damage to these areas
- weed control will be undertaken (Section 4.3.2.2).

4.3.2.2 Weed control

It is proposed that weed control works be undertaken in areas of retained vegetation to improve the quality and condition of vegetation. Weed control works will be implemented in all areas of retained vegetation as follows pre- and post-planting.

Pre-planting weed control will comprise:

- initial spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in autumn, 2-4 weeks prior to winter planting.

Post-planting wee control will comprise:

- spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in late winter/spring following planting to allow for additional removal of weeds prior to flowering and seed propagation
- broad spectrum herbicide application (i.e. Glyphosate) in summer, to coincide with summer active weeds
- annual winter/spring broad spectrum herbicide application (i.e. Glyphosate), as required
- annual summer broad spectrum herbicide application (i.e. Glyphosate), as required.

4.3.2.3 Landscaping and Street Tree Planting

It is proposed to plant street trees with black cockatoo foraging value, as per Groom (2011) and the City of Cockburn's street tree species list (Table 2). Similar street planting approaches are proposed for other residential developments in Hammond Park.

These trees should be considered also be considered in the context of bushfire risk through appropriate spacing and understorey design/management.

Table 2 City of Cockburn approved street trees that may provide Black Cockatoo foraging species

Tree Species	Common Name	Ecological Corridors	Residential Wide Verges	Residential Narrow Verges
Agonis flexuosa	WA Weeping Peppermint	X	X	
Callistemon viminalis	Weeping Bottlebrush/Captain Cook Bottlebrush	X		X
Corymbia ficifolia	Red Flowering Gum	X		X
Hakea laurina	Pin Cushion Hakea			
Hibiscus tiliaceus rubra	Red Cottonwood		X	
**Jacaranda mimosifolia*	Jacaranda		X	
**Liquidamber styraciflua*	Liquidamber		X	
**Prunus (amygdalus) dulcis*	Almond Tree		X	

Sources: (City of Cockburn, undated; Groom, 2011)

Specific street tree species will be determined for suitability by a Landscape Architect.

4.3.3 Public Open Space

As a result of extensive consultation with the City of Cockburn, the Public Open Space will be developed into two areas, being (Smith Bushfire Consultants 2022; Appendix 3):

- Retained vegetation within the northern portion of the Public Open Space:
  - area will be managed but little other intervention will occur as this area will have the current overstorey, near surface vegetation and surface vegetation retained. Public access into this area will be limited and may require some low-visual impact fencing.
  - This will be an area of around half the POS.
  - The area meets the requirements under AS 3959 section 2.2.3.2 (c) Exclusion – Low threat vegetation criteria and therefore, does not impact the BAL ratings of the neighbouring lots. The City of Cockburn will decide how to manage the bushfire fuel load so that it meets their objectives and requirements.
- Cleared vegetation within the southern portion of the Public Open Space:
  - The development options for this area will be refined and developed in partnership with the City of Cockburn.
  - The development will consider the surrounding area recreation facilities and may have a basic children play facility and a BBQ area.
  - The development and any revegetation will meet the requirements under AS 3959 section 2.2.3.2 (c) Exclusion – Low threat vegetation and non-vegetated areas criteria and therefore will not impact the BAL ratings of the neighbouring lots

A concrete path that is 1.5 -2 metres wide supported by 6 metres of cleared land will be constructed around the Public Open Space. A limestone path, approximately 1 metre wide supported by 2 metres of clearing along the edge of the boundary between the retained and cleared vegetation and then through a small portion of the retained vegetation is also proposed. These paths will provide community access to the Public Open Space and limit dieback introduction (Smith Bushfire Consultants 2022; Appendix 3).

4.3.4 Revegetation within the easement

The area proposed for earthworks will be revegetated by the proponent to the requirements of the City of Cockburn as a condition of subdivision approval for the residential development. These revegetation works must also comply with conditions imposed on revegetation within easements by Western Power (undated).

A standard revegetation methodology will be adopted for works within the easement (Appendix 3).

4.3.5 Bush Fire

Given the site is in a bush fire prone area (Section 3.4.7), a Bushfire Management Plan is being prepared for the site by Smith Bushfire Consultants, in accordance with the following:

- *State Planning Policy 3.7 – Planning in Bushfire Prone Areas* (WAPC, 2015b)
- *Guidelines for Planning in Bushfire Prone Areas* (WAPC, 2017).

Reference should be made to the Bushfire Management Plan for specific bushfire management details.

4.4 Fauna

4.4.1 Potential Impacts

Potential impacts to fauna during vegetation clearing, should be considered and managed. Impacts to fauna from construction are associated with removal of habitat, and animal injury/fatality from the use of machinery.

4.4.2 Management Measures

A Fauna Trapping and Relocation Management Plan should be prepared as a condition of subdivision approval. Some fauna management actions that should be included within the management plan, include the following:

- Clearing outside of the main avifauna breeding season is recommended, if possible.
- Prior to the commencement of clearing the clearing and construction boundary will be surveyed to ensure it is accurately located and demarcated.
- A fauna relocator will be engaged to inspect trees and to undertake fauna relocation, *if deemed necessary*. A Licence to Take or Disturb Fauna for the purpose of Relocating will be submitted to the Department of Biodiversity, Conservation and Attractions (DBCA) prior to tree removal commencing so this approval is in place, should it be required. A copy of the approved DBCA licence will be provided to the City of Cockburn prior to the commencement of works.
- Clearing will be undertaken in the direction of retained vegetation to encourage any remaining fauna to move in this direction.
- Any vehicles on site will be restricted to the clearing and construction area footprint to minimise impact to vegetation beyond this boundary. Vehicle movements will be restricted to speeds of 30 km/hour
- If any fauna is located and/or injured, contact the Project Superintendent or Environmental Consultant for instructions. If these representatives cannot be reached, contact the DBCA Wildcare helpline (9474 9055).

Whilst the proposed development will not result in a significant impact on Matters of National Environmental Significance protected under the EPBC Act, a referral of the project under this legislation was submitted in October 2021. On 1 December 2021, the Commonwealth determined the proposed action to clear vegetation to construct a residential development on Lot 28 to be not a controlled action.

4.5 Noise

A noise assessment was undertaken for the proposed development in relation to future noise impact from the Kwinana Freeway (Lloyd George Acoustics, 2021). The assessment was conducted in respect of State Planning Policy No. 5.4 Road and Rail Noise (WAPC, 2019), which considers anticipated traffic and associated traffic noise volumes for the next 20 years from when the noise assessment was undertaken. The assessment considered both indoor and outdoor noise targets.

The noise assessment identified three specific noise management areas within the development:

- No noise management required on western-most lots along Barfield Road (13 lots)
- Package A noise management measures within central 26 lots, where noise levels are between 51 dB and 53 dB $L_{Aeq(Night)}$
- Package B noise management measures within eastern 10 lots adjacent to power line easement, where noise levels are between 54 dB and 57 dB $L_{Aeq(Night)}$.

Reference should be made to the noise assessment for specific noise management details.

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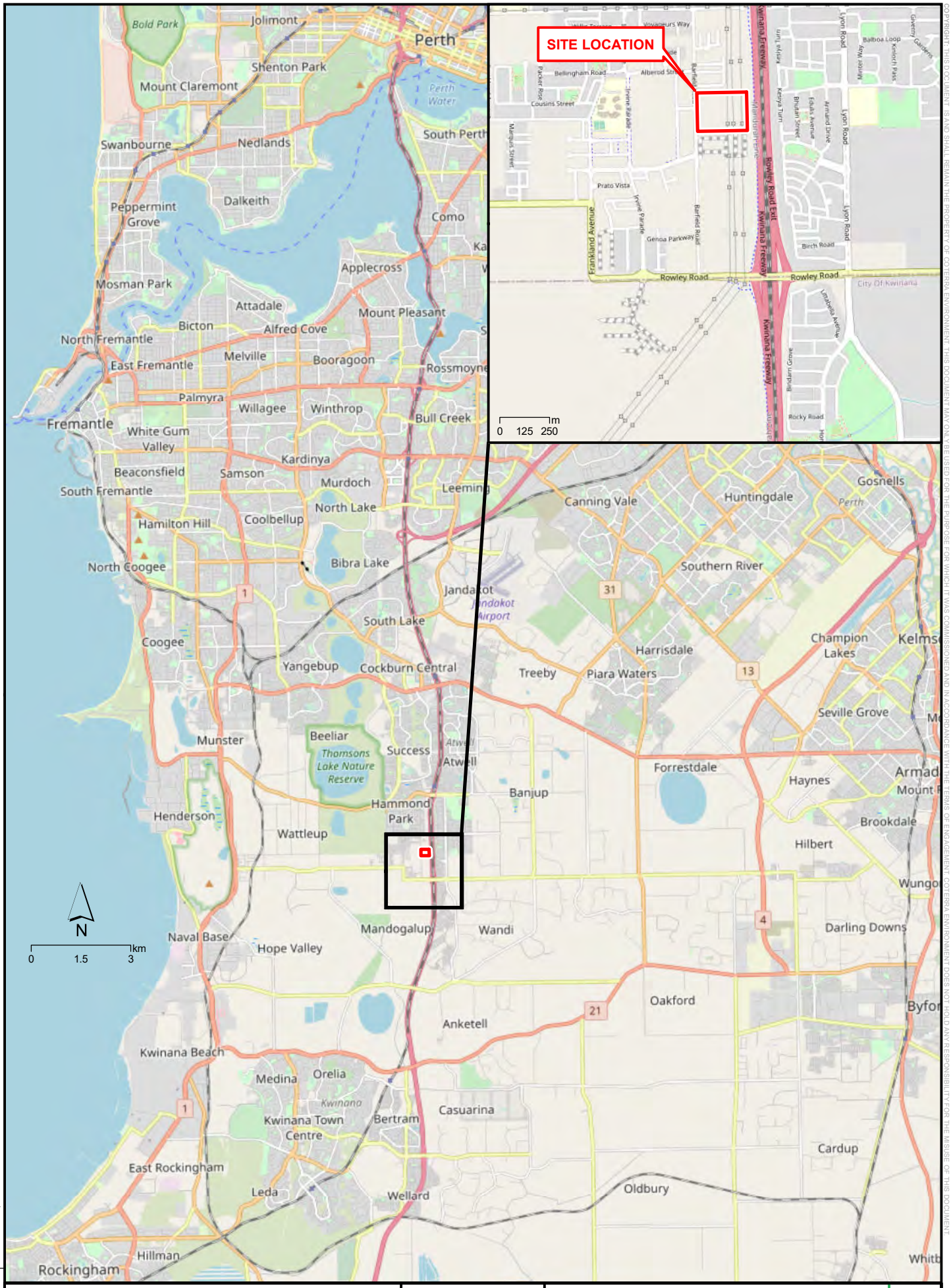

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Condor Nominees Pty Ltd
ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

REGIONAL LOCATION

Figure 1

C:\GIS\Jobs\CoTerra\MGPBAR05 - Lot 28 Barfield Road, Hammond Park, EAR\Figures\MGPBAR05_F01 Regional Location_211115.mxd

LEGEND

- Site Boundary
- Cadastre
- Easement
- Contour (mAHD)
- High Voltage Overhead Transmission Line

N

0 5 10 20 30 40 m

Scale: 1:1,000 @ A3
GDA 1994 MGA Zone 50

BARFIELD RD

KWINANA FWY

RAILWAY

KWINANA FWY

Source: Orthophoto - NearMaps, 05.08.21

ENVIRONMAPS | E: 0406 590 006
Environmental Mapping Solutions | www.environmaps.com.au

C:\GIS\Jobs\CoTerra\MGPBAR05 - Lot 28 Barfield Road, Hammond Park, EAR\Figures\MGPBAR05_F02 Subject Area and Topography_211115.mxd

COTERRA ENVIRONMENT

Job: MGPBAR05
Doc: 002
Date: 15/11/2021
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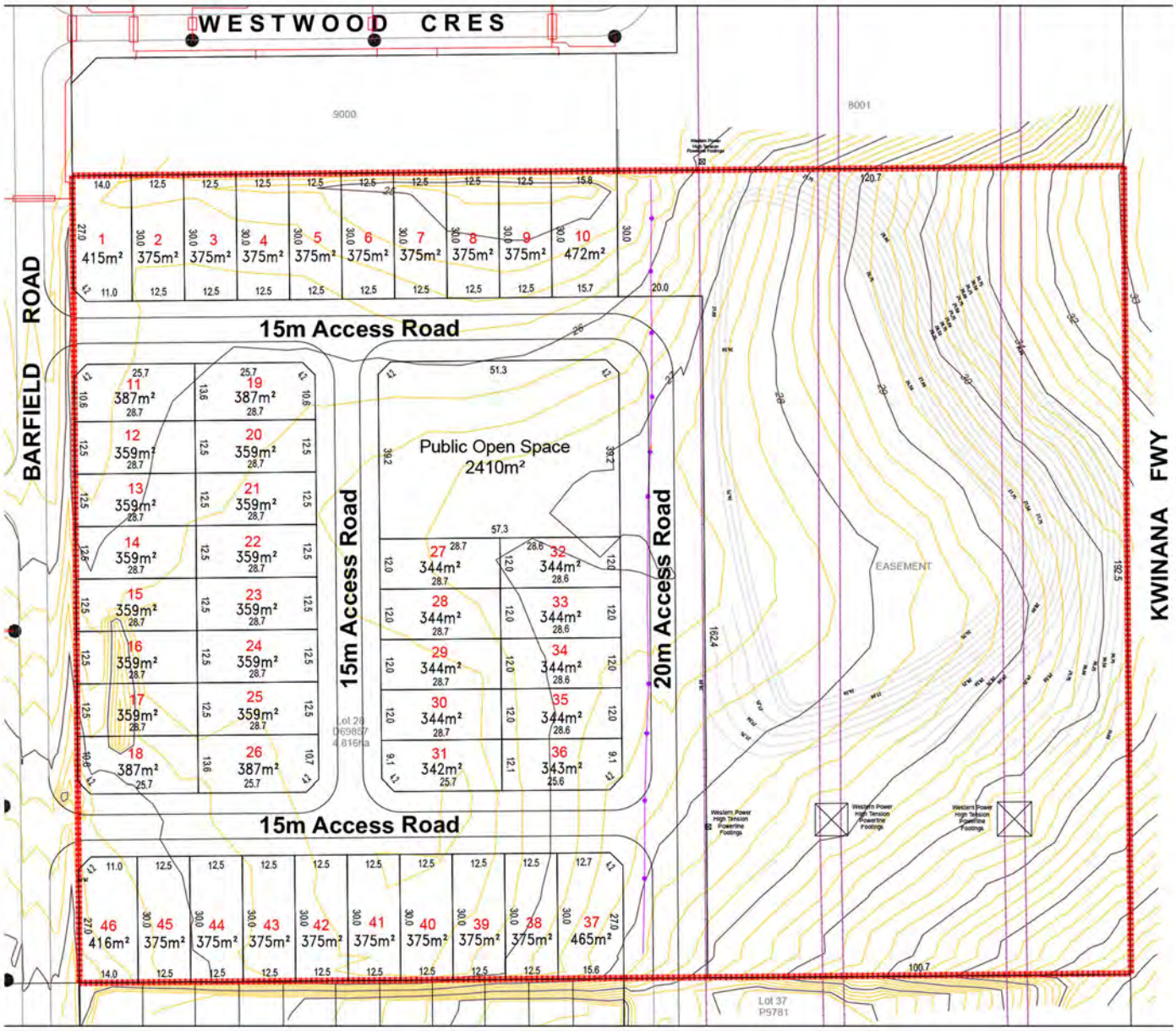
ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

SITE LOCATION

Figure 2



LEGEND

- Subject Site
- Proposed Lot Boundaries
- Contours mAHD (0.25m interval)
- Major Contours mAHD
- Minor Contours mAHD

Electrical Infrastructure

- Powerpole
- Underground Crossing
- High Voltage Cable (1kV-33kV)
- Low Voltage Cable (< 1kV)
- Transmission (33kV-330kV)

Source: Structure Plan, Michael Glendinning

ENVIRONMAPS Environmental Mapping Solutions | t: 0406 590 006 | e: simoncrofts@environmaps.com.au

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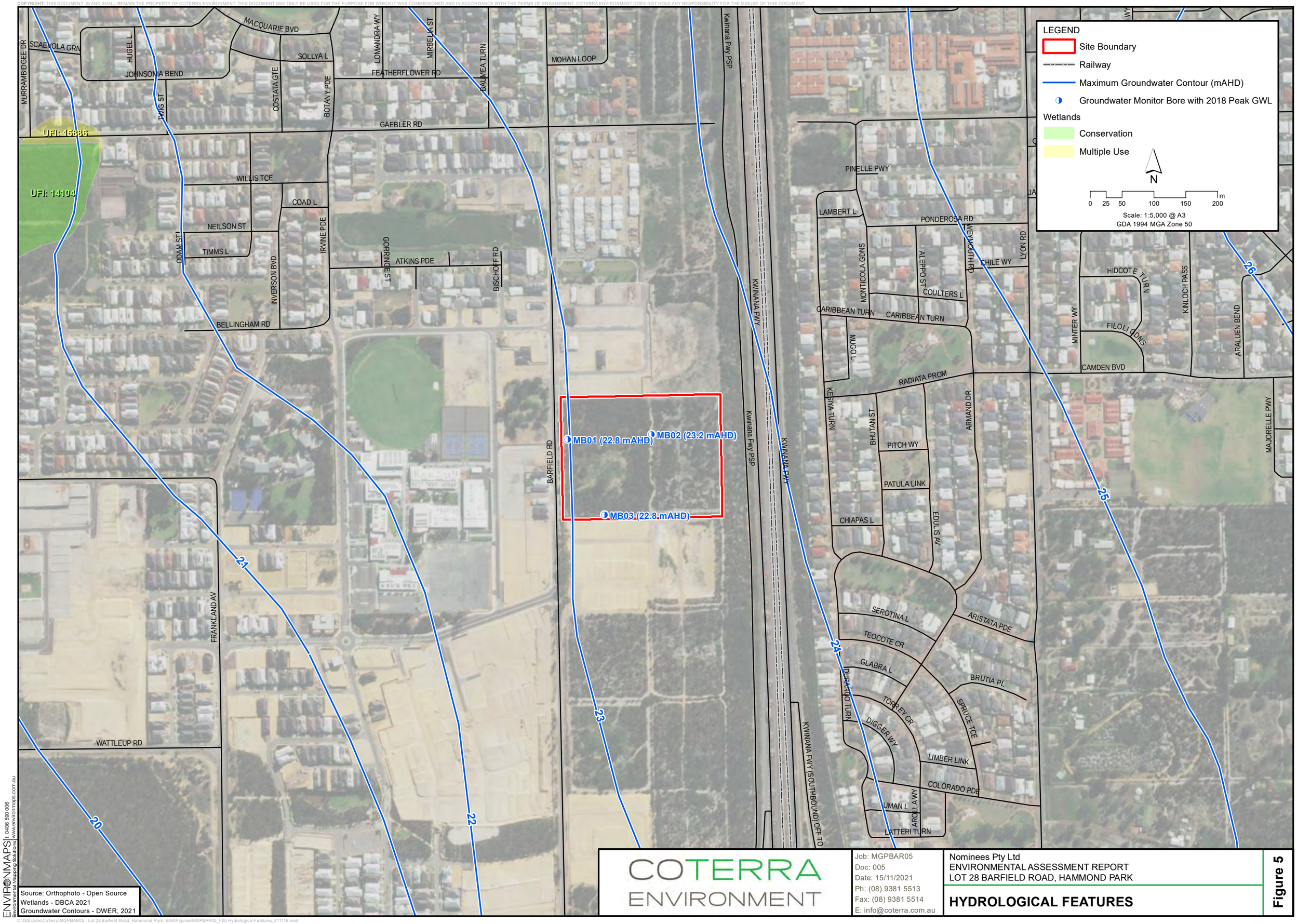
ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

PROPOSED DEVELOPMENT PLAN

Figure 3



Source: Orthophoto - Open Source
Wetlands - DBCA 2021
Groundwater Contours - DWER, 2021

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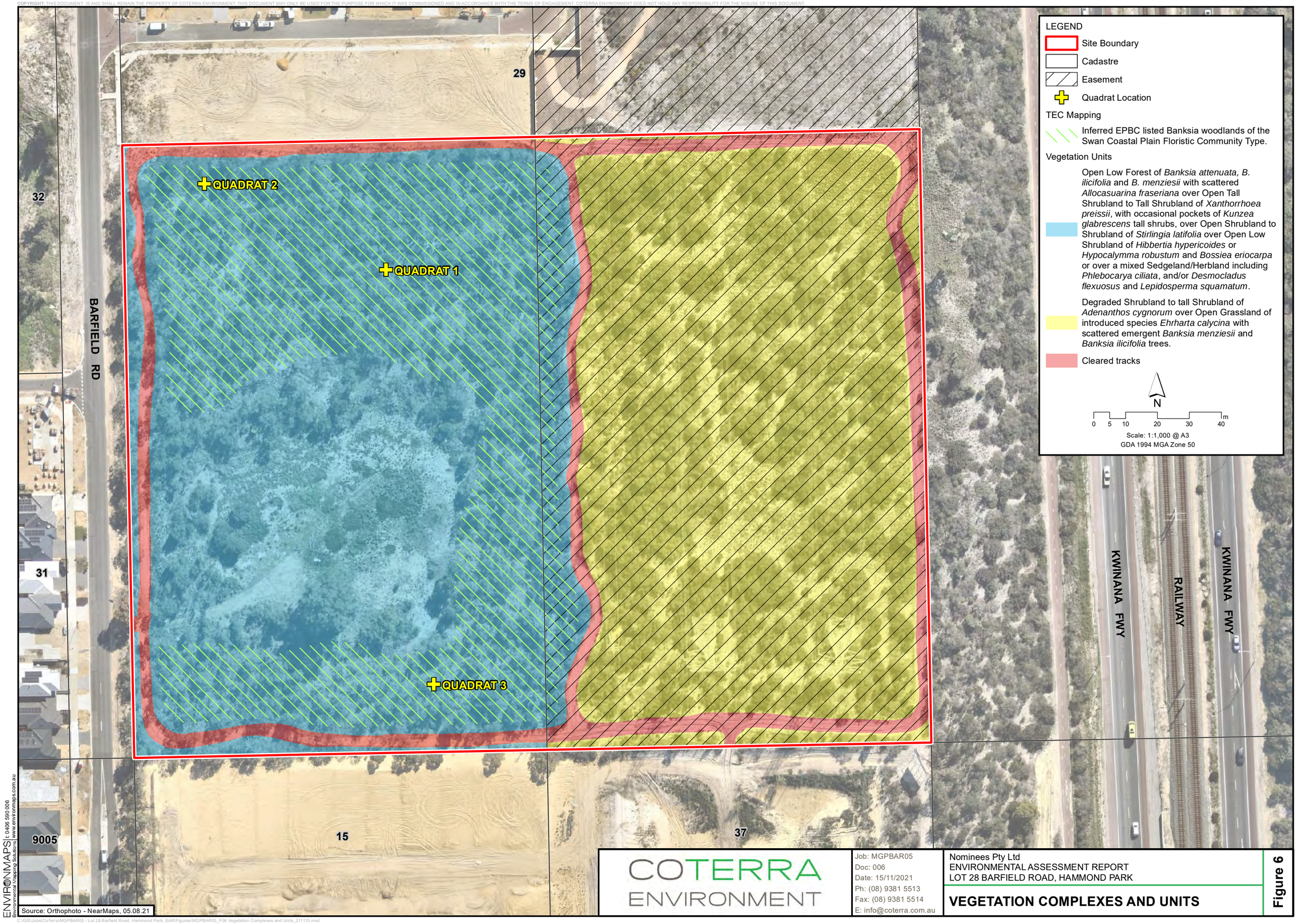
Nominees Pty Ltd
ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

HYDROLOGICAL FEATURES

Figure 5



LEGEND

- Site Boundary
- Cadastre
- Easement
- Quadrat Location

TEC Mapping

- Inferred EPBC listed Banksia woodlands of the Swan Coastal Plain Floristic Community Type.

Vegetation Units

- Open Low Forest of *Banksia attenuata, B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* over Open Tall Shrubland to Tall Shrubland of *Xanthorrhoea preissii*, with occasional pockets of *Kunzea glabrescens* tall shrubs, over Open Shrubland to Shrubland of *Stirlingia latifolia* over Open Low Shrubland of *Hibbertia hypericoides* or *Hypocalymma robustum* and *Bossiea eriocarpa* or over a mixed Sedgeland/Herbland including *Phlebocarya ciliata*, and/or *Desmocladus flexuosus* and *Lepidosperma squamatum*.
- Degraded Shrubland to tall Shrubland of *Adenanthos cygnorum* over Open Grassland of introduced species *Ehrharta calycina* with scattered emergent *Banksia menziesii* and *Banksia ilicifolia* trees.
- Cleared tracks

N

0 5 10 20 30 40 m

Scale: 1:1,000 @ A3
GDA 1994 MGA Zone 50

Source: Orthophoto - NearMaps, 05.08.21

ENVIRONMAPS | t: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

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ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

VEGETATION COMPLEXES AND UNITS

Figure 6

LEGEND

- Site Boundary
- Cadastre
- Easement

Vegetation Condition

- VG: Very Good
- G: Good
- D: Degraded
- D-CD: Degraded with patches of Completely Degraded
- CD: Completely Degraded
- CT: Cleared Tracks

N

0 5 10 20 30 40 m

Scale: 1:1,000 @ A3
GDA 1994 MGA Zone 50

29
32
31
9005
15
37
BARFIELD RD
KWINANA FWY
RAILWAY
KWINANA FWY
VG
G
D
CD
D-CD
CT

Source: Orthophoto - NearMaps, 05.08.21

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Environmental Mapping Solutions | www.environmaps.com.au

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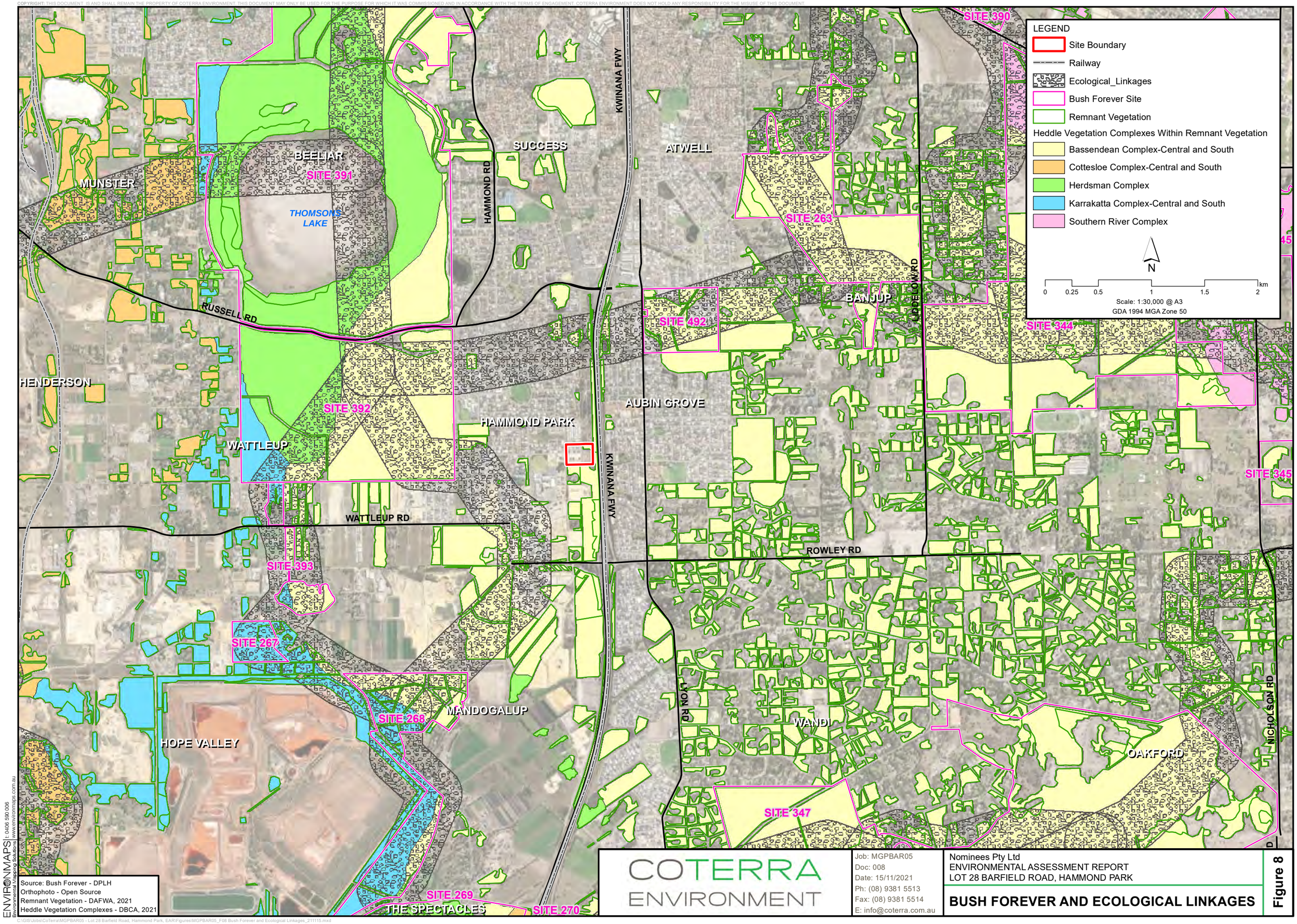
Nominees Pty Ltd
ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

VEGETATION CONDITION

Figure 7



ENVIRONMAPS | M: 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

Source: Bush Forever - DPLH
Orthophoto - Open Source
Remnant Vegetation - DAFWA, 2021
Heddle Vegetation Complexes - DBCA, 2021

C:\GIS\Jobs\CoTerra\MGPBAR05 - Lot 28 Barfield Road, Hammond Park, EAR\Figures\MGPBAR05_F08 Bush Forever and Ecological Linkages_211115.mxd

COTERRA ENVIRONMENT

Job: MGPBAR05
Doc: 008
Date: 15/11/2021
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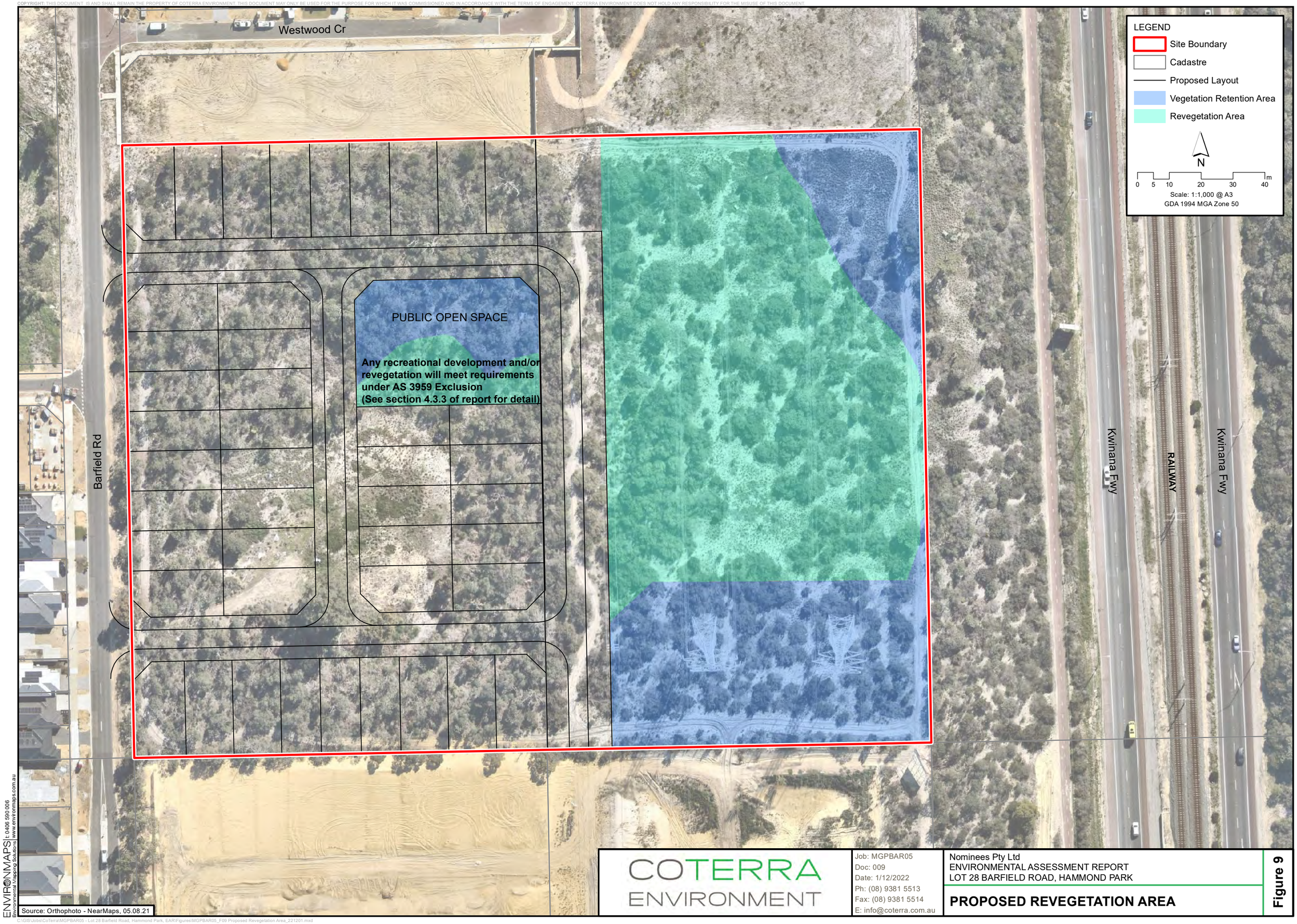
Nominees Pty Ltd
ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

BUSH FOREVER AND ECOLOGICAL LINKAGES

Figure 8



Source: Orthophoto - NearMaps, 05.08.21

ENVIRONMAPS | t: 0406 590 006
Environmental Mapping Solutions | www.environmaps.com.au

C:\GIS\Jobs\CoTerra\MGPBAR05 - Lot 28 Barfield Road, Hammond Park, EAR\Figures\MGPBAR05_F09 Proposed Revegetation Area_221201.mxd

COTERRA ENVIRONMENT

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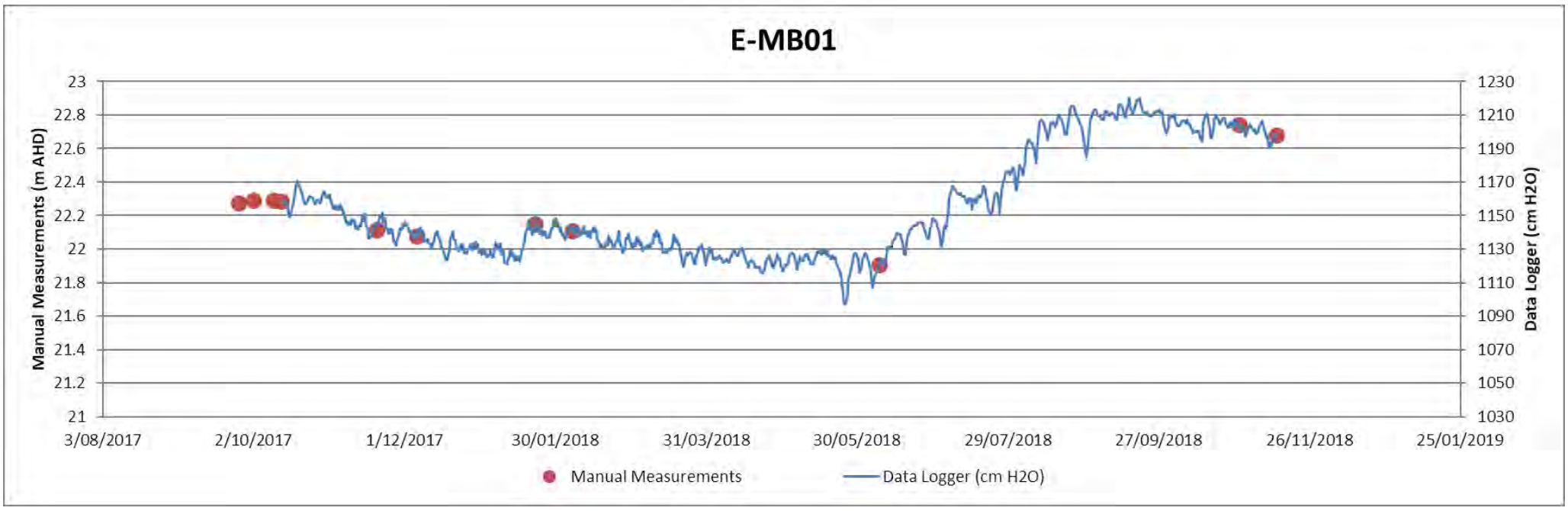
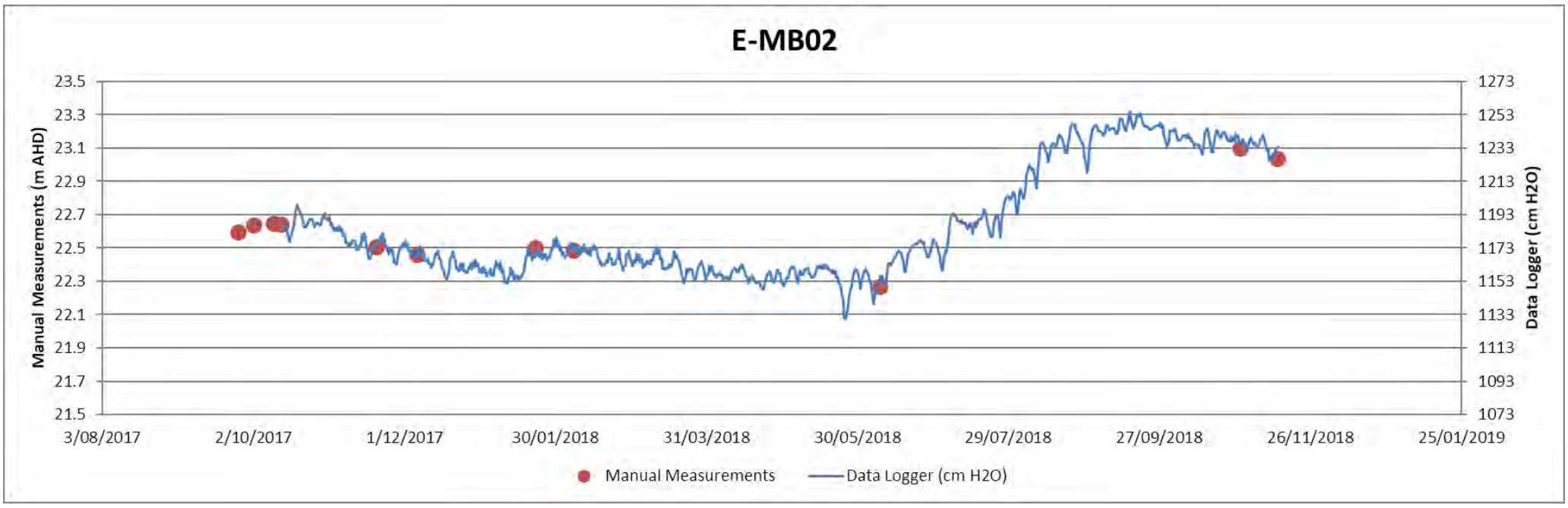
Nominees Pty Ltd
ENVIRONMENTAL ASSESSMENT REPORT
LOT 28 BARFIELD ROAD, HAMMOND PARK

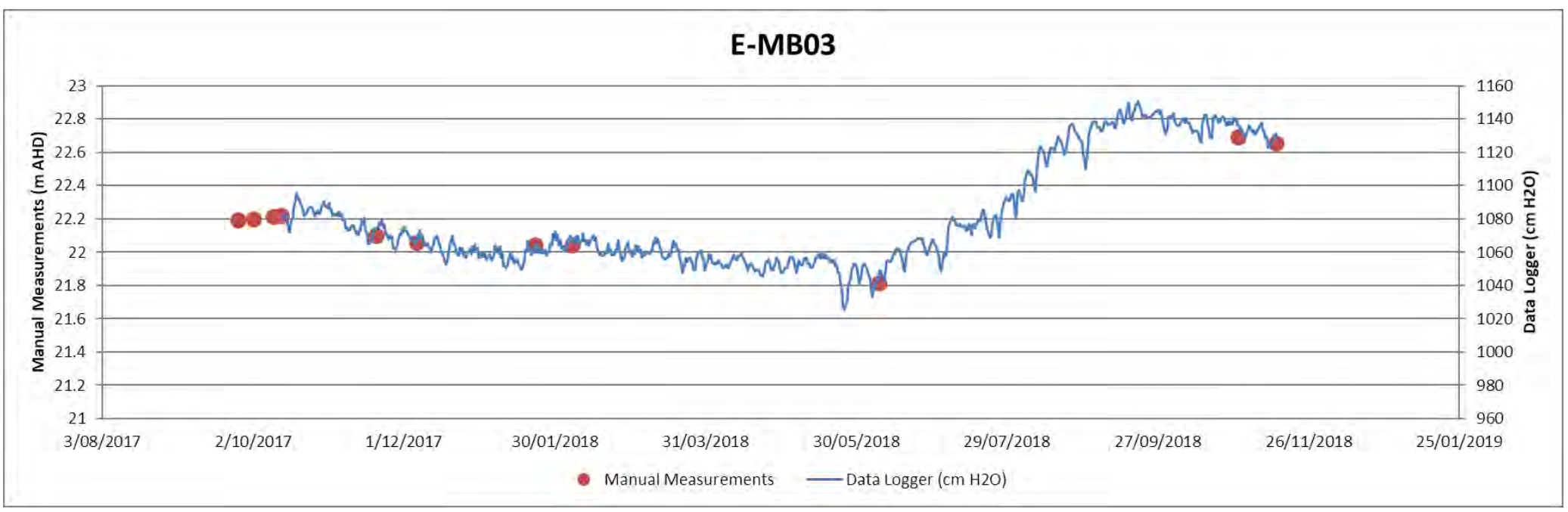
PROPOSED REVEGETATION AREA

Figure 9

Appendix 1 Groundwater monitoring results (Emerge Associates, 2018)

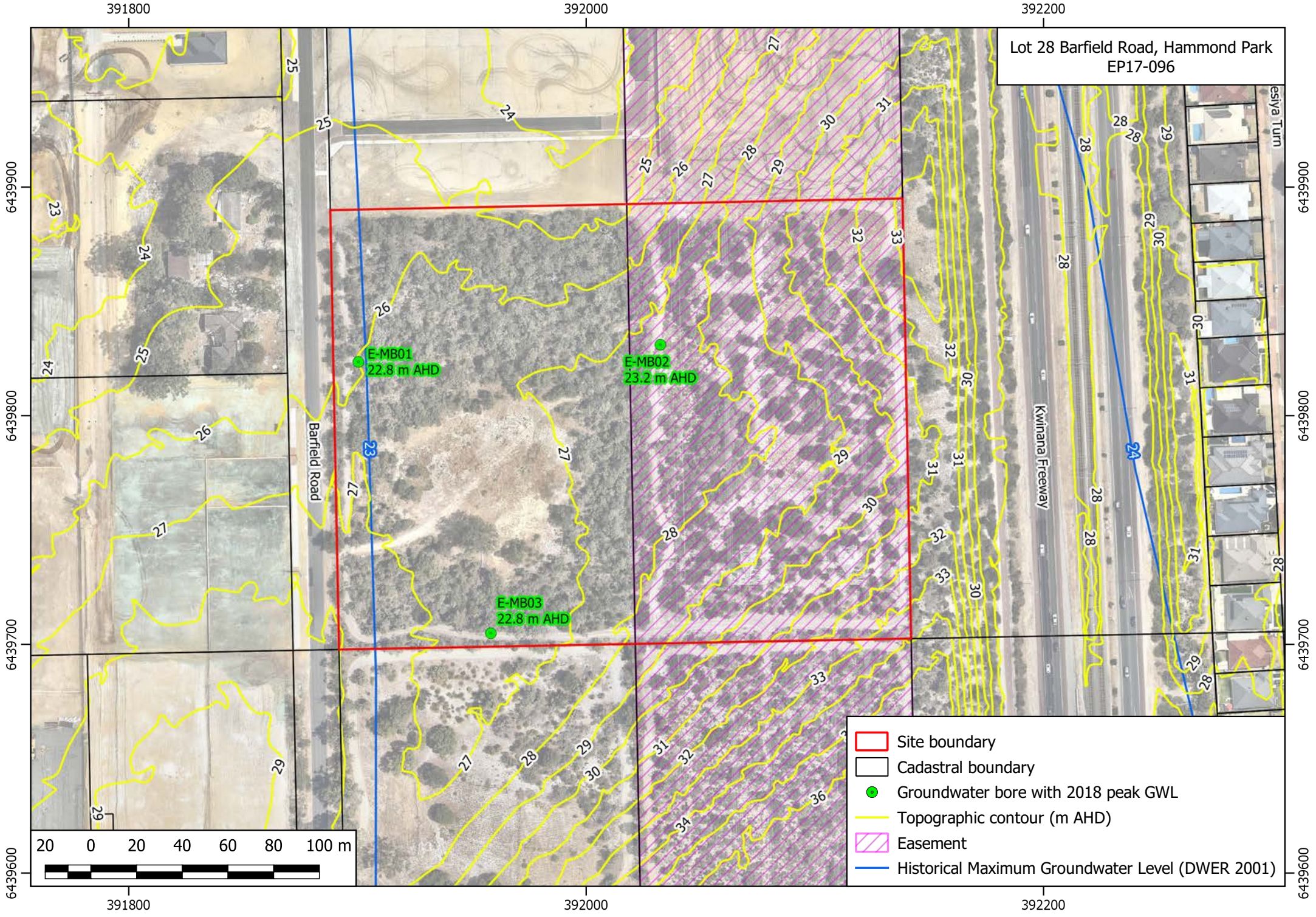






Summary of manual groundwater level measurements:

Date	E-MB01		E-MB02		E-MB03	
	m AHD	m BGL	m AHD	m BGL	m AHD	m BGL
26/09/2017	22.273	3.517	22.596	4.504	22.195	4.275
2/10/2017	22.290	3.500	22.639	4.461	22.198	4.272
10/10/2017	22.291	3.499	22.650	4.450	22.213	4.257
13/10/2017	22.284	3.506	22.643	4.457	22.219	4.251
20/11/2017	22.116	3.674	22.507	4.593	22.098	4.372
6/12/2017	22.077	3.713	22.462	4.638	22.059	4.411
22/01/2018	22.151	3.639	22.500	4.600	22.044	4.426
6/02/2018	22.110	3.680	22.488	4.612	22.045	4.425
8/06/2018	21.906	3.884	22.271	4.829	21.813	4.657
29/10/2018	22.740	3.050	23.099	4.001	22.694	3.776
13/11/2018	22.679	3.111	23.036	4.064	22.655	3.815


Lot 28 Barfield Road, Hammond Park
EP17-096
391800
392000
392200
6439900
6439800
6439700
6439600
E-MB01
22.8 m AHD
E-MB02
23.2 m AHD
E-MB03
22.8 m AHD
Barfield Road
Kwinana Freeway
esiya Turn
20 0 20 40 60 80 100 m
Site boundary
Cadastral boundary
Groundwater bore with 2018 peak GWL
Topographic contour (m AHD)
Easement
Historical Maximum Groundwater Level (DWER 2001)

Groundwater Quality -2017/2018

		Field Chemistry						*Nutrients and Nutrient Species*					
		Temperature	Electrical Conductivity	Dissolved Oxygen	Dissolved Oxygen	pH	Oxidation-Reduction potential	Ammonia (NH_3) as N	Oxides of Nitrogen (NO_X) as N	Total Kjeldahl Nitrogen (TKN) as N	Total Nitrogen (TN) as N	Total Phosphorous (TP) as P	Reactive Phosphorous (ORP) as P
Site Name	**Date of Sampling**	°C	mS/cm	mg/L	% sat	pH units	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
E-MB01	10/10/2017	20.5	0.488	1.90	21.1	4.45	-60.3	0.10	<0.01	1.4	1.4	0.04	<0.01
E-MB01	22/01/2018	20.0	0.644	0.34	3.9	4.42	63.1	0.14	<0.01	1	1.0	0.02	<0.01
E-MB01	29/10/2018	18.2	0.965	0.42	4.5	5.13	-214.0	0.05	<0.01	1.2	1.2	0.01	<0.01
E-MB02	10/10/2017	19.2	0.246	1.76	18.9	5.15	-51.2	0.02	1.81	0.40	2.2	0.03	<0.01
E-MB02	22/01/2018	21.7	0.223	0.48	5.5	5.32	54.1	<0.01	0.58	0.30	0.9	0.01	<0.01
E-MB02	29/10/2018	20.5	0.444	0.79	8.7	5.69	-263.0	0.03	5.13	1.00	6.1	0.03	<0.01
E-MB03	10/10/2017	18.2	0.601	1.31	13.8	5.67	-106.4	0.15	<0.01	0.6	0.6	0.03	<0.01
E-MB03	22/01/2018	20.4	0.493	0.28	3.1	5.88	-80.9	0.01	0.35	0.3	0.6	0.01	<0.01
E-MB03	29/10/2018	18.5	0.810	0.36	3.9	5.87	-286.0	0.10	<0.01	0.4	0.4	0.01	<0.01

Minimum		18.2	0.223	0.28	3.10	4.42	-263.0	0.01	0.35	0.30	0.6	0.01	0.00
10th Percentile		18.2	0.239	0.32	3.66	4.44	-228.7	0.02	0.42	0.30	0.6	0.01	0.00
Median		20.2	0.491	0.64	7.10	5.24	-70.6	0.05	1.20	0.80	1.1	0.03	0.00
90th Percentile		20.9	0.740	1.80	19.56	5.75	56.8	0.14	4.13	1.26	3.4	0.03	0.00
Maximum		21.7	0.965	1.90	21.10	5.88	63.1	0.15	5.13	1.40	6.1	0.04	0.00
Average		19.84	0.513	0.91	9.94	5.21	-82.3	0.07	1.97	0.78	1.8	0.02	0.00
Standard Deviation		1.22	0.236	0.66	7.11	0.55	114.5	0.06	2.20	0.43	1.8	0.01	0.00

Appendix 2 ASS Self-Assessment Form (WAPC, 2020)

GOVERNMENT OF WESTERN AUSTRALIA

Western Australian Planning Commission

Acid Sulfate Soils Self-Assessment Form

Version: 6.1 (August 2020)

Applicant

The applicant is the person with whom the WAPC will correspond and, if the application is approved, the person to whom the approval will be sent.

WAPC reference no.

Full name

Postal address

Town / suburb

Postcode

Email

Phone number

Applicant signature

Date

Application property details

Step 1

Assess the possibility of acid sulfate soils disturbance

Question 1: Are any dewatering or drainage works (either temporary or permanent) proposed to be undertaken? yes no

Question 2: Is excavation of 100 cubic metres or more of soil proposed?
(100 cubic metres is about 10 standard-sized dump truck loads.) yes no

If you have answered no to both question 1 and question 2 then no further investigation is required at this stage. Please sign this form and submit it, together with any supporting information, to the Department of Water and Environmental Regulation (DWER).

If you have answered yes to either question 1 or question 2 go on to step 2.

Step 2

Conduct an acid sulfate soils investigation in accordance with the guideline, *Identification and investigation of acid sulfate soils,* available on DWER's website at https://dwer.wa.gov.au/

Question 3: Did the acid sulfate soils investigation indicate that there are acid sulfate soils present? ___ yes ___ no

If no to question 3, then no further investigation is required at this stage. Please sign this form and submit it, together with the written results of the investigation (in the form of an acid sulfate soils report) and supporting information to DWER with a request for clearance of the acid sulfate soils condition.

If yes to question 3, please sign this form and submit it, together with the written results of the investigation (in the form of an acid sulfate soils report), an acid sulfate soils management plan and a copy of the approved subdivision plan, to DWER with a request for approval of the management plan.

Note: After completion of site works in accordance with the approved management plan you will be required to submit a closure report, prepared in accordance with DWER's acid sulfate soils guidelines, to DWER together with a request for clearance of the acid sulfate soils condition.

Tick box for attachments as appropriate

- ☐ copy of current deposited plan
- ☐ copy of approved subdivision plan
- ☐ copy of approved development plan
- ☐ acid sulfate soils investigation report
- ☐ acid sulfate soils management plan

Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Applicant signature: ..... Date: .....

Submit form and required attachments to the
Department of Water and Environmental Regulation

By email: info@dwer.wa.gov.au

Or by mail:
Department of Water and Environmental Regulation
Locked Bag 10,
Joondalup DC, WA 6919

If you have any questions relating to the Acid Sulfate Soils Self-Assessment form, please contact DWER on 1300 762 982 or email info@dwer.wa.gov.au

Appendix 3 Revegetation Methodology

Lot 28 (157 Barfield Road) Revegetation Methodology

Revegetation Areas

It is proposed to undertake revegetation works over a 0.72 hectare area within the easement adjacent to Lot 28.

The area proposed for earthworks will be revegetated by the proponent to the requirements of the City of Cockburn as a condition of subdivision approval for the residential development. These revegetation works must also comply with conditions imposed on revegetation within easements by Western Power.

Revegetation Strategy and Completion Criteria

Baseline Flora and Vegetation Data

The site is historically representative of Beard Vegetation Association 1001, which is described as 'medium very sparse woodland; Jarrah, with low woodland; Banksia or Casuarina' (Beard et al, 2005) and the Bassendean Complex – Central and South (Figure 6; Heddle et al, 1980). The Bassendean Complex – Central and south is described as "woodland of jarrah (*Eucalyptus marginata*), *Allocasuarina fraseriana, Banksia attenuata, B. grandis* and *B. menziesii* on the sand dunes to low woodland of *Melaleuca preissiana, B. ilicifolia* and *B. littoralis* and sedgelands on the low-lying moister sites. This area includes the transition of jarrah to coastal blackbutt (*E. todtiana*) in the Perth vicinity and jarrah to marri (*Corymbia calophylla*) on the moister soils. Other plant species include *Kunzea ericifolia, Hypocalymma angustifolium, Adenanthos obovatus* and Verticordia species (Heddle et al, 1980).

A detailed vegetation and flora survey was undertaken on the site (Coterra, 2017) in accordance with relevant government guidance (EPA, 2016a). Two vegetation types were observed on the site, as follows:

- An Open Low Forest of *Banksia attenuata, B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* over Open Tall Shrubland to Tall Shrubland of *Xanthorrhoea preissii*, with occasional pockets of *Kunzea glabrescens* tall shrubs, over Open Shrubland to Shrubland of *Stirlingia latifolia* over Open Low Shrubland of *Hibbertia hypericoides* or *Hypocalymma robustum* and *Bossiaea eriocarpa* or over a mixed Sedgeland/Herbland including *Phlebocarya ciliata*, and/or *Desmocladus flexuosus* and *Lepidosperma squamatum* on midslope flats, on loamy sands, was recorded predominantly in the western portion of the subject area.
- Scattered *Banksia menziesii* and *B. ilicifolia* over Shrubland to tall Shrubland of *Adenanthos cygnorum* over Open Grassland of introduced species **Ehrharta calycina* with scattered native low shrubs, on midslope sandy flats was recorded predominantly in the eastern portion of the subject area.

Current Site Condition

The proposed revegetation area comprises vegetation in 'Completely Degraded' to 'Degraded' condition, representative of the 'Scattered Banksia Shrubland, detailed above. The proposed revegetation area is not representative of Banskia Woodland.

Plate 1: Vegetation and weed presence

Plate 2: Typical vegetation within easement

Revegetation Methodology

The proposed revegetation methodology will generally comprise the following:

Clearing and Topsoil Removal

Clearing will be undertaken within the easement to facilitate development on Lot 28.

Clearing activities will be undertaken in accordance with engineering requirements for the site.

Topsoil will be removed and stored on site, for re-use in revegetation areas. It should be noted that topsoil may produce native germinates that grow above the 2 m height limitation, and as such, these may need to be destroyed (pers. comm James Lawton, 7 December 2021).

Slope and Surface Stabilisation

Slope and surface stabilisation will be conducted using either of the following:

- collection of in-situ (cleared and felled) mulched vegetation will be undertaken prior to earthworks on the site
- installation of coir netting, if required
- application of a dust suppression product (such as Gluon).

The actual methodology may involve a combination of the above techniques. These actions will be undertaken after clearing.

Species Selection

In accordance with the Transmission Easement Notice, no vegetation exceeding 1 m in height from the natural surface of the land should be grown, cultivated or maintained within the easement (Western Power, undated).

A proposed revegetation species list is provided based on vegetation historically recorded on the site, Western Power requirements for revegetation within easements, and Black Cockatoo foraging opportunities (Appendix 1).

Site Preparation

Soils within the revegetation area will be ripped to 500 mm prior to planting, if possible, depending on slope. If the site has steep batters, ripping may not be possible in these locations, and alternative methods for site preparation will be implemented.

Planting Techniques

Tubestock planting will be undertaken at a rate of 1.6 plants/m^2.

Tubestock will be sourced from accredited Dieback-free local nurseries. Where possible, local provenance material (within 50 km of the site) will be used.

Where revegetation areas cannot be fenced (below), corflute tree guards will be installed after planting. Tree guards will be removed in the first summer after planting, only if it is determined that the rabbit population will not severely impact planting (pers. comm James Lawton, 7 December 2021).

Weed Control

It is proposed that weed control works be undertaken in areas of retained vegetation to improve the quality and condition of vegetation. Weed control works will be implemented in all areas of retained vegetation as follows pre- and post-planting.

Pre-planting weed control will comprise:

- initial spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in autumn, 2-4 weeks prior to winter planting.

Post-planting weed control will comprise:

- spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in late winter/spring following planting to allow for additional removal of weeds prior to flowering and seed propagation
- broad spectrum herbicide application (i.e. Glyphosate) in summer, to coincide with summer active weeds
- annual winter/spring broad spectrum herbicide application (i.e. Glyphosate), as required
- annual summer broad spectrum herbicide application (i.e. Glyphosate), as required.

Access and Fencing

Suitable fencing (1.2 m high with rabbit netting) will be installed around revegetation areas to manage inadvertent access to the areas. In accordance with the Transmission Easement Notice, this fence must be earthed to the satisfaction of Electricity Networks Corporation in the case of a metallic fence or trellis (Western Power, undated). Fencing will not be installed to the detriment of access to Western Power infrastructure.

Signage

Signage will be installed adjacent to revegetation areas to advise “No Entry – Revegetation Area”.

Completion Criteria

Completion criteria for the revegetation areas has been determined on the basis of revegetation guidelines developed by the neighbouring City of Cockburn (2017; Table 1).

Table 1: Success Criteria for Revegetation Works

Assessment Parameter	Method	Completion Criteria
Seedling survival	5 m x 5 m quadrats Photo points/monitoring	1.6 plants/m^2 for dryland species
Species representation	5 m x 5 m quadrats/transects Photo points/monitoring	75% of dryland species
Weed cover	5 m x 5 m quadrats Photo points/monitoring	5%
Declared weeds	5 m x 5 m quadrats Photo points/monitoring	No declared weeds to be present.

Note: The completion criteria will be assessed via averaging the results from the monitoring locations.

Monitoring and Reporting

Monitoring will be undertaken to assess weed cover and plant survival rates within the revegetation area against completion criteria (Table 1). These monitoring events will occur annually commencing in:

- autumn following the year that planting was undertaken, to measure plant survival. This will inform the need for any infill planting for the upcoming winter
- spring to measure to measure plant density/success.

5 m x 5 m quadrats and photo points will be established within each revegetation area, to allow for consistency of monitoring over time. Exact locations of these quadrats and photo point locations will be provided in the first monitoring report prepared for the revegetation program.

Monitoring is to be ongoing for at least 2 years post-revegetation and shall continue until completion criteria have been met. Monitoring will also make note and include photos of any signs of erosion or storm damage to revegetation areas to enable appropriate management measures.

Once initial revegetation actions have been completed, a report will be prepared and submitted to the City of Cockburn within 30 days.

Thereafter, revegetation monitoring reports, comprising results of revegetation works, monitoring results for autumn and spring and any contingency actions that were implemented, will be prepared, and submitted to the City of Cockburn on an annual basis, and within 30 days after the completion of Spring monitoring events.

Contingency Actions

If monitoring indicates that the success criteria are not being met, contingency actions may be undertaken:

- infill planting (30% infill after Year 1 monitoring, then 15% infill after Year 2 monitoring) to increase plant numbers, plant species, ground coverage and / or replace damaged or dead seedlings
- additional broad spectrum herbicide application, or manual weed control to reduce weed coverage, as required, in winter, spring and autumn
- installation of additional corflute tree guards for protection to exclude pests.

References

City of Cockburn (2017). *Guidelines for Revegetation and Maintenance of Natural Bushland/Wetland Areas.* City of Cockburn, Perth, Western Australia.

Western Power (undated). *Transmission Easement Notice*. Western Power, Perth, Western Australia.

Proposed Vegetation Species List within Easement (up to 2 m in height)

Species	Growth Form	Approximate Height (m)
Allocasuarina humilis	Shrub	0.2-2
Anigozanthos manglesii	Herb / groundcover	0.2-1.1
Astartea scoparia		1.8
Atriplex cinerea		0.2-1.5
Beaufortia elegans		0.3-1
Bossiaea eriocarpa		0.2-1
Calothamnus quadrifidus 'Little Ripper'		0.2-0.4
Conostylis aculeata	Herb / groundcover	0.06-0.5
Conostylis candicans		0.05-0.4
Daviesia physodes	Shrub	0.4-1.8
Dianella revoluta var divaricata	Herb / groundcover	0.3-1.5
Ficinia nodosa		Up to 1
Gastrolobium capitatum	Shrub	to 1
Grevillea crithmifolia 'Green Carpet'		0.6-0.8
Hemiandra pungens		0.05-1
Hibbertia hypericoides		0.2-1.5
Hovea pungens	Shrub	0.2-1.8
Hypocalymma angustifolium	Shrub	to 1.5
Hypocalymma robustum		0.4-1.5
Kennedia prostrata	Herb / groundcover	0.1
Melaleuca huegelii Prostrate		0.2
Melaleuca seriata	Shrub	0.25-1
Patersonia occidentalis	Herb / groundcover	1.5
Pultenaea reticulata	Shrub	0.5-2
Regelia ciliata	Shrub	0.8-2
Verticordia densiflora	Shrub	0.25-2
Verticordia plumosa		0.2-1.5
Xanthorrhoea preissii	Grass Tree	2

Source: Coterra, 2017; City of Cockburn, undated (https://www.cockburn.wa.gov.au/Street-Trees-Pruning-and-Planting); Tranen (pers. comm J. Lawton, 2 December, 2021).

COTERRA
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Appendix 2: Local Water Management Strategy

Development Engineering Consultants

REPORT

CONDOR NOMINEES PTY LTD
LOT 28 BARFIELD ROAD
HAMMOND PARK

LOCAL WATER MANAGEMENT STRATEGY

NOVEMBER 2022

DEVELOPMENT
ENGINEERING
CONSULTANTS

Revision History:

Revision	Description	Checked	Approved	Date
0	Original Issue	SRA	SRA	20th December 2021
1	Updated to reflect City of Cockburn comments received on 9th March 2022	SRA	SRA	4th April 2022
2	Updated to reflect Revised Plan	SRA	SRA	30th November 2022

Executive Summary

Estate Scale

- Drainage will be directed to the existing POS/Drainage area located in Lot 8001 which is east of Westwood Crescent in the development of former Lot 29 Barfield Road, immediately north of Lot 28. The swale will be designed to ensure all events up to the major 1% AEP storm is infiltrated on site.
- Bio Retention areas will be constructed at the proposed drainage outlet to provide nutrient uptake during the infiltration process.
- The 1% AEP storm will be wholly contained within POS area.
- Information Packages will be provided to all lot purchasers to: (a) Fully inform lot owners of the requirement to install the equivalent of two by 1200mm diameter by 1200 deep soakwells prior to an outflow connection to the drainage system; (b) To encourage the use of rainwater tanks; (c) To utilise water efficient devices & appliances throughout their homes; and (d) To maximise the use Water & Nutrient-wise plants, and minimise the use of lawns.

Access Street Scale

- All piped drainage systems will be designed to accommodate the 20% AEP event.
- Where possible piped drainage will be excluded in preference of swale drains and overland flow.

Allotment Scale

- All lot owners will be encouraged to install rainwater tanks plumbed into their homes for household use in order to assist to contain the 63.2% AEP - 1 hour event on-site in lieu of soakwells.
- All lots are required to install the equivalent of 2 by 1200mm by 1200mm deep soakwells which will hold a 20% AEP storm without outflow.

Public Open Space Areas

- All swale basins constructed within any POS area will be designed to infiltrate all storms up to and including the 1% AEP event.

1 Introduction

This LWMS report has been prepared as a stand-alone document to support the Structure Plan for Lot 28 Barfield Road Hammond Park and will be used to guide the design and construction of the proposed drainage solutions for subdivision within the area.

The location of the site is shown in Appendix A, together with an aerial photograph of the existing site.

The site is located on the eastern side of Barfield Road around 750m north of the intersection between Barfield Road and Rowley Road.

1.1 Drainage / Water Management Principles and Design Objectives

The following water sensitive design criteria, principles & objectives are to be pursued &/or implemented as part of the proposed development:

- *Water Conservation & Water Efficiency*

  Objective: To maximise the reuse of stormwater and minimise the use of scheme water outside of the home and to use water as efficiently as possible - both within & outside of the home.

  Deliverable: All lot purchasers will be encouraged to install rain water tanks plumbed into their home; to use water efficient devices & appliances throughout their homes and to plant "Water-wise" & "Nutrient-wise" gardens.

  Deliverable: All water will be infiltrated on site, mimicking the pre-development conditions.

- *Water Quantity Management and Protection of Property*

  Objective: To maintain the total water cycle balance within development areas relative to the predevelopment conditions.

  Deliverable: To ensure that post-development discharge is retained on site.

  Objective: To protect the built environment from flooding or water logging.

  Deliverable: All allotments to be a minimum of 0.3m above the 1% AEP flood level.

  Deliverable: Retention basins to be provided to ensure that 1% AEP storm is disposed on sit via infiltration.

- *Water Quality Management*

  Objective: To improve the overall surface & groundwater quality of the water leaving the estate and if possible improve the quality of water leaving the development.

  Deliverable: Ensure that surface water is routed to swale basins and retained on site.

1.2 Planning Background

The subject land is zoned "Urban" under the Metropolitan Region Scheme and "Development" and "Special Use" under the City of Cockburn's Town Planning Scheme No.3 which requires a Structure Plan for land zoned "Development".

The proposed Structure Plan is detailed in Appendix A.

2 Proposed Development

2.1 Key Elements of the Structure Plan (LSP)

The site is located within the suburb of Hammond Park within the City of Cockburn and covers an area of approximately 4.8ha of undeveloped land. The site is located on the eastern side of Barfield Road around 750m north of the intersection between Barfield Road and Rowley Road.

It is proposed to develop the western portion of Lot 28 ultimately as up to 46 residential lots with an average area of some 400sqm in accordance with its "Development" zoning and compliance with the City of Cockburn's "Southern Suburbs District Structure Plan" which prescribes a minimum density of 15 dwellings/ha, with the proposed 46 lots delivering a density of 18.4 dwellings/ha.

The eastern portion of Lot 28 is subject to an easement in favour of Western Power to accommodate two 330kV transmission lines and a single 132kV transmission line. It is expected that, through the Subdivision Approval process pursuant to approval of the Structure Plan, the easement area will be reserved for Open Space and Drainage in the same manner as the constructed development on Lot 29 to the immediate north.

The land is generally higher than the surrounding area falling from around RL34m AHD on the south eastern corner of the site to around RL25.5m AHD in the north western corner of the site.

2.2 Previous Land Use

In the mid to late 1980's the front portion of the lot was cleared and a house and outbuildings were constructed which were demolished in 2017. That area remains cleared and the area beneath the power lines has been "parkland cleared".

2.3 Finished Lot Levels

Finished Lot levels will be set using on the basis that they are a minimum of 0.3m above 1% AEP TWL of Drainage basins and that they are set such that major storm will flood into POS in lieu of flooding the lots.

Further criterion is that Lots are to be at least 1.2m above AAMGL, although the existing groundwater is well below surface levels.

3 Design Criteria

The drainage requirements for developments within this area are controlled by the requirements of the City of Cockburn, which are outlined below.

Item	Description	Requirement	Source / Comment
1	Water Quality	63.2% AEP 1 hour storm to be Retained on site	DoW requirements
2	AEP for pipe design	20% AEP	Standard Council requirement
3	AEP for compensating basin design	1% AEP without outflow from site	Standard Council requirement – No predevelopment flows currently exit the site.

Item	Description	Requirement	Source / Comment
4	Min. lot freeboard	0.3m above basin 1% AEP flood level 0.3m above 1% AEP HGL in Road System	Standard Council requirement developments
5	Basin Criteria		
	Side slopes – In POS	Max. 1 in 6	Standard Council requirement
6	Run-off coefficients	Road reserves $C_{1\%}$ – 0.72 for Urban Residential Allotments $C_{1\%}$ - 0.21 IL 9.79mm CL 9.09mm/hr 0.00 – Developed Rural Areas/POS	Per Council requirements – Based on 90% paved area in road reserve with Run –off Coefficient of 0.9. Lots as per Calculation in Appendix C.

4 Pre-development Environment

4.1 Topography and Landform

The site moderately rises from RL25.5m AHD in the north western corner of the site to around RL34m on the south eastern corner of the site. The western portion of the site outside the Western Power easement grades from RL25.50m AHD in the north western corner to RL28.0m AHD in the south eastern corner. The average grade of the land is around 0.5%.

4.2 Soil Characteristics

The Perth Environmental Geology Mapping (Gozzard JR 1983 Fremantle Part Sheets 2033 I and 2133 IV) 1 indicates that part of the site area consists of a single major soil types being "S8", defined as sand, very light grey at the surface, yellow at depth, fine to medium grained, sub rounded quartz, moderately well sorted of eolian origin.

In essence the site is suitable for urbanisation, consisting of well graded sands of high permeability meaning that soakage will be effective on the site

The Western Australian Planning Commission Planning Bulletin 64 identifies the whole of the subject site as having Low to no risk of AASS and PASS occurring generally at depths of >3m no known risk of acid sulphate soils occurring.

4.3 Geotechnical

At this stage, no detailed geotechnical investigations have been taken on the site. The drilling undertaken for the groundwater monitoring generally supported the environmental geology mapping. Given the homogeneous sand on the site and excavations in the peripheral areas to the site being consistent with the environmental mapping, no geotechnical investigations have been undertaken on the site to date.

In the Subdivision Approval process pursuant to approval of the Structure Plan, further investigations will be undertaken as part of the Urban Water Management Plan for the area to confirm the soil profile of the area at the proposed development level

given that there is currently sand extraction proceeding which will involve the removal of around 8m of sand from most of the site.

Development that has been carried out in adjacent land holdings has confirmed the soil profile in the area.

4.4 Groundwater Aspects

4.4.1 General

Groundwater flow directions are well documented from regional mapping data.

According to the 2004 Groundwater Atlas[2], which generally designates Average Annual Maximum Groundwater Levels (AAMGL) as measured from the relevant bores, the groundwater levels grade down from east to west from RL22 mAHD at the eastern boundary of the site to RL21 mAHD on the western side of the site.

The 1997 Groundwater Atlas[3] indicates that the groundwater levels grade from say RL23.0m AHD on the western side of the site rising to RL24.00m AHD on the eastern boundary abutting the Kwinana Freeway, this is normally representative of maximum likely groundwater levels (MGL) rather than AAMGL.

Groundwater levels were measured from October 2017 to November 2018 and indicated peak level in September 2018 to range from RL22.80m AHD abutting Barfield Road to RL23.2mAHD on the western side of the power easement. These were compared to the peak levels of surrounding DWER bores and the MGLs accordingly calculated to grade from around 23.3mAHD on Barfield Road to RL23.7 on the western side of the power line easement.

The lowest level of the site is located on the south western corner of the site and is at around RL25.5mAHD, meaning that at its shallowest; the maximum groundwater level would be at least 2.1m below the existing site levels. Based on the measured levels of the site and calibration against the peripheral long term DWER bores, the MGLs have been calculated and are plotted on Drawings L-03 and L-04 in Appendix B.

Looking at these levels, the existing drainage area in Lot 26 the peak groundwater level is some 200mm higher than the existing base of the basin. According to the plans prepared by KCTT for the neighbouring development, the design base was RL23.50 and the peak groundwater level was RL23.40 to 23.50 – thereby indicating that it would be wet in high groundwater conditions. The recent peak in 2021 was an all time high for the area which according to aerial photography was above the existing surface. It is noted that in instances when the expression of groundwater occurs, the wet area more or less acts as a solar bore and the evaporation causes a localized lowering of the groundwater thereby reducing the effective depth of the water.

4.4.2 Predevelopment Groundwater Monitoring

1) Background Information on Data and Summary of Information Received

Monitoring and background information for the site was investigated in 2017 to 2018 as per the results below. The level information was compared to surrounding DWER

bores which have long terms results to gain an understanding of the monitoring results relative to the long term peripheral results.

2) Groundwater Level Information

The collated bore information on measured groundwater levels is outlined below in Table 4.1.

Table 4.1 – Groundwater Depth Results

Bore	EMB01	EMB02	EMB03
RL Surface	25.79	27.10	26.47
26/9/2017	22.273	22.596	22.195
2/10/2017	22.29	22.639	22.198
10/10/2017	22.291	22.645	22.213
13/10/2017	22.284	22.643	22.219
20/11/2017	22.116	22.507	22.098
6/12/2017	22.077	22.462	22.059
22/01/2018	22.151	22.5	22.044
6/02/2018	22.11	22.488	22.045
8/06/2018	21.906	22.271	21.813
29/10/2018	22.74	2.0399	22.694
13/11/2018	22.679	23.036	22.655

Given the whole of the area is likely to be an unconfined aquifer, these were correlated with long term records of DWER bores to ensure that the 95 percentile groundwater contours could be established with reasonable certainty.

Based on the bore records for the site and the surrounding bores, the MGL's grade from RL23.2mAHD on the western side of the power line to around RL22.8mAHD at Barfield Road. Based on the surrounding DWER bores being bore 61410211 on the corner of Barfield Road and Ironbark Terrace and bore 61410087 on Hammond Road opposite Cousins Street. The long term bore records indicate that maximum levels were measured in 2021 which were an average of 0.47m higher than the results recorded in 2018. As a result the maximum likely level will range from RL23.27 on Barfield Road to around RL23.67 on the western side of the power lines.

Although the development levels proposed on Lot 28 are well above this being some 2.1m above the peak groundwater levels.

The existing base of the drainage basin is set at around RL23.50mAHD meaning the base of the basin is likely to be below peak groundwater levels.. Data from recent aerial photography seems to indicate wet areas which is likely that the groundwater has reached the surface with recent high levels. The 95 percentile maximum groundwater level, which would usually be used to establish the MGL is some 0.2m

lower than the absolute maximum recorded in 2021 which means that the base is around level with the MGL.

3) Groundwater Quality Information

Chemical analysis has been undertaken within bores MB1 to MB 5 and the information for that and adjoining bores is outlined in table 4.2 below.

Table 4.2 – Groundwater Quality test results

Sample ID	Date	Trigger	Nutrients		
			Total P	Total N	NH_4-N
		LOR	0.01	0.1	0.01
		Refer Below	0.8-12[1]	5 [1]	0.04 [2]
		LIWG	NG	NG	NG
EMB01	10/10/2017		0.04	1.4	0.1
EMB02	10/10/2017		0.01	2.2	0.02
EMB03	10/10/2017		0.03	0.6	0.15
EMB01	22/01/2018		0.02	1	0.14
EMB02	22/01/2018		0.01	0.9	<0.01
EMB03	22/01/2018		0.01	0.6	0.01
EMB01	29/10/2018		0.01	1.2	0.05
EMB02	29/10/2018		0.03	6.1	0.03
EMB03	29/10/2018		0.01	0.4	0.1

1. Irrigation Guidelines ANZECC/ARMCANZ 2000, Chapter 9
2. Values for Wetland environments - Table 3.3.6 ANZECC/ARMCANZ 2000 Freshwater and Marine WQ Guidelines Chapter 3

In looking at the measured nutrient levels it is evident that all nitrogen and phosphorous levels are currently within allowable ANZECC limits, however the measured total Nitrogen at MB02 is slightly elevated above other records.

There was some evidence of growing areas on the site and it may be that there was historic use of fertilisers that may appear in the records following the winter rains. In addition to that, the peak levels were coincidental with the adjoining development works commencing.

The location of existing monitoring bores is shown on Predevelopment Catchment Plan L03 in Appendix B. It is proposed that these bores will be retained for future monitoring.

4.5 Surface Water Aspects

4.5.1 General

As shown in Appendix B, the current site is divided into a single catchment falling to the north of the site. The land keeps falling to the existing development meaning that the existing drainage basin is well located to cater for the site.

4.6 Environmental Assets and Water-Dependent Ecosystems

There are no wetlands or conservation areas within 1.0km of the site.

4.7 Existing Infrastructure and Design Constraints

Sufficient capacity is available in the adjoining development to service the development of the subject land.

The whole of the site is proposed to be sewered into existing infrastructure to the west of the site, which is located within Barfield Road.

5 Water Sustainability Initiatives

5.1 General

The current State Government requirement to increase the efficiency of water use in new developments to a target of less than 100kl per person per year is proposed to be implemented within the development.

This is proposed to be achieved by:

- Increased water efficiency in the household by encouraging the use of waterwise appliances through regulation and financial incentives.
- Encouragement of the use of rainwater tanks to supplement scheme water for irrigation.
- The use of low water requirement plants and minimizing turf areas for gardens and POS areas

5.2 Individual Lot Owner Initiatives

Water conservation will be encouraged by the developer through the promotion of native, water-wise gardens and water efficient household devices & appliances. All requirements for the purchaser will be outlined in their purchase contract and associated information handouts.

The information will also outline the case for all lot owners to use rainwater tanks plumbed into their homes to assist with the retention of the 63.2% AEP event.

5.3 Estate Public Open Space (POS) Initiatives

5.3.1 Aims

The provision of POS within Lot 28 has been resolved with the City of Cockburn and the WAPC and is expected to be resolved through the Structure Plan approval process, however it should be noted that, through the Subdivision Approval process

pursuant to approval of the Structure Plan, the easement area is expected to be ceded to the Crown as a Reserve for Recreation and Drainage in the same manner as Lot 8001 which was ceded from Lot 29 to the immediate north pursuant to the construction of its "Development" zone.

In the same manner as Lot 29, the proponents of Lot 28 have obtained Western Power's approval to earthwork within their transmission easement over the eastern portion of Lot 28 (which is zoned "Special Use") to obtain fill for the proposed development on the western portion of Lot 28 which is zoned "Development". The earthworked batters will be revegetated and the flatter area closest to the development will be grassed and irrigated.

The drainage impacts of the Open Space within Lot 28's Western Power easement will be managed to ensure that:

- The maximum depth of water within drainage basins during a 1% AEP storm is limited to 1.2m.
- Flush kerbs may be constructed abutting POS areas with either direct run-off for infiltration in lower areas or with swales for infiltration/conveyance to drainage basin areas.

The proposed landscaping development of the Open Space area will address the following objectives:

- Minimising irrigation & fertiliser demands via appropriate species selection
- Managing fertiliser application to minimise impacts on water quality.
- Weed Management
- Fauna Protection

5.3.2 General POS initiatives

The treatment of the potential POS within the Open Space area will typically consist of grassed areas with designated areas of native planting and mulching. All areas will be designed to minimise irrigation requirements with predominantly native plantings incorporated into the landscape design and the use of low water requirement grasses such as kikuyu.

Detailed landscape plans will be prepared at the time of subdivision in accordance with agreed requirements with the City of Cockburn which will address the objectives outlines in Section 5.3.1.

5.3.3 Irrigation

1) Water Sources and required Allocations:

For the POS irrigation the overall water use is limited to a maximum of 7500kl per hectare per annum in accord with the Department of Water requirements. The total area to be irrigated over the total development is approximately 2.00ha (Allowing verges around POS areas to be irrigated) which will require an annual bore yield of some 15,000kL per annum.

An application has been lodged with DWER for this allocation.

Standard conditions require irrigation usage to be metered monthly and submitted annually in accord with DoW requirements.

2) Programming and Irrigation Minimisation.

Establishment irrigation for trees and native POS planting areas is expected to be used for a period of between 2 and 3 years after planting then disconnected.

Typically, watering will start with 10mm three times / day for initial establishment over a period of around 1 month, depending on the weather and the time of the year. This should then be reduced to 10mm once/day for a period of around 2 months - dependent on the time of year. The watering is then reduced to 10mm applied 2 to 3 times a week.

Irrigation should be programmed and maintained to minimise the water used across the site, with the following mechanisms to minimise water use.

- The system should be checked regularly to detect faults and ensure water is being used effectively and efficiently.
- In general the system should be checked at a frequency of
    - November to April - Once per fortnight.
    - May to October - Once a month.
- All sprinklers should be checked to fully pop-up and retract, bubblers and that nozzles are free of blockages and sprinklers are providing adequate coverage. Particular attention should be paid to irrigation of transplanted mature trees and street trees to ensure they are receiving adequate water.
- The watering regime for planted areas should reflect the plants needs in accordance with the plant type and natural rainfall, in accordance with the Water Corporation's "Water-wise" guidelines. Watering should be monitored throughout the year and adjusted accordingly to ensure appropriate watering. Watering should only take place within the hours stipulated by the Water Corporation (Currently 6.00pm to 9.00am).

The Irrigation Schedule is expected to be as follows (based on landscape hydrozones):

- Turf should be separated from shrubbery and turf and shrubbery should be supplied by different stations of irrigation and scheduled separately.
- Areas of turf subject to lower wear in sheltered environments &/or are not in visually prominent positions should be scheduled to receive a lesser amount of irrigation than areas of turf that are subject to high levels of wear, in exposed environments &/or in visually prominent locations;
- Low Water use plants should be scheduled to receive a lesser amount of water than areas of higher water use; and,
- Irrigation should be progressively withdrawn from areas of native shrubbery.

As part of the landscape works, the topsoil in the landscaped areas will be improved to ensure free drainage and nutrient retention properties prior to planting.

6 Stormwater Management Strategy

6.1 Pre-Development Hydrology

As outlined in Section 4, the site consists of sand with excellent soakage characteristics and is moderately steep with most portions of the site grading at around 0.5%.

Based on the fact that little or no run-off occurs from the site and all rainfall is infiltrated, it has been assumed that there is no predevelopment flow from the site. A plan detailing the predevelopment catchment boundaries is shown in L03 in Appendix B.

The majority of the area grades to a low point to the north of the site abutting the neighbouring land.

As outlined above, despite the topography indicating these flow paths, the permeability of the surface means that infiltration occurs at a greater rate than run-off meaning that little or no runoff leaves the site. In the unlikely event that runoff reached the isolated low points, the water infiltrates in that area.

6.2 Pre- & Post- Development Hydrology

The drainage strategy is proposed to infiltrate all stormwater on site within the existing drainage basin off Westwood Ave.

The existing basin has not been provided with a bio retention area despite being excavated close to the existing groundwater levels. As a result it is proposed that a bio retention area will be constructed as part of these works.

Soakage at source will be employed for all allotments without outflow for all storms up to the 20% AEP storm. Beyond that, water will surcharge and run overland to the street drainage system and be conveyed to the drainage basins.

Basins will generally be constructed as swales within POS areas. The basin arrangements are generally constructed as a two tiered arrangement as follows:

- Water will drain into a bioretention area which will contain the 1EY 1 hour storm.
- For the lower, less regular AEP storms, water will then surcharge into a vegetated area which will contain all other storms up to the 1% AEP.

GPT's will be constructed at entry to the POS soakage areas to ensure that all litter and sediment is contained for easy cleaning.

The areas required to contain flows from the post development catchments areas are summarised in Table 6.1 - Refer also to Appendices B and C for the catchment plan and detailed calculations:

Table 6.1 – Drainage Basin Areas/Catchments and Areas affected by Drainage

Basin Description	Total Catchment Lots 28 and 29
Impervious Catchment (Ha) ($C_{1\%}$)	2.43

Basin Description	Total Catchment Lots 28 and 29
Storage provided (1% AEP)	2,519
Storage provided (20% AEP)	827
Storage provided (63.2% AEP)	452
Site Area Required (1% AEP)(m^2)	5,961
Site Area Required (20% AEP)[1] (m^2)	5,410
Site Area Required (63.2% AEP) [1] (m^2)	5,284
$TWL_{1\%}$ (mAHD)	23.95
Critical Tc (63.2% AEP) (hours)	2
Critical Tc (20% AEP) (hours)	2
Critical Tc (1% AEP) (hours)	9
Basin Drying Time (63.2% AEP) (hours)	16
Basin Drying Time (20% AEP) (hours)	24
Basin Drying Time (1% AEP) (hours)	80

6.3 63.2% AEP event

6.3.1 General

The 63.2% AEP event is typically seen as the storm where most nutrients and particulate matter is generated from.

The separation distance between all of the development and the groundwater is around 2.7m and as generally agreed with DoW, no groundwater control measures are required.

It is proposed that the 63.2% AEP 1 hour storm will be retained on site without outflow in accordance with DoW requirements. This is proposed to be undertaken at the various levels as outlined in the following sections.

6.3.2 Lots:

Lots will either retain water on site in rainwater tanks in conjunction with soakwells or install soakwells to infiltrate water to ensure no outflow into the street drainage system. All Lots are required be fitted with the equivalent 2 by 1200 diameter by 1.2m deep soakwells to achieve full retention of all storms up to the 20% AEP storm without outflow.

Beyond this storm, stormwater will surcharge from the soakwells and run overland to the street drainage system and some infiltration will occur, particularly in back yards.

6.3.3 Streets:

The 63.2% AEP 1 hour storm for roadways, will be contained firstly within drainage pits with open bases to permit soakage for small rainfall events thereby encouraging further soakage "at source". The baseless pits will cater for around 1.5-2.0mm of rainfall.

Overland flow will be employed in lieu of piped drains where possible. Where roads are constructed adjacent to open space and opportunities for soakage are available, flush kerbs may be used in conjunction with swale drainage in lieu of a piped drainage system. This is subject to final landscape design details and agreement from the Local Authority at detailed design stage.

The remainder of the 63.2% AEP 1 hour event will be contained within the below ground storage without overflow to any surrounding POS areas.

A GPT will be installed prior to any inflow from the piped drainage system into the drainage basin to limit the siltation of the basin.

6.3.4 Detention Basins

Beyond the measures employed in baseless pits and lineal swales, the remainder of the 63.2% AEP 1 hour storm will be retained within the retention basin area. The drainage basins will retain the water until it infiltrates.

Details of the proposed retention basins are included in Appendix D.

6.3.5 Non structural measures

Non structural measures will also be employed to reduce the sources of nutrients. These measures involve providing advice to lot purchasers and stakeholders to reduce nutrient sources from the application of garden fertilisers and eroded particulate matter particularly from the new urban areas during the housing construction phase and in establishment of gardens.

Minimisation of nutrient loading can obviously be achieved through:

- Education of local residents and Council maintenance personnel; and
- By implementing frequent street and storm water maintenance programs – particularly during housing construction.
- By planting and using appropriate native species.

6.4 20% AEP event

All piped drainage systems will be designed to accommodate the 20% AEP event, without any inundation of roadways.

6.5 1% AEP event

For the major event, lot drainage flows in excess of the 20% AEP storm will surcharge and run overland. All roads within the estate will be designed to accommodate and direct extreme event flows towards each POS and drainage basin.

The land will be divided into the same catchment areas as detailed in the post development plan as Appendix B.

6.6 Finished Lot Levels (Relative to the 1% AEP flood levels)

As outlined in Section 0, the land is proposed to be filled a minimum of 300mm above the top water level of drainage basins. In all cases, lots will be set to ensure conveyance for major storms will be along the roadways without flooding homes.

6.7 POS Credits

As outlined in the LSP document all POS credit calculations have been based upon current "Liveable Neighbourhood" policy guidelines - where 100% of the area covered by the 63.2% AEP event of each compensating basin is typically not included as a "usable" POS area. The 20% AEP event is designated as a restricted area normally attracting a 100% credit for the area between the 63.2% AEP and the 20% AEP levels provided this comprises less than 20% of the total POS allocation.

The affected areas of the drainage basins are detailed in Table 6.1. It is noted that the drainage is proposed to be directed to an area that has been provided to the City for the sole purpose of drainage and rehabilitation. By using this area, the POS area within Lot 28 can be fully utilized for recreation and vegetation retention rather than performing a drainage function.

6.8 Best Management Practices Water Quality Targets

The DoW's Stormwater Manual provides guidelines and information on best management practices that may be applied at land development and construction sites to improve stormwater management and environmental performance.

Poorly managed land development sites can often be a major source of stormwater pollution. Certain construction activities can allow pollutants to be transported (via existing stormwater systems or over-land flow) to adjoining receiving water bodies.

The major source of pollutants from construction activities in this instance will potentially be from:

- Eroded materials in the interim period between opening up the surface of the site and implementing the drainage management measures.
- Litter & waste storage areas- that allow materials to be blown by wind or washed away by rainfall into existing stormwater systems.
- Wash-down areas– poor practices can allow materials to enter stormwater systems.
- Placement & storage of delivered products- particularly sand and soil stockpiles where such materials may be tracked by vehicles onto roads, or blown, or washed on to roads which then get into existing stormwater systems.
- Dewatering activities– which can cause sedimentation of downstream water bodies.

Consequently no construction activities will commence on the site until an appropriate approved Environmental Management Plan (EMP) is prepared that fully addresses:

- litter and waste management practices (non-hazardous & hazardous materials);

- vehicle & equipment washing-down practices;
- water conservation practices;
- product placement & storage practices;
- dewatering activities (if applicable); and
- Any other practices that may adversely impact upon receiving water bodies.

This will be prepared by the contractor undertaking the civil works on the subdivision together with the engineering consultant.

The Best Management measures proposed for this area are proposed to be:

- Non Structural Measures to be implemented reduce applied nutrient loading.
- On Site Retention of 63.2% AEP 1 hour storm.

Research has indicated that this approach will achieve reductions of at least 80% of total suspended solids; 60% of total phosphorus; 45% of total nitrogen & 70% of gross pollutants compared to a conventional drainage system.

7 Groundwater Management Strategy

7.1 Groundwater Level Management

Groundwater levels for the site location are plotted on the site plan in Appendix B. In general the levels are several metres below the site levels. Development levels are generally at a minimum of RL25.6mAHD which is well above the maximum likely groundwater level of around RL22mAHD.

There is no further need for controls of groundwater levels and all drainage pipework will be laid well above the controlled groundwater levels.

7.2 Actions to Address Acid Sulphate Soils or Contamination

The ASS mapping for the area indicates that there is no known risk of ASS soils occurring within 3.0m of natural soil surface (or deeper).

Therefore there is little or no risk of the development proposal encountering any ASS soils.

8 The next stage – Subdivisions and Urban Water management Plans

The structure plan area is under the ownership of a single owner such that the drainage system can be implemented in accord with the development programme.

As a result, the staging of the development and any temporary facilities as required will be addressed in the Urban Water Management Plan (UWMP) which will be required for the subdivision proposal. It is anticipated that the ultimate drainage strategy will generally fit within the framework of this Local Water Management Strategy.

The UWMP will build on the concepts of this report providing ongoing monitoring results and addressing the following major points:

- Further detail in the design of the detention basins.

- Detailed geotechnical investigations.
- Further detail in landscape proposals.
- Testing of groundwater quality for irrigation purposes.

Once this data is received, the approach outlined herein will be reviewed with detailed work required to:

- Finalise the design of the swales in the POS.
- Detail the Drainage basins including the various inlet configurations and edge treatments to ensure the overall functional and aesthetic outcomes are satisfactory.
- Review the drainage calculations relative to final planning proposals for the site to ensure that the land use assumptions within the drainage calculations herein are consistent.

9 Monitoring

9.1 General

Post development monitoring is proposed to be undertaken over the site quarterly following the completion of the first stage. It is proposed to use the same suite of bores used for the pre- development monitoring as detailed in Drawing U-03 in Appendix B.

It is acknowledged that some of these bores may be impacted by the works and if this occurs, they will be reinstated as close as possible to their original locations but in a suitably accessible location.

The level will be measured and samples will be sent to a NATA registered laboratory to undertake the following tests:

Table 9.1 – Proposed Post Development testing regime

Test	Abbreviation	Trigger levels (Based on 10% Exceedance of Initial Levels) (mg/1)
Total Phosphorous	TP	0.044
Ammonia-Nitrogen	NH_3	0.165
Total Kjeldahl Nitrogen	TKN	6.71
Salinity	EC or TDS	N/A
pH		N/A

The water will be sampled quarterly January, March, June and October commencing after the first stage of development has been completed and will be carried out for two

years following completion of the last stage of civil construction and until hand over of the POS to the City of Cockburn, whichever is the latter.

Hand over to the City of Cockburn will occur two years after completion of establishment works. In the interim period, the developer will accept responsibility for the maintenance and monitoring of the landscaping and monitoring works.

An annual report will be submitted to the City of Cockburn and the DWER until 2 years after the completion of the last stage.

9.2 Contingency Response

The results will be compared between the initial results to those measured each year.

In the event that any of the indicators from the sampling exceeds the initial measurements by 10% for two consecutive samples, Council and DWER will be notified and the matter will be investigated at the developers cost.

The possible contingency measures are as follows:

1. Reduction in irrigation or fertiliser use in key areas and review of timing.
2. Soil amendment in high nutrient areas
3. Increased planting of water and nutrient thirsty plants in groundwater recharge areas.

The measures employed and the timing will be resolved at the time with the DWER and Council.

If standing water occurs within the basin areas for excessive periods of time within the maintenance period for the landscaping (That is two years following completion of the last stage of civil construction or until hand over of the POS to the City of Rockingham, whichever occurs first), the developer shall at its cost investigate the issue and provide a solution for approval by the Local Authority. Following agreement on a strategy, the developer shall implement the strategy and undertake any required rectification works at its cost.

10 Implementation

10.1 Commitments

The developers are committed to

1) Physical Outcomes – To be undertaken at the time of construction.

- Ensuring that all storm water drainage from the estate is infiltrated on site.

2) Non Structural – To be undertaken as part of sales documentation, by providing Information Packages to all lot purchasers to:

- Fully inform lot owners of the requirement to install the equivalent of two 1200mm diameter by 1200mm deep soakwell prior to outflow into the drainage system in the event a rainwater tank is not installed or reduced storage equivalent to the storage of a rainwater tank in the event that one is used.
- To encourage the use of rainwater tanks (plumbed into their homes); and

- To utilise water efficient devices & appliances throughout their homes, and to encourage all purchasers to install Water & Nutrient-wise plants.

3) Further investigation and reporting:

- Prepare Urban Water Management plans to support further detailed subdivision planning.
- Undertake geotechnical investigations.

10.2 Maintenance Schedules (Incl. Roles & Responsibilities)

Maintenance schedules and arrangements will be resolved as part of the Urban Water Management planning and will be dependent on the detailed design and operation of the mechanisms required. As a brief summary, table 10.1 has been included to provide guidelines for likely maintenance responsibilities.

Table 10.1 – Proposed Maintenance Programme for the development

#	Drainage Element:	Possible Maintenance and Inspection Frequency:	Responsibility:
1	Rainwater tank(s); trapped underground soakage / connection pit(s)	Annually inspection & clean-out (as necessary) – just prior to winter rains	Lot Owner
2	Swale Areas, table drains and detention basins	During developer maintenance period (2 year in conjunction with Landscaping)	Developer
		Inspect, clean-out & maintain plants ~fortnightly intervals (depending on loading) – as part of POS maintenance works	Council
		After developer maintenance period:	
		Inspect, clean-out & maintain plants (as required) as part of standard Council POS maintenance program	
3	Drainage culverts, standard table drains, pipes and pits	During developer maintenance period: (12 month Defects liability period)	Developer
		Inspect, clean-out & maintain structures annually – just prior to winter (& then again in Aug / Sept if necessary)	Council
		After developer maintenance period:	
		Inspect, clean-out & maintain structures at least annually – just prior to winter – but inspection frequency will need to be higher during home construction phase	
4	Trapped Pits and GPT's	During developer maintenance period: (12 month Defects liability period)	Developer
		Inspect, clean-out & maintain pits tri-annually – just prior to winter & then around June / July & again in Oct / Nov for the first two years	
		After developer maintenance period:	
		Inspect, clean-out & maintain pits tri-annually – just prior to winter & then around June / Aug – but inspection frequency will need to be higher during home construction phase.	
5	Base of compensating basins	Initial formal inspection & assessment of performance of bases (say) at around year 3 & then every 5 – 10 years.	Council

10.3 Funding

The cost for the implementation of the capital water management measures will be borne by the developers. Maintenance and monitoring costs will be borne by the developers for the periods as outlined in the maintenance schedule table in section 10.2 above.

10.4 Review

Following the approval of this document, it is not expected that the LWMS for this development will need to be reviewed as this forms the broad structure of the approach for the drainage in the area.

In general minor amendments can be made, provided they meet the outcomes sought within this report. In the event that the management measures used within the state have significantly changed or the first subdivision application following the expiration of 4 years from the first subdivision approval whichever is the later, the measures used for management of stormwater should be reviewed.

11 References:

1. Environmental Geology Mapping - Part Sheets 2033 I and 2133 IV, Gozzard JR 1983
2. Perth Groundwater Atlas (Edition 4), Department of Environment, 2004
3. Perth Groundwater Atlas, Waters and Rivers Commission, October 1997.

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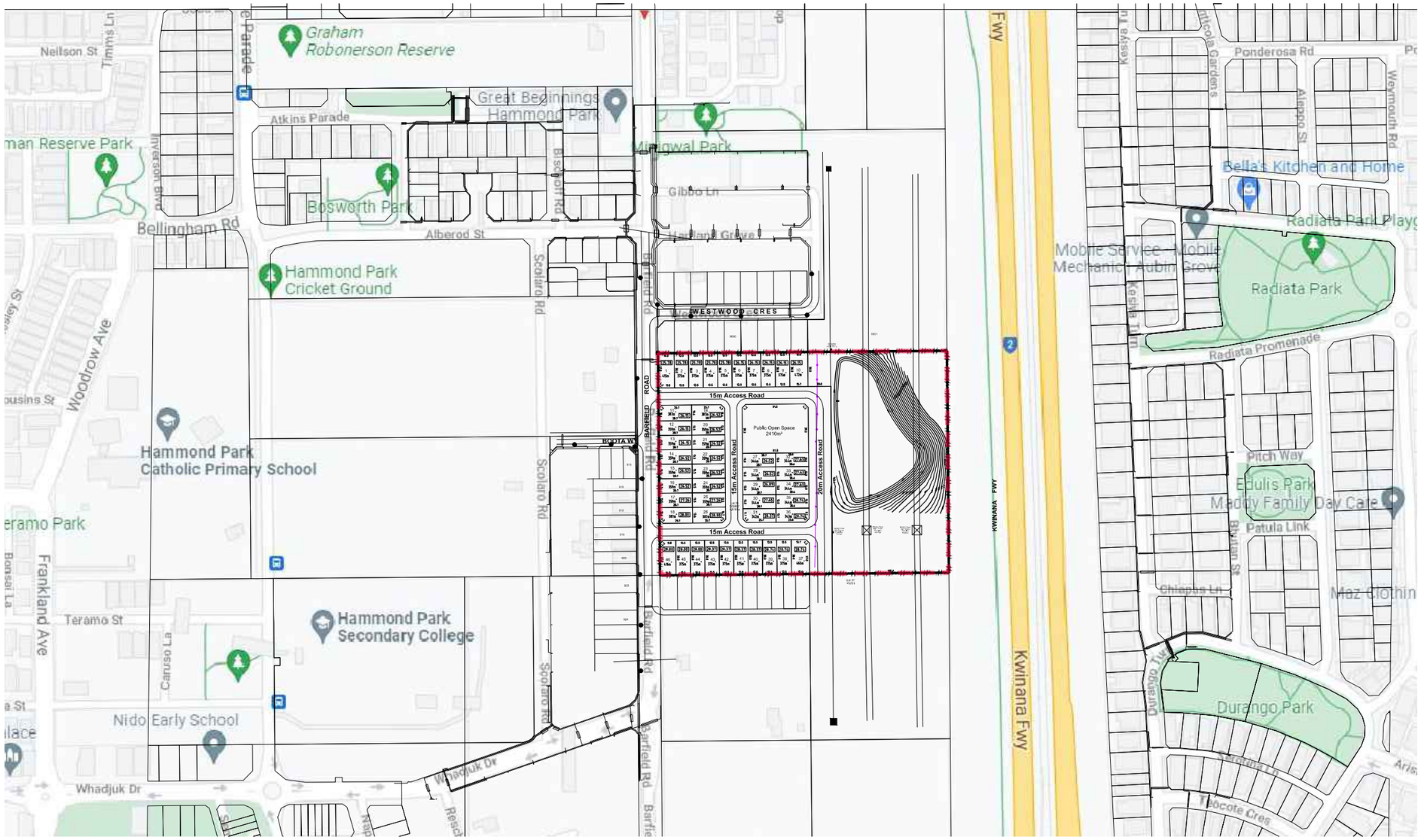
APPENDIX A –

- **L- 01 Locality Plan**
- **L- 02 Aerial Photo with Development Superimposed Thereon**
- **Indicative Subdivision Plan**

LEGEND

Site BOUNDARY



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B	30/11/22	JEG	LAYOUT AMENDED	SRA
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PROJECT: LOT 28 BARFIELD ROAD HAMMOND PARK

W.A.P.C. No. -

DRAWING: LOCAL WATER MANAGEMENT STRATEGY LOCALITY PLAN

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LEGEND

Site BOUNDARY

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LOT 28 BARFIELD ROAD HAMMOND PARK

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DRAWING:
LOCAL WATER MANAGEMENT STRATEGY
AERIAL PHOTO

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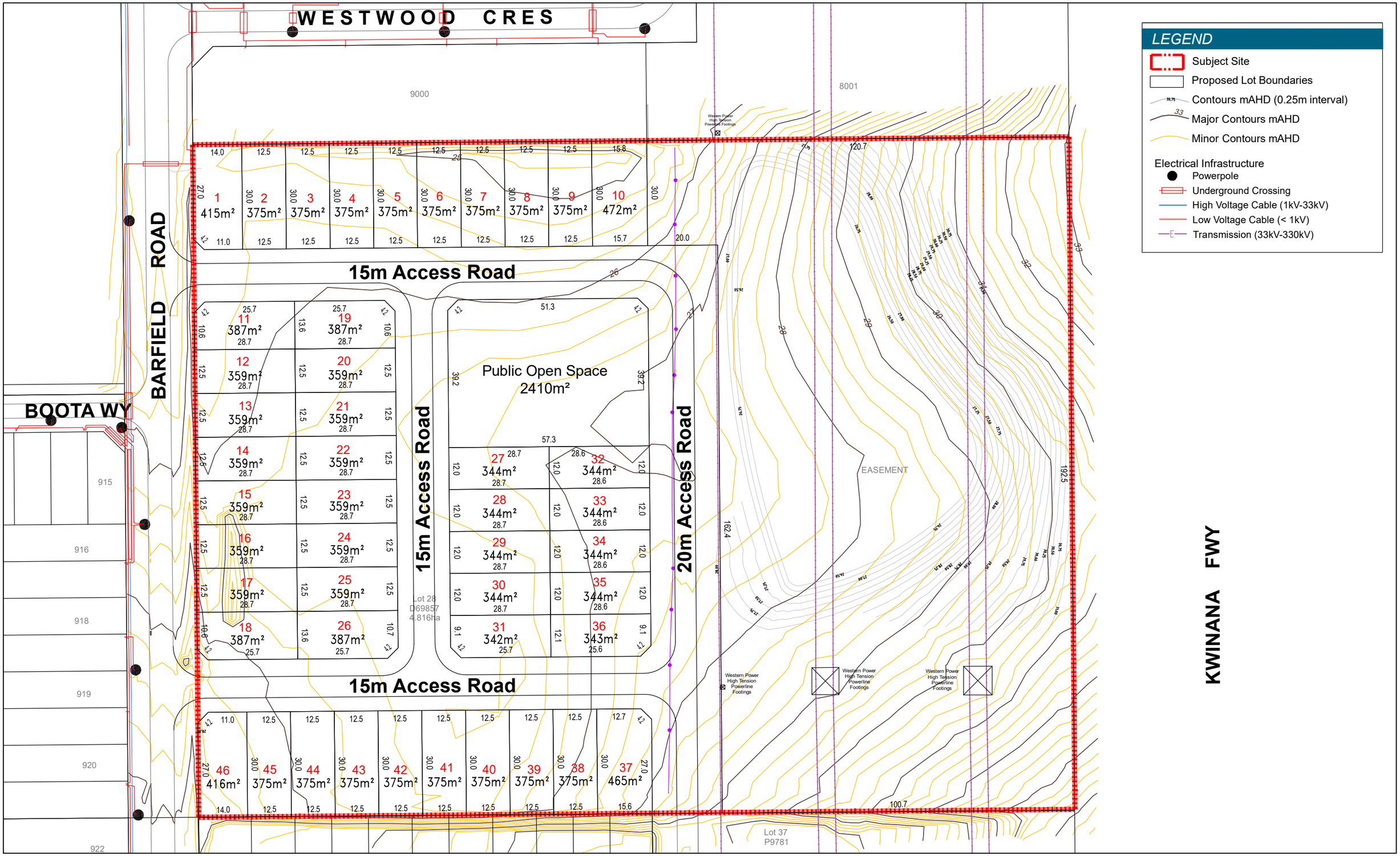

LEGEND

- Subject Site
- Proposed Lot Boundaries
- Contours mAHD (0.25m interval)
- Major Contours mAHD
- Minor Contours mAHD

Electrical Infrastructure

- Powerpole
- Underground Crossing
- High Voltage Cable (1kV-33kV)
- Low Voltage Cable (< 1kV)
- Transmission (33kV-330kV)

SUBDIVISION PLAN

Lot 28 Barfield Road, Hammond Park

10 0 10 20 50 100m

Michael Glendinning Property

Source of Information

Site boundaries: Landgate, MNG
Projection: PCG94

NOTE

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

Project Lot 28 Barfield Road, Hammond Park I Scale 1:1000 @ A3 I Date November 2022

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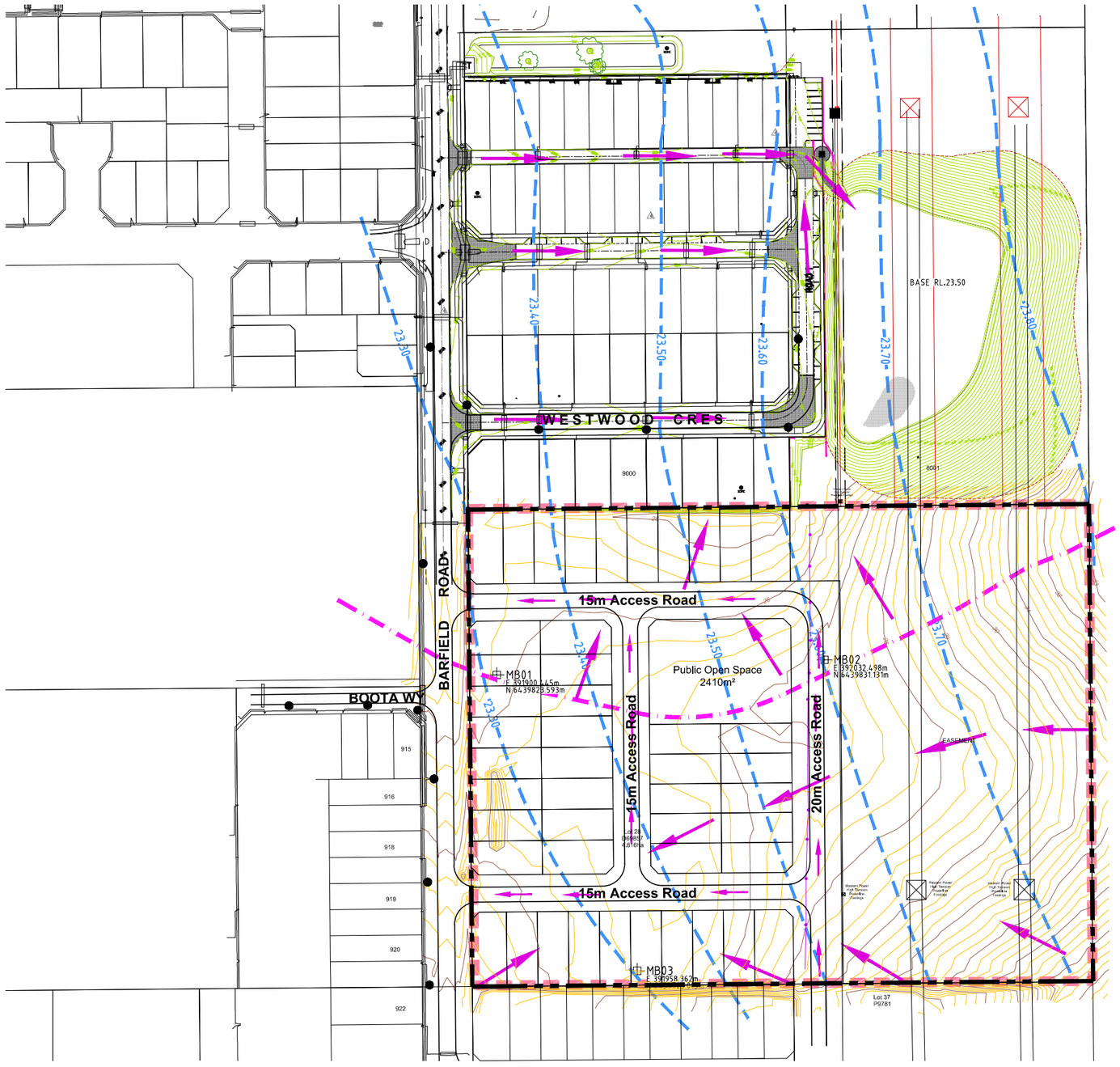
APPENDIX B – DRAINAGE CATCHMENT PLANS

- **L- 03 - Pre-development catchment plan**
- **L- 04 - Post development catchment plan with flow directions and proposed drainage basins**
- **L- 05 – Drainage and basin details**



LEGEND

- CATCHMENT AREA
- EXISTING SURFACE CONTOURS (23)
- WATER CONTOURS (2.90)
- IMPLIED NATURAL RIDGE
- FLOW ARROW
- MONITORING BORE (MB01 — NAME; E 661.597m, N 489.355m, RL 10.00m — SURFACE LEVEL; 2.5m — DEPTH; Ø 150 — BORE DIAMETER)

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DRAWING: LOCAL WATER MANAGEMENT STRATEGY PRE-DEVELOPMENT CATCHMENT PLAN
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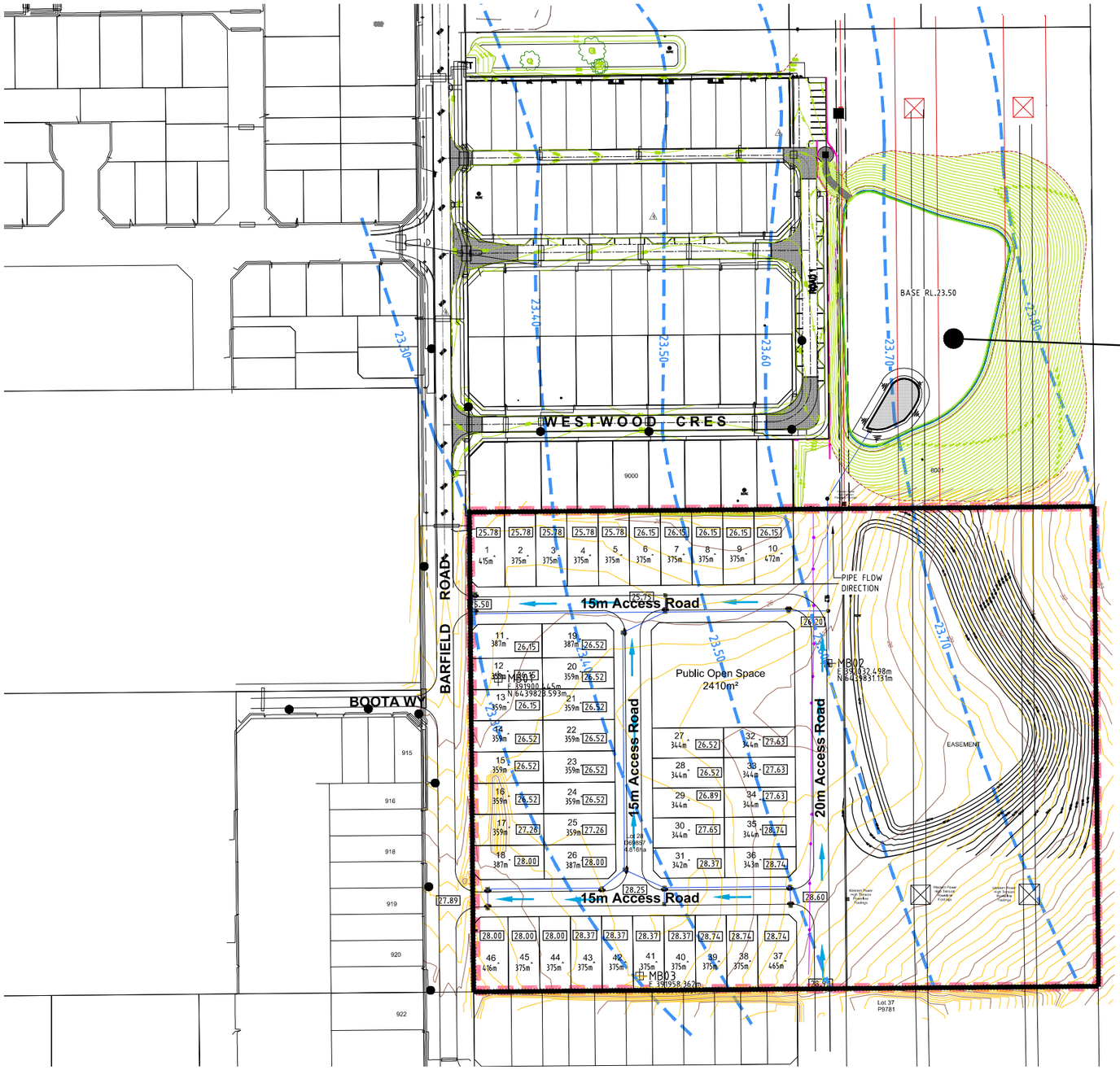
PROJECT NUMBER PRO1022 DRAWING NUMBER L03



LEGEND

- CATCHMENT AREA
- 23 — CONTOURS
- 2.90 — GROUND WATER CONTOURS
- DRAINAGE BASIN
- SURFACE FLOW ARROW
- MB01 — NAME; E 636.159m, N 497.057m; R.L.0.00m — SURFACE LEVEL; 2.5m — DEPTH; Ø 150 — BORE DIAMETER — MONITORING BORE
- 28.50 — ROAD LEVEL
- 1% A.E.P.
- 20% A.E.P.
- 1EY

BASIN DETAILS

TOTAL IMPERVIOUS AREA (1% AEP))	2.43ha
1% AEP STORAGE REQUIRED	2519m³
AREA AT TWL (1%)	5961m²
RL (TWL) (1%)	23.95m AHD
20% AEP STORAGE REQUIRED	827m³
AREA AT TWL (20%)	5410m²
RL (TWL) (20%)	23.66m AHD
1EY STORAGE REQUIRED	452m³
AREA AT TWL (1EY)	5284m²
RL (TWL) (1EY)	23.59m AHD
PEAK OUTFLOW (1%)	0 l/s
PEAK GWL AT SITE (95 PERCENTILE)	23.50m AHD

1:1000 (A1)

No.	DATE	BY	REVISION	
C	30/11/22	JEG	LAYOUT AMENDED	SRA
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DRAWING: LOCAL WATER MANAGEMENT STRATEGY POST-DEVELOPMENT CATCHMENT PLAN
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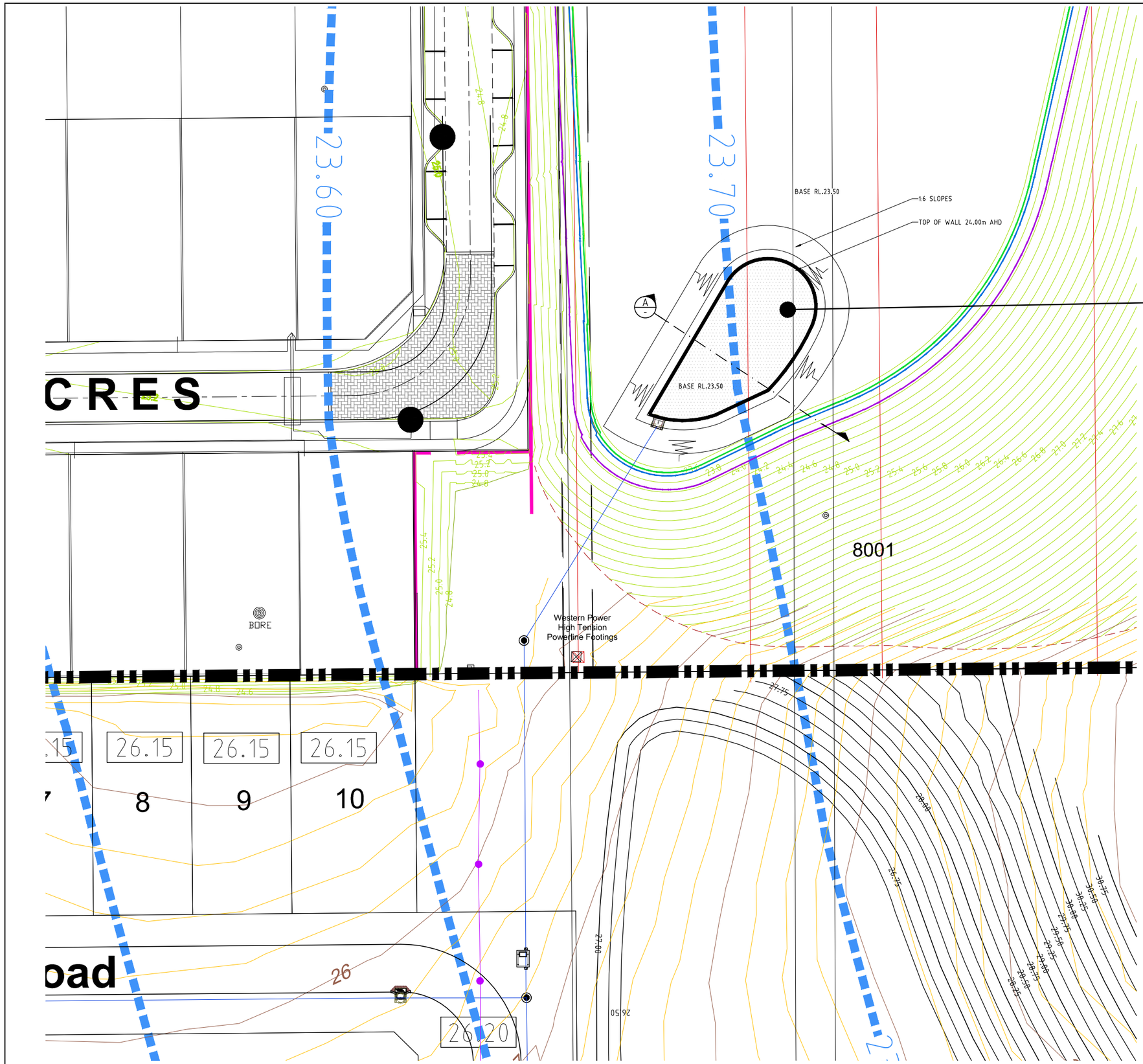

LEGEND

- 23 — CONTOURS
- 2.90 — GROUND WATER CONTOURS
- DRAINAGE BASIN
- FLOW ARROW
- MB01 — NAME; E 636.159m; N 7,497,057m; R.L.0.00m — SURFACE LEVEL; 2.5m — DEPTH; Ø150 — BORE DIAMETER — MONITORING BORE
- 28.50 — ROAD LEVEL
- 1% A.E.P.
- 20% A.E.P.
- 1EY

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AREA AT TWL (1EY)	5284m²
RL (TWL) (1EY)	23.59m AHD
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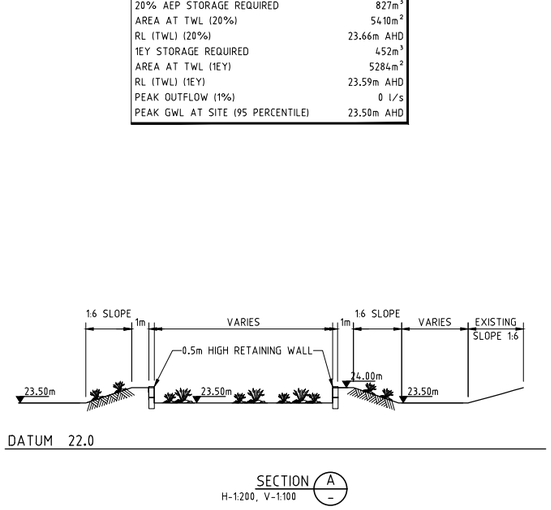
PEAK GWL AT SITE (95 PERCENTILE)	23.50m AHD



SECTION A
H-1:200, V-1:100

HORIZ.- 1:200 (A1)
VERT.- 1:100 (A1)

1:250 (A1)

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DRAWING: LOCAL WATER MANAGEMENT STRATEGY BASIN DETAILS

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DATE	DESIGNED	APPROVED	
22/12/21	JEG	SRA	

PROJECT NUMBER: PRO1022
DRAWING NUMBER: L05

PCSump Version 6.1

Environmental and Water Resource Software

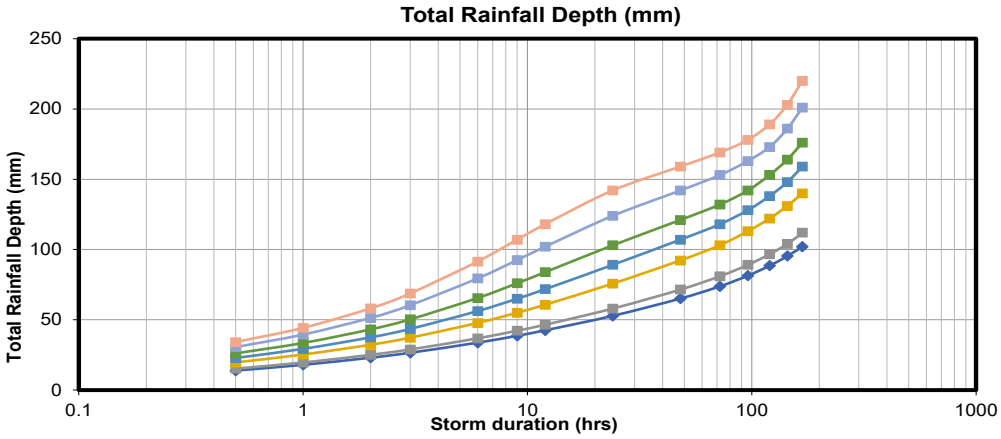
Project Number/Name:	Lot 28 Barfiled Road, Hammond Park
Project Description:	Northern Basin in Neighbours land

Model Selection:	Shallow Water Table Model
Design AEP(EY)/ARI	1% AEP (100 year ARI)
Design Rainfall Region:	Perth Metro
Design Rainfall Location:	Bibra Lake
Latitude:	-32.099216
Longitude:	115.817393
Temporal Pattern:	West Flatlands
Climate Change Selection (Y/N)	N
Effective Service Life	
Consequence of Failure	
Adjustment Applied	

Swale Selection (Y/N)	N

Total Rainfall Depth (mm)

Duration	EY	Annual Exceedance Probability (AEP)					
	1 EY	50%	20%	10%	5%	2%	1%
30 min	13.8	15.2	19.6	22.8	26.1	30.5	34.1
1 hour	17.9	19.6	25.2	29.3	33.5	39.4	44.2
2 hour	23	25.1	32.2	37.5	43.2	51.3	58.1
3 hour	26.5	28.9	37.2	43.5	50.3	60.3	68.7
6 hour	33.7	36.8	47.7	56.2	65.5	79.4	91.4
9 hour	38.6	42.3	55	65	76	92.5	107
12 hour	42.5	46.5	60.7	71.8	83.9	102	118
24 hour	52.8	58	75.7	89.1	103	124	142
48 hour	65.1	71.5	92.2	107	121	142	159
72 hour	73.8	81	103	118	132	153	169
96 hour	81.4	89.1	113	128	142	163	178
120 hour	88.5	96.7	122	138	153	173	189
144 hour	95.4	104	131	148	164	186	203
168 hour	102	112	140	159	176	201	220



Basin:

Type	Area (ha)	IL (mm)	CL (mm/hr)	PL(%)
Roads	1.56			28.0%
Resi Lots	3.7438	9.79	9.09	

Basin	0.5159			0.0%
POS	4.355			100.0%

Basin Parameters:

Soil Characteristics:	
Saturated Hydraulic Cond. (m/day)	5
Clogged Layer Permeability (m/day)	
Clogged Layer Thickness (mm)	
Soil Suction (cm)	
Porosity	
Aquifer Storage Coefficient	0.2
Base of Aquifer (mAHD)	-17
Design Groundwater Level (mAHD)	23.2
Initial Conditions:	
Water Depth in Basin (m)	0
Wetting Front Depth (m)	0
Initial Degree of Soil Saturation (%)	0%
Basin Geometry:	
Stage-Area-Volume Relationship Entered (Y/N)	N
Base Length (m)	90
Base Width (m)	57
Average Slope (1 in X)	6
Basin Base Elevation (mAHD)	23.5
Maximum Allowable TWL (mAHD)	24.7

Pipe Outflow:

Entrance Type	
Pipe Diameter (mm)	
Pipe Length (m)	
Upstream Invert Level (mAHD)	
Downstream Invert Level (mAHD)	

Weir Outflow:

Weir Type:	
Weir Coefficient	
Weir Width (m)	
Weir Level (mAHD)	

PCSUMP
Environmental and Water Resource Software

Project Number / Name:

Lot 28 Barfiled Road, Hammond Park

Project Description:

Northern Basin in Neighbours land

Model Selection: **Shallow Water Table Model**

Results:

	Design Storms				Maximum (Mean of Temporal Patterns)					
Storm	Duration [hrs]	Rainfall Depth [mm]	EY/AEP [%]	Depth [m]	Level [mAHD]	Clearance to Allowable TWL [m]	Volume [m^3]	Area [m^2]	Temporal Pattern No.
1	30 min	34.1	1%	0.24	23.74	0.96	1,272	5,557	10
2	1 hour	44.2	1%	0.31	23.81	0.89	1,653	5,683	3
3	2 hour	58.1	1%	0.38	23.88	0.82	2,075	5,819	3
4	3 hour	68.7	1%	0.39	23.89	0.81	2,158	5,846	1
5	6 hour	91.4	1%	0.42	23.92	0.78	2,315	5,896	5
6	9 hour	107.0	1%	0.45	23.95	0.75	2,519	5,961	3
7	12 hour	118.0	1%	0.37	23.87	0.83	2,049	5,811	8
8	24 hour	142.0	1%	0.31	23.81	0.89	1,702	5,698	5
9	48 hour	159.0	1%	0.2	23.70	1.00	1,071	5,492	1
10	72 hour	169.0	1%	0.16	23.66	1.04	859	5,420	2
11	96 hour	178.0	1%	0.13	23.63	1.07	675	5,359	2
12	120 hour	189.0	1%	0.12	23.62	1.08	644	5,348	1
13	144 hour	203.0	1%	0.14	23.64	1.06	741	5,381	6
14	168 hour	220.0	1%	0.1	23.60	1.10	505	5,302	7
Critical	***6***	***9 hour***	***107.0***	***1%***	***0.45***	***23.95***	***0.75***	***2,519***	***5,961***	***3***

Notes:

Temporal pattern matching closest to mean water level

If Water Level is coloured Red, Maximum Capacity of the Basin has been Exceeded

PCSUMP
Environmental and Water Resource Software

Project Number / Name:

Lot 28 Barfield Road, Hammond Park

Project Description:

Northern Basin in Neighbours land

Model Selection: **Shallow Water Table Model**

Results:

	Design Storms				Maximum (Mean of Temporal Patterns)					
	Storm	Duration [hrs]	Rainfall Depth [mm]	EY/AEP [%]	Depth [m]	Level [mAHD]	Clearance to Allowable TWL [m]	Volume [m^3]	Area [m^2]	Temporal Pattern No.
	1	30 min	19.6	20%	0.11	23.61	1.09	547	5,316	4
	2	1 hour	25.2	20%	0.13	23.63	1.07	703	5,368	2
	3	2 hour	32.2	20%	0.16	23.66	1.04	827	5,410	6
	4	3 hour	37.2	20%	0.15	23.65	1.05	797	5,400	9
	5	6 hour	47.7	20%	0.14	23.64	1.06	753	5,385	9
	6	9 hour	55.0	20%	0.13	23.63	1.07	664	5,355	7
	7	12 hour	60.7	20%	0.11	23.61	1.09	583	5,328	4
	8	24 hour	75.7	20%	0.09	23.59	1.11	454	5,284	6
	9	48 hour	92.2	20%	0.05	23.55	1.15	280	5,226	7
	10	72 hour	103.0	20%	0.04	23.54	1.16	181	5,192	9
	11	96 hour	113.0	20%	0.02	23.52	1.18	103	5,165	10
	12	120 hour	122.0	20%	0.03	23.53	1.17	151	5,182	5
	13	144 hour	131.0	20%	0.02	23.52	1.18	112	5,168	7
	14	168 hour	140.0	20%	0.02	23.52	1.18	111	5,168	2
Critical	***3***	***2 hour***	***32.2***	***20%***	***0.16***	***23.66***	***1.04***	***827***	***5,410***	***6***

Notes:

Temporal pattern matching closest to mean water level

If Water Level is coloured Red, Maximum Capacity of the Basin has been Exceeded

PCSUMP
Environmental and Water Resource Software

Project Number / Name:

Lot 28 Barfield Road, Hammond Park

Project Description:

Northern Basin in Neighbours land

Model Selection: **Shallow Water Table Model**

Results:

	Design Storms				Maximum (Mean of Temporal Patterns)					
	Storm	Duration [hrs]	Rainfall Depth [mm]	EY/AEP [%]	Depth [m]	Level [mAHD]	Clearance to Allowable TWL [m]	Volume [m^3]	Area [m^2]	Temporal Pattern No.
	1	30 min	13.8	1 EY	0.05	23.55	1.15	269	5,222	9
	2	1 hour	17.9	1 EY	0.07	23.57	1.13	377	5,258	2
	3	2 hour	23.0	1 EY	0.09	23.59	1.11	452	5,284	5
	4	3 hour	26.5	1 EY	0.08	23.58	1.12	395	5,264	1
	5	6 hour	33.7	1 EY	0.07	23.57	1.13	365	5,255	3
	6	9 hour	38.6	1 EY	0.05	23.55	1.15	279	5,225	6
	7	12 hour	42.5	1 EY	0.04	23.54	1.16	226	5,207	2
	8	24 hour	52.8	1 EY	0.03	23.53	1.17	133	5,176	5
	9	48 hour	65.1	1 EY	0	23.50	1.20	12	5,134	4
	10	72 hour	73.8	1 EY	0.01	23.51	1.19	24	5,138	4
	11	96 hour	81.4	1 EY	0.01	23.51	1.19	34	5,142	2
	12	120 hour	88.5	1 EY	0.01	23.51	1.19	29	5,140	2
	13	144 hour	95.4	1 EY	0	23.50	1.20	15	5,135	10
	14	168 hour	102.0	1 EY	0.01	23.51	1.19	34	5,142	10
Critical	***3***	***2 hour***	***23.0***	***1 EY***	***0.09***	***23.59***	***1.11***	***452***	***5,284***	***5***

Notes:

Temporal pattern matching closest to mean water level

If Water Level is coloured Red, Maximum Capacity of the Basin has been Exceeded

Development Engineering Consultants - Drainage Basin Spreadsheet

Project: Lot 28 Barfield Road, Hammond Park

Client: Condor Nominees Pty Ltd

Location: At-lot detention calculations to establish runoff coefficient

Designer: SRA

Location:	**Lot 28 Barfield Road, Hammond Park**			
Nearest grid cell:	**Latitude**	**32.1875(S)**	**Longitude**	**115.8375(E)**

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Data to be input

Rainfall AEP (percentage)	1	ARI	v Descriptor v
1EY impervious catchment (Ha)	0.025	100	Infrequent
Required storage (1EY - 1hr) (m^3)	3.881		

Catchment details	Paved area	Unpaved area	Total
Lot area (m^2)			**400.00**
Proportion paved	**70%**	**30%**	**100%**
Area paved (Ha)	**0.028**	**0.012**	**0.040**
Runoff coefficient (C_{10})	0.90	0.00	
ARI multiplier	1.00	1.20	
Runoff coefficient (C_y)	0.90	0.00	
Impervious area (Ha)	**0.025**	**0.000**	**0.025**

Effective C

0.63

AEP	ARI	Effective C	Multiplier
63.2	1	0	-
50	1.44	0	-
20	4.48	0	-
10	9.49	0.01	1.00
5	20	0.09	9.00
2	50	0.17	17.00
1	100	0.21	21.00

Volume and dimensions of available storage

Area above ground inundated to 0.03m deep (backyard and front yard) (m^2)	40.00	0.03	1.20
Storage provided manholes/pipe (m^3)	-		
Number of soakwells	2.00		
Diameter of soakwells (m)	1.20		
Depth of each soakwell (m)	1.20		
Storage required soakwells (m^3)	**2.71**		
Strorage provided (m^3)	3.91		
Effective Initial Loss (mm)	**9.79**		
Soakage rate (L/s/m^2)	0.020	*1.70 m/day*	

NOTE: All water is retained in soakwells up to and including 5% AEP (1 in 20yr ARI) without surcharge. For greater AEP storms water will surcharge soakwells and soak over an area of 40m^2 to a maximum depth of 30mm within the lot, and then enter the road drainage system.

Development Engineering Consultants - Drainage Basin Spreadsheet

Client: **Condor Nominees Pty Ltd**

Location: **At-lot detention calculations to establish runoff coefficient**

ENGINEERING CONSULTANTS

Volume of storage required is 1m^3 per	**92.84 m^2**	**of paved lot area**
Volume of storage required is 1m^3 per	**102.19 m^2**	**of total lot area**

T_C (min)	T_C (hr)	I (mm/hr)	Q_{IN} (L/s)	Total V_{IN} (m^3)	Q_{OUT} (soakage) (L/s)	Effective Continuing Loss (mm/hr)	V_{OUT} (soakage) (m^3)	Net storage (after soakage) (m^3)	V_{OUT} required (m^3)	Q_{OUT} (L/s)
10	0.17	131.00	9.2	5.50	1.01	**9.09**	0.61	4.90	0.98	1.64
15	0.25	105.00	7.4	6.62	1.01	**9.09**	0.91	5.71	1.79	1.99
20	0.33	88.60	6.2	7.44	1.01	**9.09**	1.21	6.23	2.32	1.93
30	0.50	69.00	4.8	8.69	1.01	**9.09**	1.82	6.88	2.96	1.65
45	0.75	53.40	3.7	10.09	1.01	**9.09**	2.73	7.37	3.45	1.28
60	1.00	44.50	3.1	11.21	1.01	**9.09**	3.63	7.58	3.67	1.02
90	1.50	34.60	2.4	13.08	1.01	**9.09**	5.45	7.63	3.71	0.69
120	2.00	29.10	2.0	14.67	1.01	**9.09**	7.27	7.40	3.48	0.48
150	2.50	25.50	1.8	16.07	1.01	**9.09**	9.09	6.98	3.06	0.34
180	3.00	22.90	1.6	17.31	1.01	**9.09**	10.90	6.41	2.49	0.23
240	4.00	19.30	1.4	19.45	1.01	**9.09**	14.54	4.92	1.00	0.07
300	5.00	16.90	1.2	21.29	1.01	**9.09**	18.17	3.12	0.00	0.00
360	6.00	15.20	1.1	22.98	1.01	**9.09**	21.81	1.18	0.00	0.00
480	8.00	12.70	0.9	25.60	1.01	**9.09**	29.08	-3.47	0.00	0.00
720	12.00	9.81	0.7	29.67	1.01	**9.09**	43.61	-13.95	0.00	0.00
960	16.00	8.51	0.6	34.33	1.01	**9.09**	58.15	-23.83	0.00	0.00
1440	24.00	5.92	0.4	35.80	1.01	**9.09**	87.23	-51.42	0.00	0.00
2880	48.00	3.32	0.2	40.16	1.01	**9.09**	174.45	-134.29	0.00	0.00
4320	72.00	2.34	0.2	42.46	1.01	**9.09**	261.68	-219.22	0.00	0.00

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APPENDIX D – APPLICATION FOR GROUNDWATER LICENCE

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Condor Nominees Pty Ltd		
Description of Water Resource	Jandakot Perth - Superficial Swan	**Annual Water Entitlement**	15,000kL
Location of Water Source	LOT 28 ON PLAN 69857 - Volume/Folio 1754/135 - Lot 28 BARFIELD RD HAMMOND PARK		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Irrigation of up to 2 ha of public open space	LOT 28 ON PLAN 69857 - Volume/Folio 1754/135 - Lot 28 BARFIELD RD HAMMOND PARK
Duration of Licence	From 28 January 2022 to 28 January 2032	

This Licence is subject to the following terms, conditions and restrictions:

1. The annual water year for water taken under this licence is defined as 1 June to 31 May.

2. The licensee shall not use water for sprinkler irrigation between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.

3. Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

End of terms, conditions and restrictions

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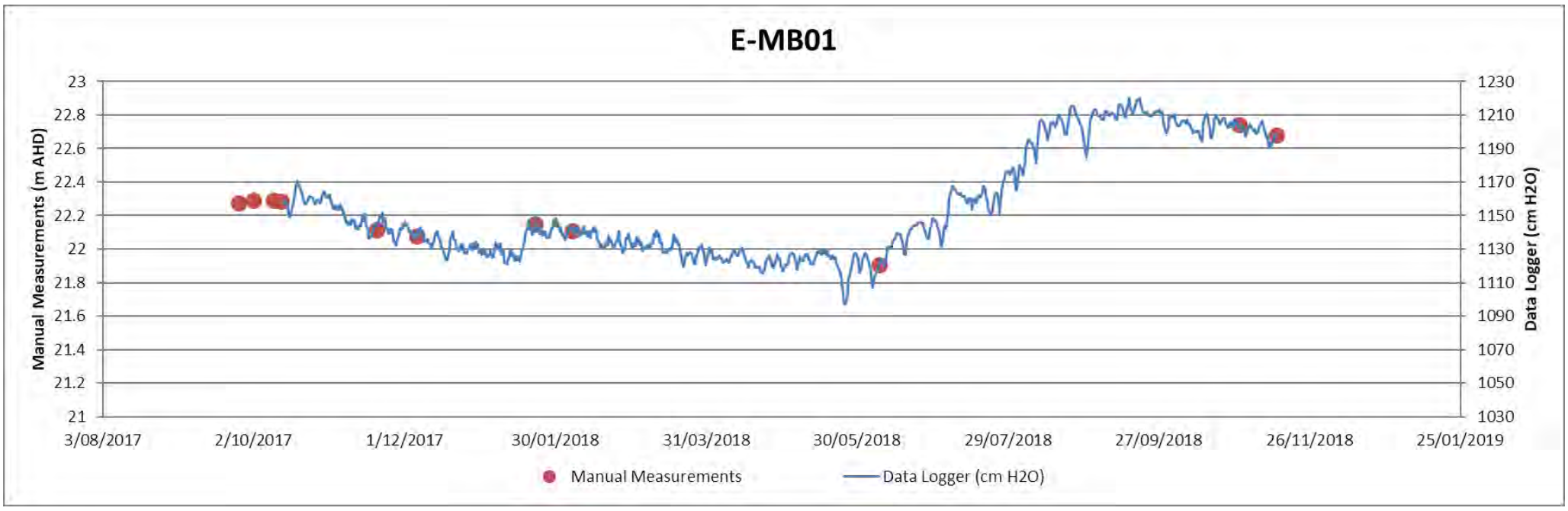
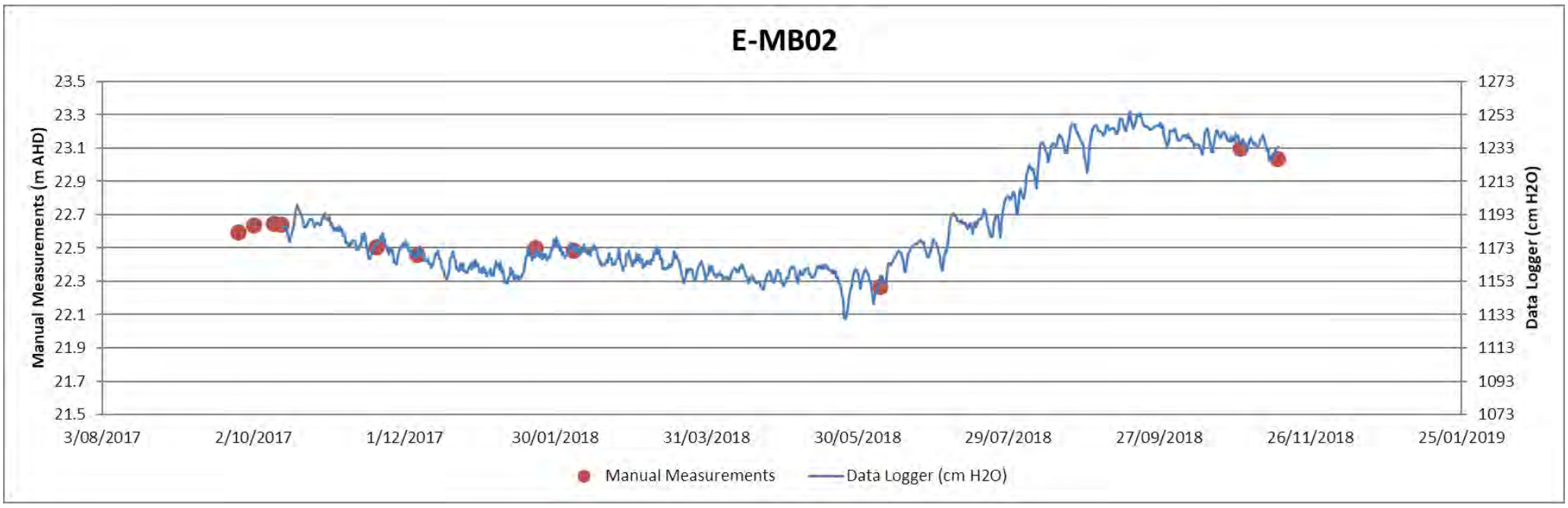
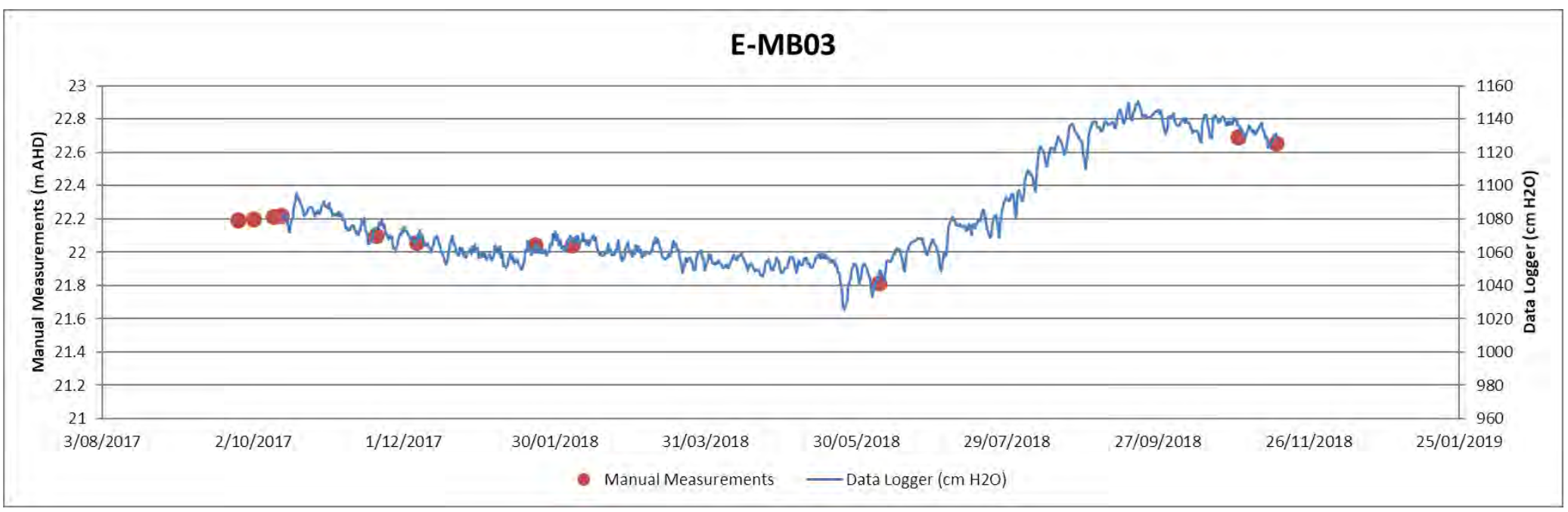
APPENDIX E –

- **RECORDED GROUNDWATER MONITORING DATA AND BORE RECORDS**
- **DWER BORE RECORDS AND RECONCILIATION**

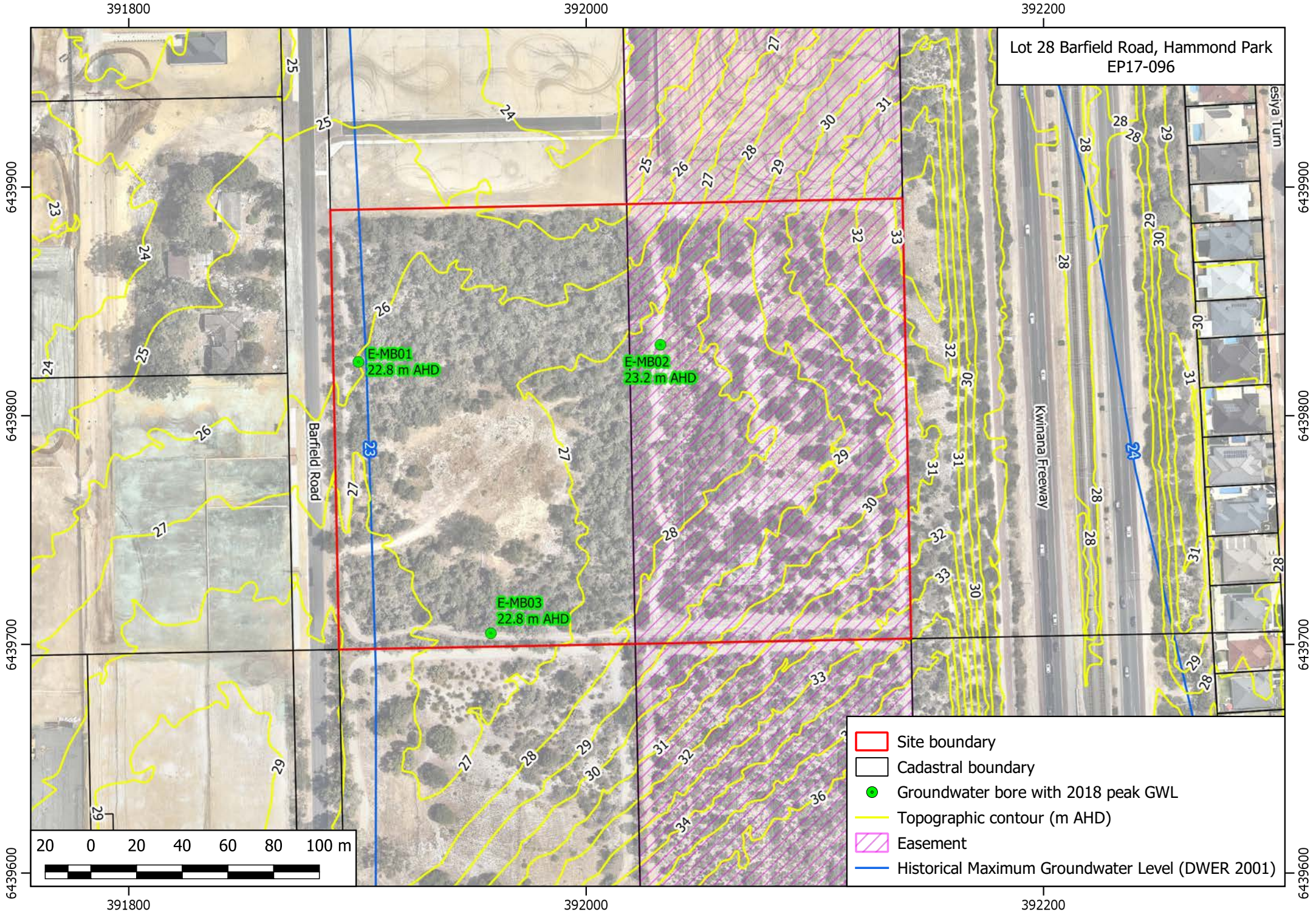






Summary of manual groundwater level measurements:

Date	E-MB01		E-MB02		E-MB03	
	m AHD	m BGL	m AHD	m BGL	m AHD	m BGL
26/09/2017	22.273	3.517	22.596	4.504	22.195	4.275
2/10/2017	22.290	3.500	22.639	4.461	22.198	4.272
10/10/2017	22.291	3.499	22.650	4.450	22.213	4.257
13/10/2017	22.284	3.506	22.643	4.457	22.219	4.251
20/11/2017	22.116	3.674	22.507	4.593	22.098	4.372
6/12/2017	22.077	3.713	22.462	4.638	22.059	4.411
22/01/2018	22.151	3.639	22.500	4.600	22.044	4.426
6/02/2018	22.110	3.680	22.488	4.612	22.045	4.425
8/06/2018	21.906	3.884	22.271	4.829	21.813	4.657
29/10/2018	22.740	3.050	23.099	4.001	22.694	3.776
13/11/2018	22.679	3.111	23.036	4.064	22.655	3.815


Lot 28 Barfield Road, Hammond Park
EP17-096
391800
392000
392200
6439900
6439800
6439700
6439600
E-MB01
22.8 m AHD
E-MB02
23.2 m AHD
E-MB03
22.8 m AHD
Barfield Road
Kwinana Freeway
esiya Turn
20 0 20 40 60 80 100 m
Site boundary
Cadastral boundary
Groundwater bore with 2018 peak GWL
Topographic contour (m AHD)
Easement
Historical Maximum Groundwater Level (DWER 2001)

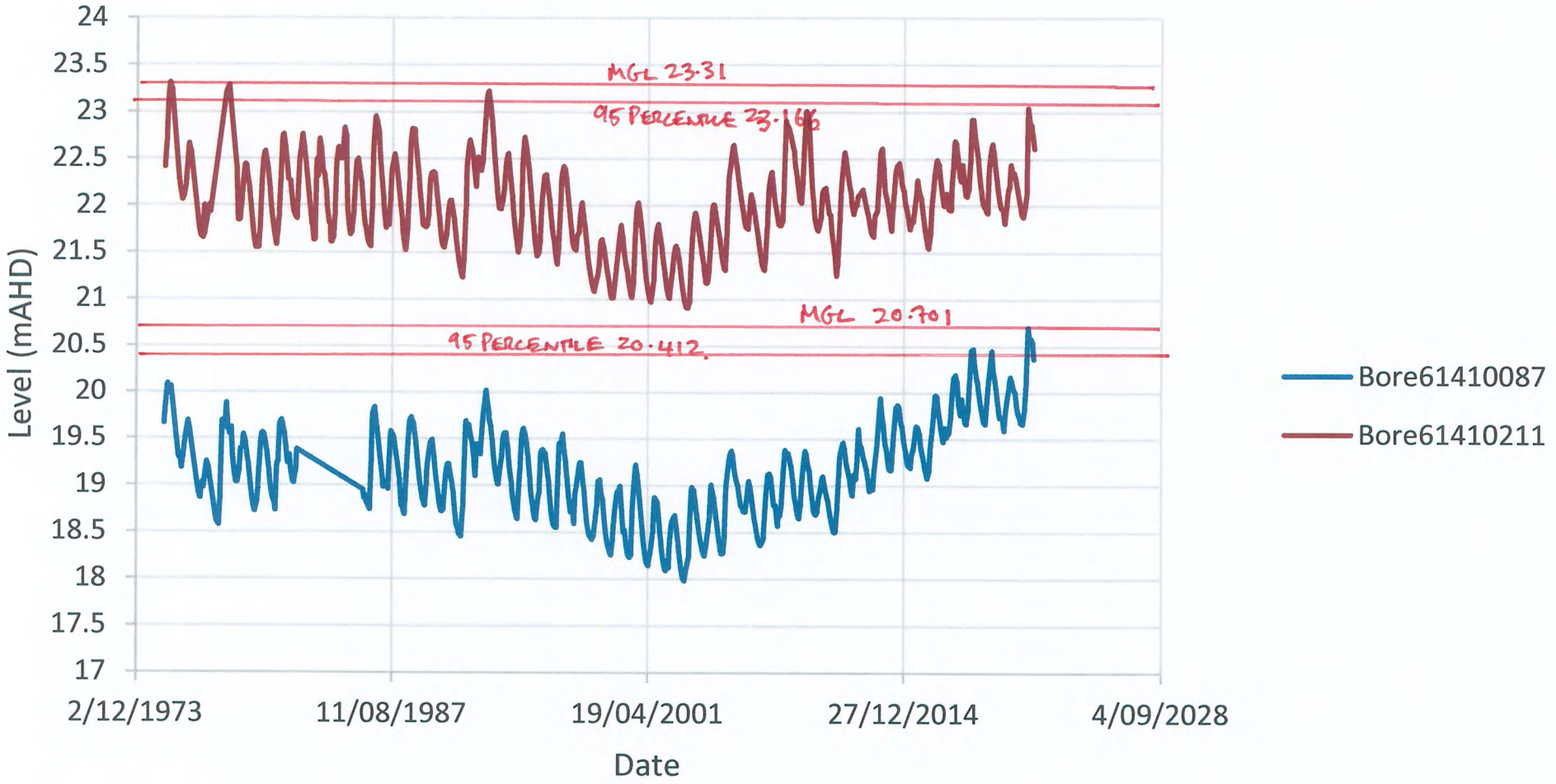
Groundwater Quality -2017/2018

		Field Chemistry						*Nutrients and Nutrient Species*					
		Temperature	Electrical Conductivity	Dissolved Oxygen	Dissolved Oxygen	pH	Oxidation-Reduction potential	Ammonia (NH_3) as N	Oxides of Nitrogen (NO_X) as N	Total Kjeldahl Nitrogen (TKN) as N	Total Nitrogen (TN) as N	Total Phosphorous (TP) as P	Reactive Phosphorous (ORP) as P
Site Name	**Date of Sampling**	°C	mS/cm	mg/L	% sat	pH units	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
E-MB01	10/10/2017	20.5	0.488	1.90	21.1	4.45	-60.3	0.10	<0.01	1.4	1.4	0.04	<0.01
E-MB01	22/01/2018	20.0	0.644	0.34	3.9	4.42	63.1	0.14	<0.01	1	1.0	0.02	<0.01
E-MB01	29/10/2018	18.2	0.965	0.42	4.5	5.13	-214.0	0.05	<0.01	1.2	1.2	0.01	<0.01
E-MB02	10/10/2017	19.2	0.246	1.76	18.9	5.15	-51.2	0.02	1.81	0.40	2.2	0.03	<0.01
E-MB02	22/01/2018	21.7	0.223	0.48	5.5	5.32	54.1	<0.01	0.58	0.30	0.9	0.01	<0.01
E-MB02	29/10/2018	20.5	0.444	0.79	8.7	5.69	-263.0	0.03	5.13	1.00	6.1	0.03	<0.01
E-MB03	10/10/2017	18.2	0.601	1.31	13.8	5.67	-106.4	0.15	<0.01	0.6	0.6	0.03	<0.01
E-MB03	22/01/2018	20.4	0.493	0.28	3.1	5.88	-80.9	0.01	0.35	0.3	0.6	0.01	<0.01
E-MB03	29/10/2018	18.5	0.810	0.36	3.9	5.87	-286.0	0.10	<0.01	0.4	0.4	0.01	<0.01

Minimum		18.2	0.223	0.28	3.10	4.42	-263.0	0.01	0.35	0.30	0.6	0.01	0.00
10th Percentile		18.2	0.239	0.32	3.66	4.44	-228.7	0.02	0.42	0.30	0.6	0.01	0.00
Median		20.2	0.491	0.64	7.10	5.24	-70.6	0.05	1.20	0.80	1.1	0.03	0.00
90th Percentile		20.9	0.740	1.80	19.56	5.75	56.8	0.14	4.13	1.26	3.4	0.03	0.00
Maximum		21.7	0.965	1.90	21.10	5.88	63.1	0.15	5.13	1.40	6.1	0.04	0.00
Average		19.84	0.513	0.91	9.94	5.21	-82.3	0.07	1.97	0.78	1.8	0.02	0.00
Standard Deviation		1.22	0.236	0.66	7.11	0.55	114.5	0.06	2.20	0.43	1.8	0.01	0.00


Site Location
Hammond
Gaebler Rd
Willis Tce
Neilson St
Weetman Rd
Bellingham Rd
Frankland Ave
Plumwood Ave
Ironbark Tce
Lindley Ln
Botany Pde
Macquarie Bvd
Burdekin Vsta
Murrumbidgee Dr
Hammond Rd
Atkins Pde
Alberod St
Irvine Pde
Barfield Rd
Pinelle Pwy
Birch Rd
Spruce Tce
Frankland Park
61419610
61419609
61419608
61403902
61410211
61403164
61403082
61470913
61406521
61410087
61403659
61470911
61403703
61404004
61403866
61470912
61403113
61403605
61470764
61410102
61410101
61415024
61403670
61470686
61470900
61410104
61410099

DWER BORE RECORDS SURROUNDING SUBJECT SITE



Appendix 3: Bushfire Management Plan

Smith Bushfire Consultants

BUSHFIRE MANAGEMENT PLAN

Lot 28 (No 157) Barfield Road, Hammond Park

City of Cockburn

BPAD Bushfire Planning & Design Accredited Practitioner Level 2

Prepared by Ralph Smith
SMITH BUSHFIRE CONSULTANTS Pty Ltd
BPAD 27541
smith.consulting@bigpond.com
0458 292 280

Site visited 2 December 2021; Report completed 13 December 2023

Bushfire management plan/Statement addressing the Bushfire Protection Criteria coversheet

Site address: Lot 28 Barfield Road, Hammond Park

Site visit: Yes ☑ No ☐

Date of site visit (if applicable): Day 2 Month December Year 2021

Report author: Ralph Smith

WA BPAD accreditation level (please circle):

Not accredited ☐ Level 1 BAL assessor ☐ Level 2 practitioner ☑ Level 3 practitioner ☐

If accredited please provide the following.

BPAD accreditation number: 27541 Accreditation expiry: Month August Year 2024

Bushfire management plan version number: 1.7

Bushfire management plan date: Day 30 Month November Year 2023

Client/business name: Michael Glendinning Property Pty Ltd

	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?		✓
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the bushfire protection criteria elements)?		✓

Is the proposal any of the following (see SPP 3.7 for definitions)?	Yes	No
Unavoidable development (in BAL-40 or BAL-FZ)		✓
Strategic planning proposal (including rezoning applications)	✓	
Minor development (in BAL-40 or BAL-FZ)		✓
High risk land-use		✓
Vulnerable land-use		✓

None of the above ☐

Note: Only if one (or more) of the above answers in the tables is yes should the decision maker (e.g. local government or the WAPC) refer the proposal to DFES for comment.

Why has it been given one of the above listed classifications (E.g. Considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

The information provided within this bushfire management plan to the best of my knowledge is true and correct:

Signature of report author  Date 13 December 2023

Table of Contents

List of Figures

List of Appendices

Full Content Detail

Document control

Report Version	Purpose	Author/reviewer and accreditation details	Date Submitted
1	Support the Structure Plan application	Ralph Smith	14 December 2021
1.1	Text and plan modifications	Ralph Smith	19 December 2021
1.2	Text modifications following City of Cockburn comments	Ralph Smith	21 March 2022
1.3	Text and map revision	Ralph Smith	29 November 2022
1.4	Map revision	Ralph Smith	30 November 2022
1.5	Text and map revisions	Ralph Smith	20 March 2023
1.6	Revisions pursuant to WAPC Schedule of Modifications	Ralph Smith	16 October 2023
1.7	Revisions following City of Cockburn meeting	Ralph Smith	10 December 2023
1.7b	Minor text changes	Ralph Smith	10 December 2023
1.7c	Minor text changes	Ralph Smith	13 December 2023

Section 1: Proposal Details

Under the City of Cockburn's Town Planning Scheme No. 3 (TPS No.3) Lot 28 Barfield Road is partly zoned Development and partly Special Use due to the existence of a Western Power easement which accomodates high voltage electrical supply infrastructure above the eastern part of the propoerty adjacent the Kwinana Freeway. The project is at the Structure Plan stage. The site is referenced as Structure Plan for Lot 28 Barfield Road, Hammond Park. The site is also subject to the requirements of the City's "Southern Suburbs District Structure Plan – Stage 3 (SSDSP3)" which shows the broad allocation and location of land use activities and will form the basis of assessing detailed proposals for individual properties. The District Structure Plan is a "guiding document" adopted by the Council, and is not a structure plan adopted pursuant to section 6.2.9, of the City's TPS No. 3. Therefore land uses and zones are not given the full effect as though they are part TPS No.3.

To progress the subdivision and development of a land holding it is necessary for landowners or groups of small landowners to prepare and submit a detailed Structure Plan (previous nomenclature being Local Structure Plan or LSP), and supporting reports for their proposal. Each Structure Plan should be generally in accordance with the SSDSP3, and should show detail including the proposed road and lot layout, detail areas of POS, R-Codes and other information set in the Development Area provisions of TPS No. 3.

Any significant departures from the SSDSP3 would need to be identified and justified. While the SSDSP3 indicates an area of POS within the portion of Lot 28 zoned Development, the location and indicative size of an area of POS within the DSP, other developers within the DSP have negotiated with the City and WAPC alternative locations and sizes to consolidate their POS through the Structure Plan process. The possible location of the POS within the Western Power easement has been the subject of preliminary discussions with Western Power, City of Cockburn and the Department of Planning, Lands and Heritage (DPLH) and is resolved. The POS will be within the development and not in the Western Power easement and will comply with AS 3959: 2018 section 2.2.3.2 (e) Exclusion–Low threat vegetation and non-vegetated areas.

All Structure Plans are to be adopted by Council and endorsed by the WAPC in accordance with the Development Area provisions of the Scheme.

The entire site is declared as bushfire prone and therefore AS 3959 construction standards for the future dwellings do apply for all dwellings.

The Environmental Assessment Report (EAR) and revegetation plan developed by Coterra Environment are referenced in this Bushfire Management Plan (Plan) and a number of items, such as the revegetation area map have been copied into the Plan, but the EAR should be considered when considering environmental issues, including the revegetation to shrubland.

The City of Cockburn submitted to the WAPC that the revegetation should be classified as scrub with the Western Power easement. Western Power require the height of the revegetation within the easement to not excede three metres. AS 3959 prescribes scrub to have a height of between, 2 metres and 6 metres. The City of Cockburn have acknowledged that it is difficult to have scrub vegetation stop at a three metre height and have agreed that they will be responsible for the future management of the scrub vegetation and its height maintenance. The areas to be revegetated will be excavated and have the soil surface height reduced by several metres. This means that vegetation that is currently level with the subdivision site will be significantly higher and uplsope of the revegetation.

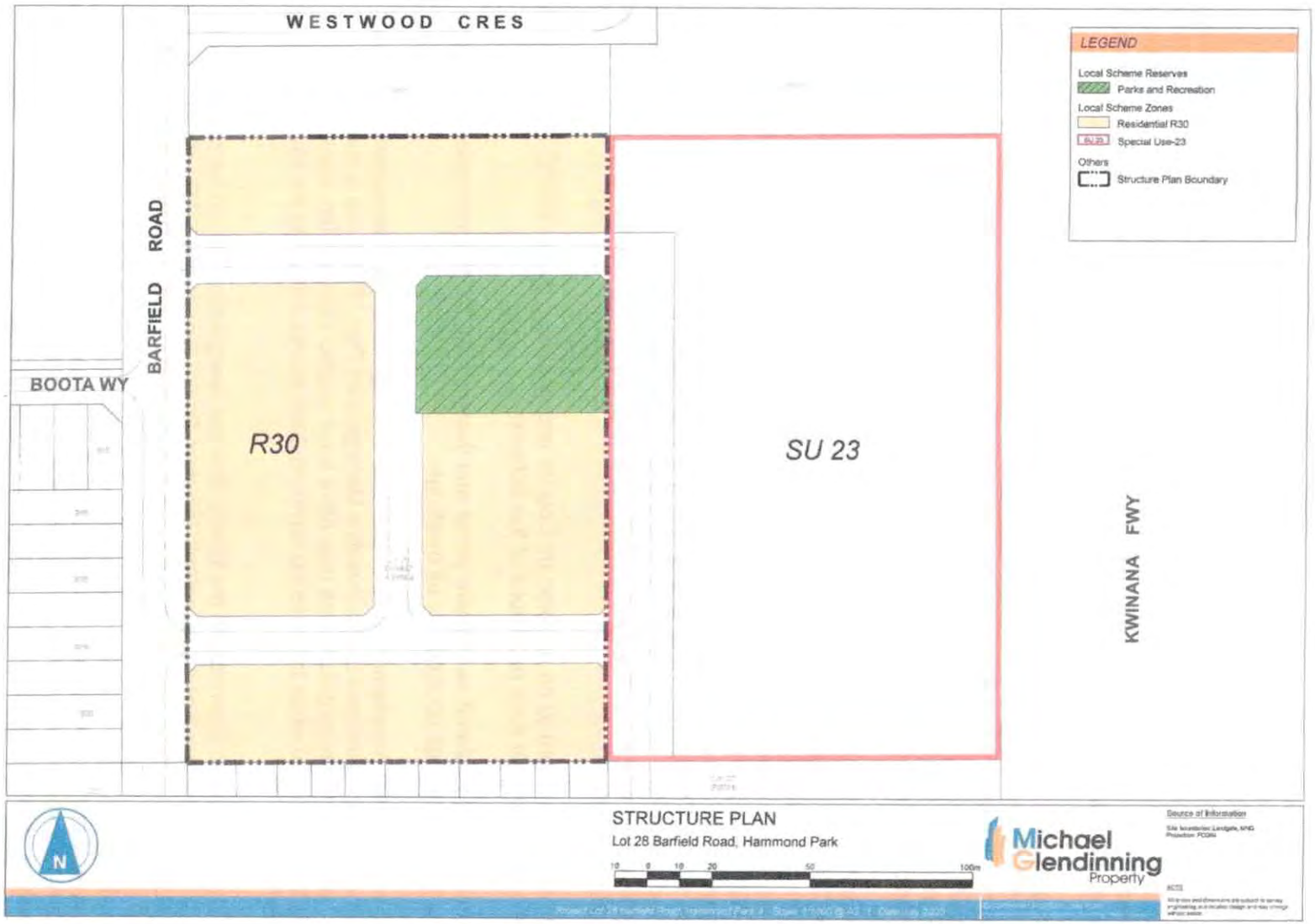


Figure 1. The copy of the structure plan showing local Scheme Zones.

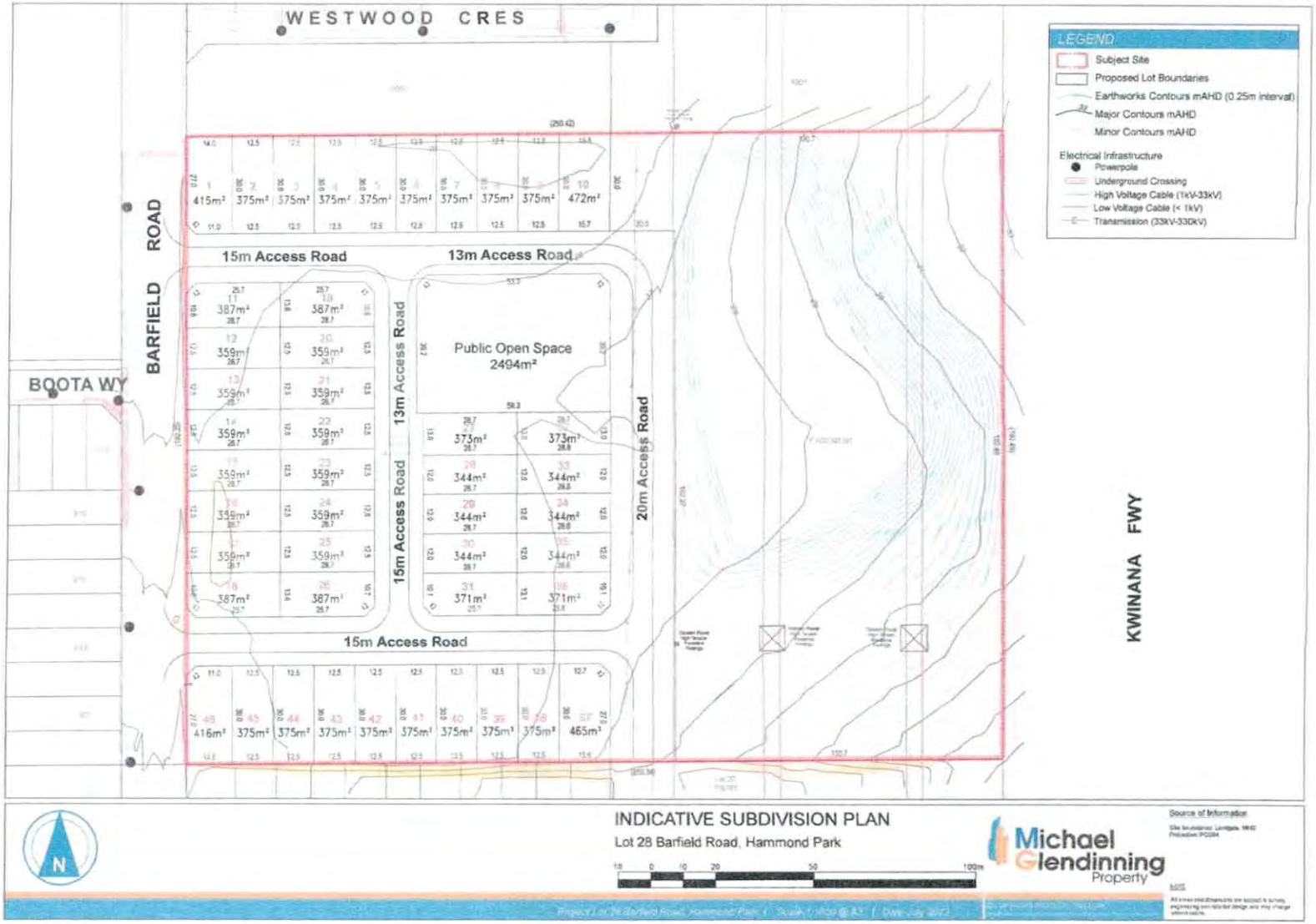


Figure 2. The copy of the subdivision plan.

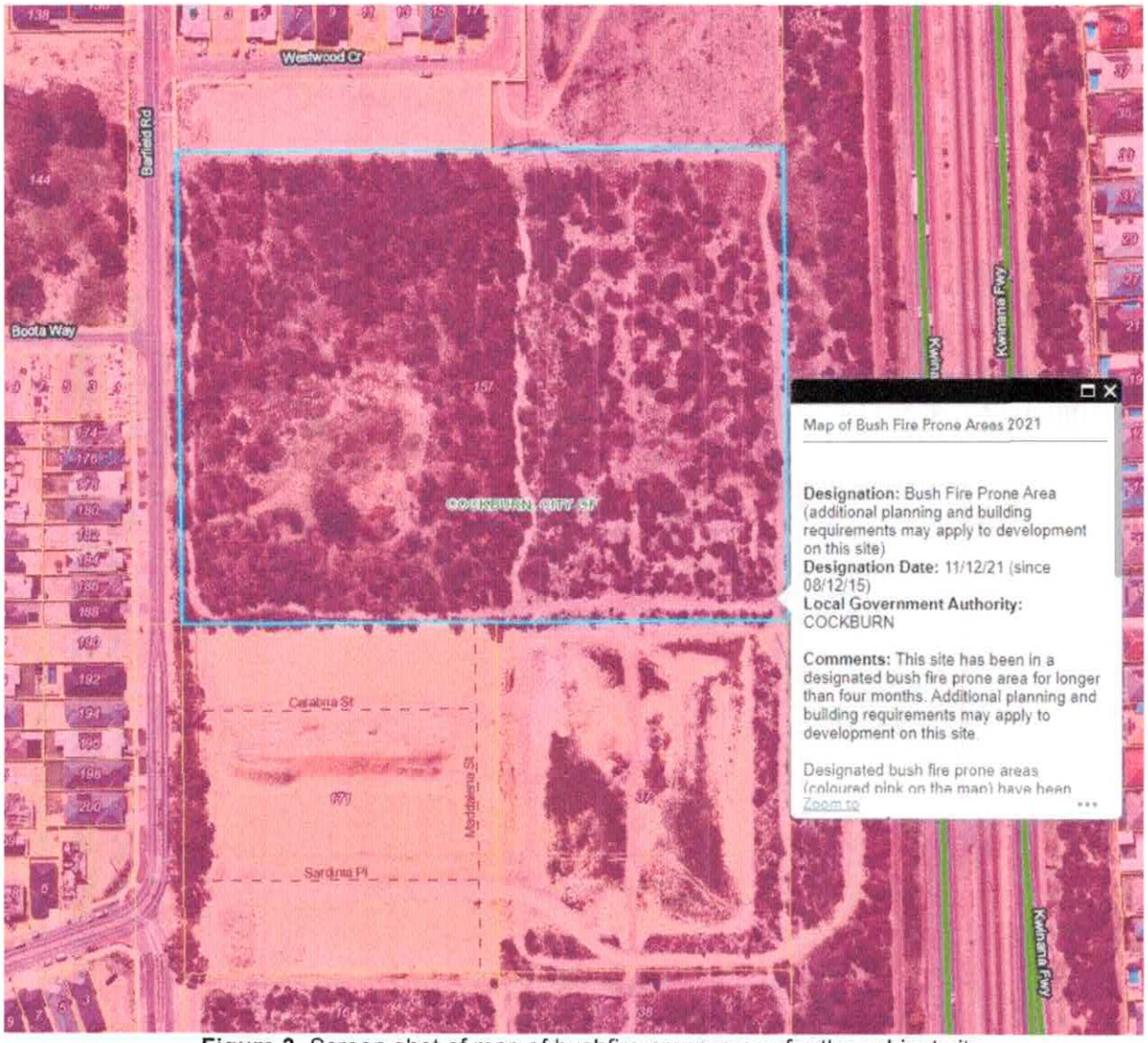


Figure 3. Screen shot of map of bushfire prone areas for the subject site.

Section 2: Environmental Considerations

The State Planning Policy 3.7 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values. A desktop search has identified that the following are not registered for the development site or immediately surrounding area:

- Threatened and priority flora;
- Threatened and priority fauna;
- Contaminated site registration;
- Clearing Regulation – Environmental Sensitive Areas;
- Black Cockatoo Breeding Sites; and
- Carnaby Cockatoo Confirmed roost sites.

The desktop search also identified that the following cultural issues are not registered for the development site or immediately surrounding area:

- Aboriginal heritage site; or
- Heritage council site.

Subsection 2.1: Native Vegetation – modification and clearing

There is a need to clear areas of native vegetation as a component of this development and comply with the protection requirements as required for the Western Power easement. The proposed clearing was referred to the Federal Government's Department of Agriculture, Water and the Environment in November 2021 and was approved as "not a controlled action" on 1 December 2021, as identified in the EAR, paving the way for the lodgement of the proposed Structure Plan.

Subsection 2.2: Re-vegetation/Landscape Plans

There is a comprehensive revegetation plan that has been developed after wide consultation with the Government instrumentalities, e.g. Western Power and the local government. This will result in retention of natural vegetation, creation of shrubland areas, and the establishment of public amenity and recreation areas. The shrubland must be revegetated to a height of less than two-metres to meet Western Power's requirements in the easement. There will be a six-metre wide strip of managed grassland between the 20 metre wide road and the revegetated shrubland. Additionally there may be cultivated gardens developed once people move into the dwellings, but this is not a component of a site revegetation plan.

Section 3: Bushfire Assessment Results

Any dwellings located on the new lots have all been assessed as being with BAL rating of BAL–29 or less (it is anticipated that most of the lots will be BAL–12.5 or BAL–LOW). These BAL ratings align with the State Government criteria of not having dwellings located in areas above BAL–29.

All new dwellings will need to be constructed to the appropriate BAL rating as shown on the BAL contour plan within the BMP.

Subsection 3.1: Assessment Inputs

The assessment inputs are shown in the forthcoming pages and are supported by a vegetation assessment, photographic evidence and text to support the vegetation assessment and a BHL assessment map.

The primary site visit was conducted on the 2 December 2021, there was also a site visit with City of Cockburn staff to consider the POS. Whilst the site visit was primarily to consider the POS vegetation the other vegetation on the development site and surrounding areas was discussed. There were also several meetings with City of Cockburn staff to discuss the BMP content and other items at the City offices.

Site Assessment

The assessment of the proposed subdivision was undertaken on 2 December 2021 for the purpose of determining the vegetation classification and the BAL Contour Map in accordance with AS 3959 (Method 1).

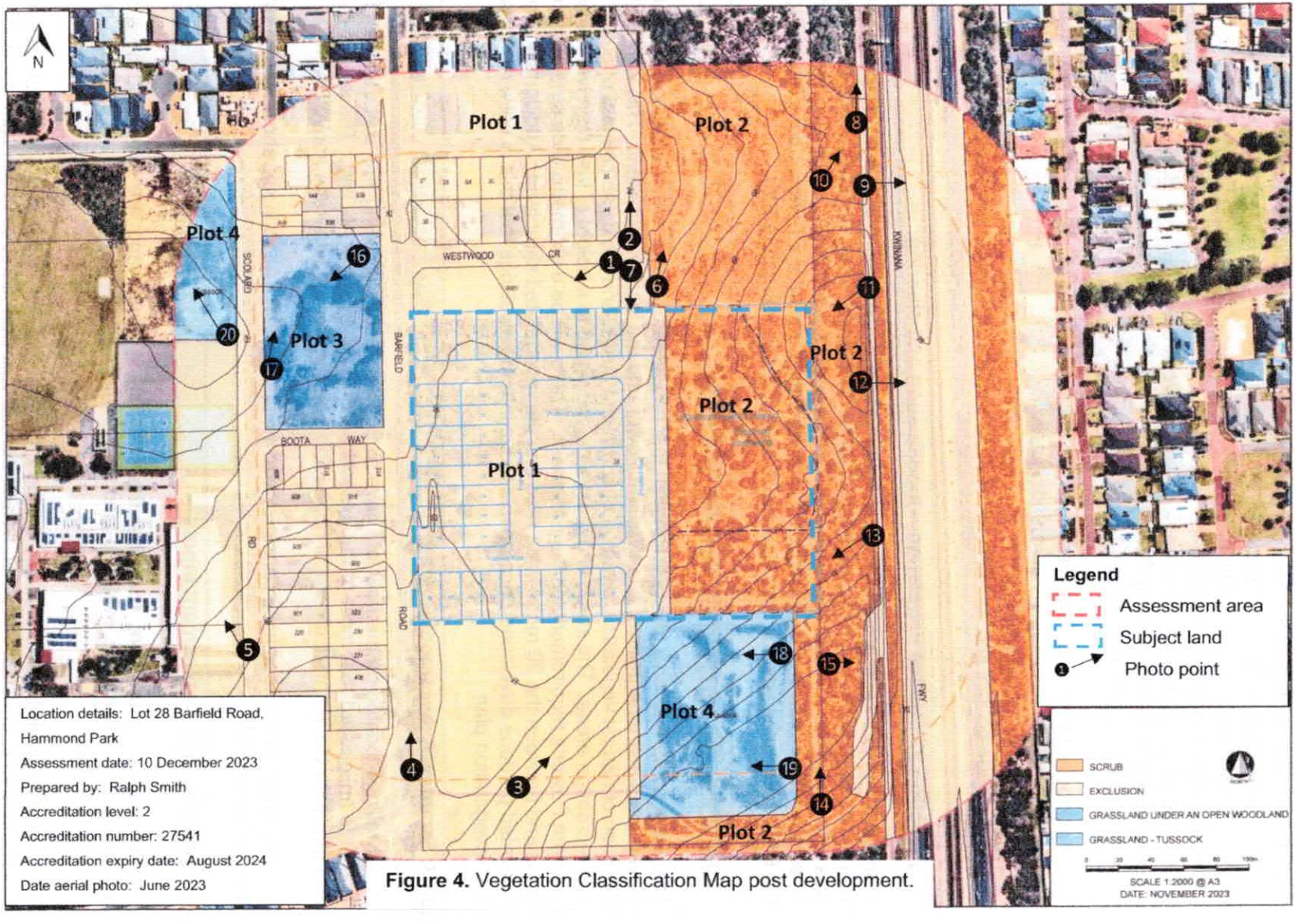


Figure 4. Vegetation Classification Map post development.

Vegetation Classification

All vegetation within 150 metres of the proposed subdivision as indicated on the site assessment plan was classified in accordance with the Western Australian Government criteria and Clause 2.2.3 of AS 3959 was applied. Each distinguishable vegetation plot with the potential to determine the Bushfire Attack Level is identified below. AS 3959 only requires consideration of 100 metres between vegetation and the building and 50 metres between vegetation and the building for grassland.

Plot 1
Exclusion – Low threat vegetation and non-vegetated areas.
Clause 2.2.3.2 (e) and (f).

Photo ID: Photo 1 Looking at the cleared neighbouring lot and the dwellings being built.

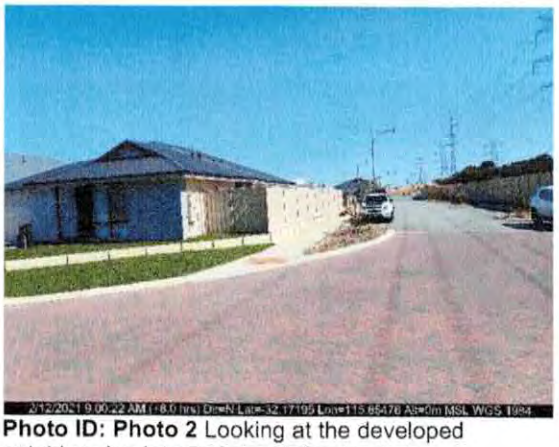


Photo ID: Photo 2 Looking at the developed neighbouring lots and road infrastructure.

Photo ID: Photo 3 Looking at the cleared land south of the development site.

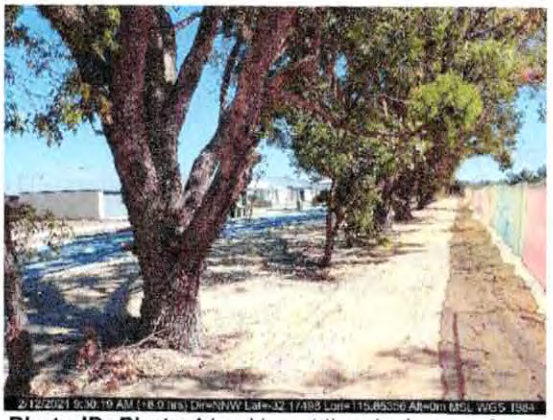


Photo ID: Photo 4 Looking at the single row of windbreak trees, road and dwellings with gardens.

Photo ID: Photo 5 Looking at the low threat vegetation and the school buildings

Photo ID: Photo 6 Looking at the low threat vegetation on the land to the north of the development site.

Photo ID: Photo 7 Looking at the low threat vegetation on the land to the north of the development site.

Plot 2
Class D – Scrub (AS 3959 classification – D – 13)

The revegetation in this section of the site will comply with Western Power requirements regarding vegetation height. Western Power requires the height of the revegetation to be less than three-metres tall. There are no photographs of the scrub in the revegetation area as this is a component of the post development revegetation. The City of Cockburn submitted to the WAPC that the revegetation should be classified as scrub with the Western Power easement.. Western Power require the height of the revegetation within the easement to not excede three metres. AS 3959 prescribes scrub to have a height of bertween 2 metres and 6 metres. The City of Cockburn have acknowledged that it is difficult to have scrub vegetation stop at a three metre height and have agreed that they will be responsible for the future management of the scrub vegetation and its height maintenance. The areas to be revegetated will be excavated and have the soil surface height reduced by several metres. This means that vegetation that is currently level with the subdivision site will be significantly higher and uplsope of the revegetation.

Established scrub is shown in the following photographs.

Plot 3

Photo ID: Photo 8 Looking at the scrub, path and freeway.

Photo ID: Photo 9 Looking at the scrub across the freeway and railway line.

Photo ID: Photo 10 Looking at the scrub vegetation.

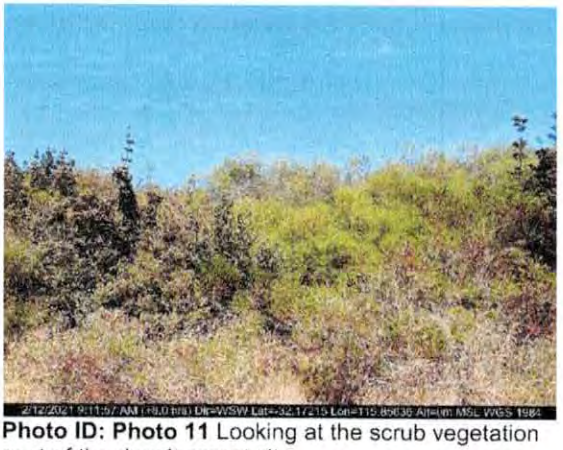


Photo ID: Photo 11 Looking at the scrub vegetation east of the development site.

Photo ID: Photo 12 Looking at the scrub east of the freeway and railway line.

Photo ID: Photo 13 Looking at the scrub south-east of the development site.

Photo ID: Photo 14 Looking at the scrub south of the development site.

Photo ID: Photo 15 Looking at the scrub vegetation.

Plot 3

Class G – Grassland under an open woodland (AS 3959 classification – G – 06).

Photo ID: Photo 16 Looking at the grassland under an open woodland west of the development site.

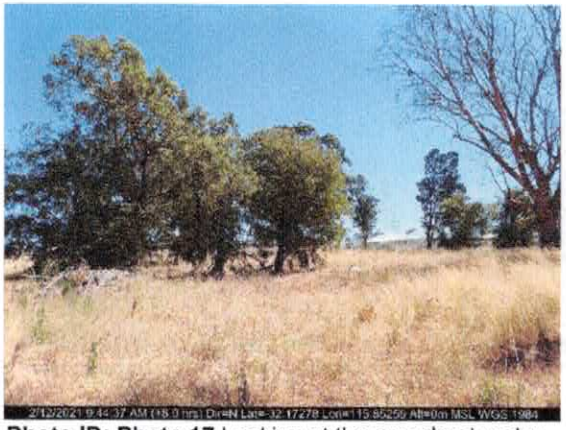


Photo ID: Photo 17 Looking at the grassland under an open woodland west of the development site.

Plot 4

Class G – Grassland (AS 3959 classification – G – 22).

Photo ID: Photo 18 Looking at the tussock grassland south of the development site.

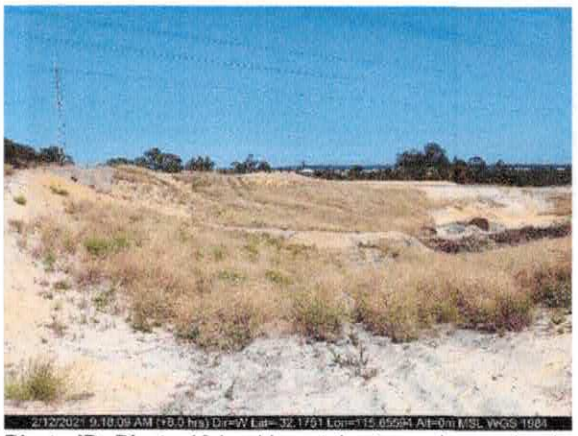


Photo ID: Photo 19 Looking at the tussock grassland south of the development site.

Photo ID: Photo 20 Looking at the tussock grassland west of the development site.

Notes to Accompany Vegetation Classification

1. Plot 1
Exclusion – Low threat vegetation and non-vegetated areas
Clause 2.2.3.2 (e) and (f)

This plot comprises the established suburban houses and gardens, vacant lots, school, roads and the housing and infrastructure component of the development site. There is a single row of trees on a neighbouring development site which appear to have been retained a windbreak.

This plot also comprises the area of limestone track and low threat vegetation on the lot to the north of the development site in the POS managed by the City of Cockburn. The six metre wide strip of grassland to the east of the 20 metre access road and between the subdivision site and the revegetated scrub area will be managed by the City of Cockburn.

2. Plot 2
Class D – Scrub (AS 3959 classification – D – 13).

The scrub revegetation will comply with Western Power requirements regarding vegetation height. Western Power requires the height of the revegetation to be less than three-metres tall. There are no photographs of the scrub in the revegetation area as this is a component of the post development revegetation. The City of Cockburn submitted to the WAPC that the revegetation should be classified as scrub with the Western Power easement.. Western Power require the height of the revegetation within the easement to not excede three metres. AS 3959 prescribes scrub to have a height of bertween two metres and six metres. The City of Cockburn have acknowledged that it is difficult to have scrub vegetation stop at a three metre height and have agreed that they will be responsible for the future management of the scrub vegetation and its height maintenance. Additionally the areas to be revegetated will be excavated and have the soil surface height reduced by several metres. This means that vegetation that is currently level with the subdivision site will be significantly higher and uplsope of the revegetation.

The scrub plot is the largest current vegetation classification by areas within the land to the west, and both north and south of the development site and includes the freeway road reserve. It has been classified as a scrub on the basis of the vegetation species, being primarily *Banksia spp.* (and less than six metres in height in average across the vegetation) and the changes associated with AS 3959:20018.

3. Plot 3
Class G – Grassland under an open woodland (AS 3959 classification – G – 06).

This plot comprises the grass under an open woodland across Barfield Road from the development site and the revegetation on the neigbouring lot to the north. The vast majority of this vegetation west of the development site is contained between dwellings to the north and south, section of the school facilities to the west and then tussock grassland.

4. Plot 4
Tussock Grassland (AS 3959 classification – G – 22)

This plot comprises the tussock grass west of the grassland under an open woodland and south of the development site. The grassland appears to have been applied as a sand stabilisation process from previous development site works on the neighbouring lands.

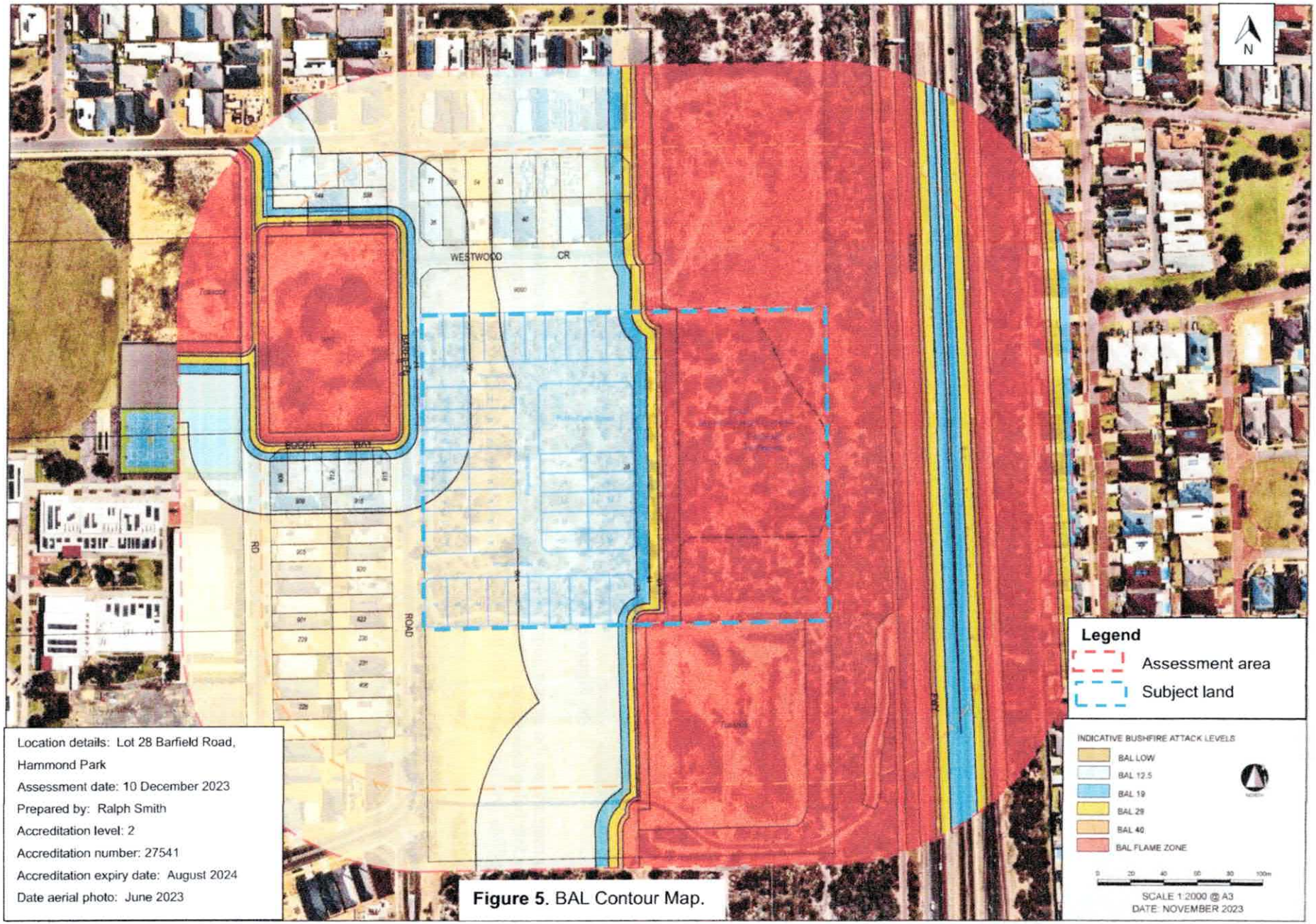


Figure 5. BAL Contour Map.

Slope

Figure 6. Two-metre contour lines (pre-development).

The contour map shows the slopes prior to the significant earth works that will be undertaken on the development lot and also the lots being developed on the neighbouring land. The vegetation that is being retained is upslope of the development lots and associated with the Western Power easement and retained native vegetation.

Figure 7. The slope over the vegetation.

Figure 7 shows the slope along Boota Way and across the entire 103.42 metres the slope is 0.6% or 0.34° which is effectively flat. This road runs parallel to Plot 5 and there is a closer distance between contour lines than the neighbouring contour lines, demonstrating worst case scenario. Plot 6 which is south of the development lot and adjacent to the vegetation that will remain post development is level or upslope of the portion of the development site that will have housing established.

Subsection 3.2: Assessment outputs

Plot	Applied Vegetation Classification	Effective Slope Under the Classified Vegetation (degrees)	Separation Distance to the Classified Vegetation (metres)	BAL Contour
1	Exclusion – Low threat vegetation and non-vegetated areas Clause 2.2.3.2 € & (f)	Not applicable	Not applicable	LOW
2	Exclusion – Low threat vegetation Clause 2.2.3.2 (f)	Not applicable	Not applicable	LOW
3	Class C – Shrubland	Upslope	34	12.5
4	Class D – Scrub	Upslope	20	12.5
5	Class G – Grassland under an open woodland	Level	22	12.5
6	Tussock Grassland	Level	23	12.5

Note: Plot 2 and Plot 4 will only be in place after the development and the revegetation has occurred on the development site.

Section 4: Identification of bushfire hazard issues

The most significant bushfire hazard is the extensive native vegetation associated with the Banksia scrub on the development lot and the land neighbouring the development site, including the vegetation in the Freeway road reserve. The slope on the development site is a potential bushfire hazard reduction as the vegetation is upslope of the proposed lots and the south-west wind is the most common wind in the afternoon in summer. The native vegetation will be sufficiently separated from any future dwelling, and the potential bushfire, and the protection to the dwelling will be enhanced by constructing to the appropriate standard.

The public roads will be constructed to the appropriate standard as prescribed in the IPWEA Subdivision Guidelines and approved by the City of Cockburn. This will minimise any potential bushfire hazard associated with access. The WAPC queried the absence of cul-de-sacs and battle-axe lots in the BMP and the Indicative Subdivision Plan. There is an absence of these roads in the BMP as there are none in the Indicative Subdivision Plan.

Section 5: Assessment against the Bushfire Protection Criteria

Subsection 5.1: Compliance Table

Bushfire protection criteria	Method of Compliance Acceptable solutions	Proposed bushfire management strategies
Element 1: Location	A1.1 Development location	The potential future dwellings will be located in an area that is restricted to the BAL rating BAL–29 or less.
Element 2: Siting and design	A2.1 Asset Protection Zone (APZ)	There is no requirement for an APZ associated with any new dwellings within the development.
Element 3: Vehicular Access	A3.1 Two access routes	Barfield Road provides multiple access options for the proposed new lots, and links to a substantial road network.
	A3.2 Public road	New roads associated with the development will be built to comply with the Guidelines.
	A3.3 Cul-de-sac (including a dead-end-road)	Not applicable. There are none of these types of roads in the Indicative Subdivision Plan.
	A3.4 Battle-axe	Not applicable. There are none of these types of roads in the Indicative Subdivision Plan.
	A3.5 Private driveway longer than 50 m.	It is anticipated that there will not be any driveways longer than 70 m constructed with this development. If there are they, will be compliant with the Guidelines.
	A3.6 Emergency access way	Nil will be constructed with this development.
	A3.7 Fire service access routes (perimeter roads)	Nil will be constructed with this development. Firebreaks and fuel loads will continue to be maintained in accordance with the Shire's firebreak order.
	A3.8 Firebreak width	During establishment, and after subdivision, firebreaks will be maintained so as to comply with the City's firebreak and fuel order.
Element 4: Water	A4.1 Reticulated areas	A reticulated scheme water system developed to comply with the State's requirements will be connected as a component of this development. This includes fire hydrants.
	A4.2 Non-reticulated areas	Not applicable.
	A4.3 Individual lots within non-reticulated areas (Only for use if creating 1 additional lot and cannot be applied cumulatively)	Not applicable.

LEGEND

Subject land

Sealed roads

REQUIREMENTS

1. The site will be serviced by a reticulated scheme water system developed to comply with the State's requirements. It will be connected as a component of this development. This includes fire hydrants.
2. This is the principal hazard vegetation being the Banksia scrub.
3. Principal access road for access and egress.
4. Scrub revegetation on the neighbouring lot to the north. This is reticulated, and under the management of the City of Cockburn.
5. Land cleared and being developed.
6. Grassland under an open woodland (<10% overstorey cover).
7. Proposed revegetation to scrub with reduced height requiremets to meet Western Power easement requirements.

Location details: Lot 28 Barfield Road, Hammond Park
Assessment date: 10 December 2023
Prepared by: Ralph Smith
Accreditation level: 2
Accreditation number: 27541
Accreditation expiry date: August 2024
Date aerial photo: June 2023
Version No: 1.7

Figure 8. Spatial representation of bushfire management strategies.

Section 6: Responsibilities for Implementation and Management of the Bushfire Measures

This section is to set out the responsibilities of the developer/s, landowner/s and local government with regards to the initial implementation and ongoing maintenance of the required actions.

DEVELOPER – PRIOR TO ISSUE OF TITLES		
No.	**Implementation Action**	**Subdivision Clearance**
1	A notification pursuant to Section 165 of the *Planning and Development Act 2005*, is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating or 12.5 or above, advising the existence of a hazard or other factor. Notice of this notification is to be included in the diagram or plan of survey (deposited plan). The notification is to state as follows: "*This land is within a bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner and is subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land*" (Western Australian Planning Commission).	
2	Comply with the relevant local government annual firebreak notice issued under s33 of the Bush Fires Act 1954.	
3	The developer will be responsible for extending the reticulated scheme water network into the development that is compliant with the State's requirements.	
4	The developer is responsible for construction of roads within the development	

LANDOWNER/OCCUPIER – ONGOING	
No.	**Management Action**
1	Comply with the relevant local government annual firebreak notice issued under s33 of the Bush Fires Act 1954.

CITY OF COCKBURN – ONGOING	
No.	**Management Action**
1	Publish and enforce the annual firebreak notice issued under s33 of the Bush Fires Act 1954.
2	Maintain the POS areas as 'Exclusion' as defined in AS 3959, section 2.2.3.2.
3	Maintain the public roads to the required standard.
4	Maintain the 20 metre wide road reserve along the eastern side of the structure plan, within SU23 land will be maintained by the City as low threat vegetation as per AS 3959
5	Maintain the area of land identified as 20 Westwood Crescent, Hammond Park 6164 in line with the approved bushfire Management Plan for the Lot 29 Barfield Structure Plan.

Appendix 1

The following is an extract from the City of Cockburn "Firebreak & Fire Hazard Notice 2022/2023."

Firebreaks and Fire Hazards

Fire Hazards

Properties under 4047m2 - All flammable materials such as dry grass and weeds must be slashed, mowed or trimmed down to a maximum height of 50mm across the entire property and all dead vegetation must be removed. This must be put in place by 1 November each year and maintained to 15 April.

Firebreak requirements

Properties over 4047m2 - A firebreak is an area where flammable material (such as wood, leaves and grass) has been cleared to provide vehicle access and help minimise the spread of a fire.

Firebreaks must be put in place by 1 November each year and maintained up until 15 April the following year. Extensions will not be granted.

Property inspections by the City

Inspections of private property commence in November and are ongoing until April each year. We have had high levels of compliance within the rural areas, which shows strong community understanding of the impending dangers from bushfires through summer.

Important note: If you receive a letter from the City outlining works you need to undertake to reduce fire risks, you must comply with the advice before the due date or a contractor will be appointed by the City and all associated costs will be charged to you.

Need help with your firebreaks or slashing? Visit the Yellow Pages for contractors.

Please refer to the City's Fire Control Order for more information on how to make your property compliant.

Appendix 2

Location of the current fire hydrants (blue dots) in the general area of the development and compliant with the Water Corporation standards. The site will be serviced by the reticulated scheme water system which includes the provision of fire hydrants and will be compliant with the State's requirements.

Appendix 3

Copy of the landscape plan for the POS. The landscape plan has been designed to comply with AS 3959: 2018 section 2.2.3.2 (e), (c) and (f) which makes it compliant for Exclusion–Low threat vegetation and non-vegetated areas.

Appendix 4

Extract of the Revegetation Plan for the Western Power easement. The revegetation plan has been developed by Coterra Environment and this figure and methodology are an extract from their report.

Lot 28 (157 Barfield Road) Revegetation Methodology

Revegetation Areas

It is proposed to undertake revegetation works over a 1.09 hectare area within the easement adjacent to Lot 28.

The area proposed for earthworks will be revegetated by the proponent to the requirements of the City of Cockburn as a condition of subdivision approval for the residential development. These revegetation works must also comply with conditions imposed on revegetation within easements by Western Power.

Revegetation Strategy and Completion Criteria

1.1 Baseline Flora and Vegetation Data

The site is historically representative of Beard Vegetation Association 1001, which is described as 'medium very sparse woodland; Jarrah, with low woodland; Banksia or Casuarina' (Beard et al, 2005) and the Bassendean Complex – Central and South (Heddle et al, 1980). The Bassendean Complex – Central and south is described as "woodland of jarrah (*Eucalyptus marginata*), *Allocasuarina fraseriana, Banksia attenuata, B. grandis* and *B. menziesii* on the sand dunes to low woodland of *Melaleuca preissiana, B. ilicifolia* and *B. littoralis* and sedgelands on the low-lying moister sites. This area includes the transition of jarrah to coastal blackbutt (*E. todtiana*) in the Perth vicinity and jarrah to marri (*Corymbia calophylla*) on the moister soils. Other plant species include *Kunzea ericifolia, Hypocalymma angustifolium, Adenanthos obovatus* and Verticordia species (Heddle et al, 1980).

A detailed vegetation and flora survey was undertaken on the site (Coterra, 2017) in accordance with relevant government guidance (EPA, 2016a). Two vegetation types were observed on the site, as follows:

- An Open Low Forest of *Banksia attenuata, B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* over Open Tall Shrubland to Tall Shrubland of *Xanthorrhoea preissii*, with occasional pockets of *Kunzea glabrescens* tall shrubs, over Open Shrubland to Shrubland of *Stirlingia latifolia* over Open Low Shrubland of *Hibbertia hypericoides* or *Hypocalymma robustum* and *Bossiaea eriocarpa* or over a mixed Sedgeland/Herbland including *Phlebocarya ciliata*, and/or *Desmocladus flexuosus* and *Lepidosperma squamatum* on midslope flats, on loamy sands, was recorded predominantly in the western portion of the subject area.
- Scattered *Banksia menziesii* and *B. ilicifolia* over Shrubland to tall Shrubland of *Adenanthos cygnorum* over Open Grassland of introduced species **Ehrharta calycina* with scattered native low shrubs, on midslope sandy flats was recorded predominantly in the eastern portion of the subject area.

1.2 Current Site Condition

The proposed revegetation area comprises vegetation in 'Completely Degraded' to 'Degraded' condition, representative of the 'Scattered Banksia Shrubland, detailed above. The proposed revegetation area is not representative of Banksia Woodland.

Plate 1: Vegetation and weed presence

Plate 2: Typical vegetation within easement

1.3 Bushfire Management

Given the site is in a bush fire prone area, a Bushfire Management Plan has been prepared for the site by Smith Bushfire Consultants, in accordance with the following:

- State Planning Policy 3.7 – Planning in Bushfire Prone Areas (WAPC, 2015b)
- Guidelines for Planning in Bushfire Prone Areas (WAPC, 2021).

Reference should be made to the Bushfire Management Plan for specific bushfire management details. In relation to the revegetation area, the following key components should be noted:

- The revegetation area within the easement area has been classified as Class D - Scrub as per the Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS 3959).
- The species that will be chosen for revegetation will meet the AS 3959 criteria for Scrub and that no more than 10% of the overstorey vegetation is accommodated.
- As per the Bushfire Management Plan, the City of Cockburn have agreed to accept responsibility for future management of the scrub vegetation and its height maintenance.
- The land directly east and north (both abutting the 20m road reserve) will be grassed and managed as low threat vegetation as per AS 3959.

1.4 Revegetation Methodology

The proposed revegetation methodology will generally comprise the following:

1.4.1 Clearing and Topsoil Removal

Clearing will be undertaken within the easement to facilitate development on Lot 28.
Clearing activities will be undertaken in accordance with engineering requirements for the site.
Topsoil will be removed and stored on site, for re-use in revegetation areas. It should be noted that topsoil may produce native germinates that grow above the 3 m height limitation, and as such, these may need to be destroyed.

1.4.2 Slope and Surface Stabilisation

Slope and surface stabilisation will be conducted using either of the following:

- collection of in-situ (cleared and felled) mulched vegetation will be undertaken prior to earthworks on the site
- installation of coir netting, if required
- application of a dust suppression product (such as Gluon).

The actual methodology may involve a combination of the above techniques. These actions will be undertaken after clearing.

1.4.3 Species Selection

The Western Power Transmission Easement Notice, states that no vegetation exceeding 1 m in height from the natural surface of the land should be grown, cultivated or maintained within the easement (Western Power, undated).
Given the easement will be excavated, Western Power has provided written consent (dated 17 April 2023) for the revegetation height restriction to be lifted to 3m. Appendix 1 presents the proposed revegetation species list which is based on vegetation within the general location, reflective of Banksia Woodland and the application of a 3m height restriction within the Western Power easement.

1.4.4 Site Preparation

Soils within the revegetation area will be ripped to 500 mm prior to planting, if possible, depending on slope. If the site has steep batters, ripping may not be possible in these locations, and alternative methods for site preparation will be implemented.

1.4.5 Planting Techniques

Tubestock planting will be undertaken at a rate of 1.6 plants/m^2.

Tubestock will be sourced from accredited Dieback-free local nurseries. Where possible, local provenance material (within 50 km of the site) will be used.

Where revegetation areas cannot be fenced (below), corflute tree guards will be installed after planting. Tree guards will be removed in the first summer after planting, only if it is determined that the rabbit population will not severely impact planting (pers. comm James Lawton, 7 December 2021).

1.4.6 Weed Control

It is proposed that weed control works be undertaken in areas of retained vegetation to improve the quality and condition of vegetation. Weed control works will be implemented in all areas of retained vegetation as follows pre- and post-planting.

Pre-planting weed control will comprise:

- initial spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in autumn, 2-4 weeks prior to winter planting.

Post-planting weed control will comprise:

- spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in late winter/spring following planting to allow for additional removal of weeds prior to flowering and seed propagation
- broad spectrum herbicide application (i.e. Glyphosate) in summer, to coincide with summer active weeds
- annual winter/spring broad spectrum herbicide application (i.e. Glyphosate), as required
- annual summer broad spectrum herbicide application (i.e. Glyphosate), as required.

1.4.7 Access and Fencing

Suitable fencing (1.2 m high with rabbit netting) will be installed around revegetation areas to manage inadvertent access to the areas. In accordance with the Transmission Easement Notice, this fence must be earthed to the satisfaction of Electricity Networks Corporation in the case of a metallic fence or trellis (Western Power, undated). Fencing will not be installed to the detriment of access to Western Power infrastructure.

1.4.8 Signage

Signage will be installed adjacent to revegetation areas to advise "No Entry – Revegetation Area".

1.4.9 Bushfire management

The proposed revegetation area will have no more than 10% of the overstorey vegetation within the revegetation area located in the easement. The Revegetation Plan, which will be prepared following subdivision approval, will provide further detail on the planting regimes and how this will be accomplished.

1.5 Completion Criteria

Completion criteria for the revegetation areas has been determined on the basis of revegetation guidelines developed by the neighbouring City of Cockburn (2017; Table 1).

Table 1: Success Criteria for Revegetation Works

Assessment Parameter	Method	Completion Criteria
Seedling survival	5m x 5m quadrats Photo points/monitoring	1.6 plants/m^2 for dryland species
Species representation	5m x 5m quadrats/transects Photo points/monitoring	75% of dryland species
Weed cover	5m x 5m quadrats Photo points/monitoring	5%
Declared weeds	5m x 5m quadrats Photo points/monitoring	No declared weeds to be present.

Note: The completion criteria will be assessed via averaging the results from the monitoring locations.

1.6 Monitoring and Reporting

Monitoring will be undertaken to assess weed cover and plant survival rates within the revegetation area against completion criteria (Table 1). These monitoring events will occur annually commencing in:

- autumn following the year that planting was undertaken, to measure plant survival. This will inform the need for any infill planting for the upcoming winter
- spring to measure to measure plant density/success.

5m x 5m quadrats and photo points will be established within each revegetation area, to allow for consistency of monitoring over time. Exact locations of these quadrats and photo point locations will be provided in the first monitoring report prepared for the revegetation program.

Monitoring is to be ongoing for at least 2 years post-revegetation and shall continue until completion criteria have been met. Monitoring will also make note and include photos of any signs of erosion or storm damage to revegetation areas to enable appropriate management measures.
Once initial revegetation actions have been completed, a report will be prepared and submitted to the City of Cockburn within 30 days.

Thereafter, revegetation monitoring reports, comprising results of revegetation works, monitoring results for autumn and spring and any contingency actions that were implemented, will be prepared, and submitted to the City of Cockburn on an annual basis, and within 30 days after the completion of Spring monitoring events.

1.7 Contingency Actions

If monitoring indicates that the success criteria are not being met, contingency actions may be undertaken:

- infill planting (30% infill after Year 1 monitoring, then 15% infill after Year 2 monitoring) to increase plant numbers, plant species, ground coverage and / or replace damaged or dead seedlings
- additional broad spectrum herbicide application, or manual weed control to reduce weed coverage, as required, in winter, spring and autumn
- installation of additional corflute tree guards for protection to exclude pests.

Proposed Vegetation Species List within Easement (up to 2 m in height)

Species	Growth Form	Approximate Height (m)
Acacia pulchella	Shrub	0.3-3
Allocasuarina humilis	Shrub	0.2-2
Anigozanthos manglesii	Herb / groundcover	0.2-1.1
Astartea scoparia		1.8
Atriplex cinerea		0.2-1.5
Banksia attenuata	Shrub	0.4-10 0.4-2 (often a shrub in drier areas)
Banksia menziesii	Shrub	1.3-7 1-3 (lower spreading shrub in the more northern parts of its range)
Beaufortia elegans		0.3-1
Bossiaea eriocarpa		0.2-1
Calothamnus quadrifidus 'Little Ripper'		0.2-0.4
Conostylis aculeata	Herb / groundcover	0.06-0.5
Conostylis candicans		0.05-0.4
Daviesia physodes	Shrub	0.4-1.8
Dianella revoluta var divaricata	Herb / groundcover	0.3-1.5
Ficinia nodosa		Up to 1
Gastrolobium capitatum	Shrub	to 1
Grevillea crithmifolia 'Green Carpet'		0.6-0.8
Hakea prostrata	Shrub	1-3
Hemiandra pungens		0.05-1
Hibbertia hypericoides		0.2-1.5
Hovea pungens	Shrub	0.2-1.8
Hypocalymma angustifolium	Shrub	to 1.5
Hypocalymma robustum		0.4-1.5
Kennedia prostrata	Herb / groundcover	0.1
Melaleuca huegelii Prostrata		0.2
Melaleuca seriata	Shrub	0.25-1
Patersonia occidentalis	Herb / groundcover	1.5
Pultenaea reticulata	Shrub	0.5-2

Source: Coterra, 2017; City of Cockburn, undated (https://www.cockburn.wa.gov.au/Street-Trees-Pruning-and-Planting); Tranen (pers. comm J. Lawton, 2 December, 2021).

Images of the proposed species for the revegetation of the Easement


Acacia pulchella


Allocasuarina humilis


Anigozanthos manglesii


Astartea scoparia


Atriplex cinerea


Banksia attenuata


Banksia menziesii


Beaufortia elegans


Bossiaea eriocarpa


Calothamnus quadrifidus


Conostylis aculeata


Conostylis candicans


Daviesia physodes


Dianella revoluta var divaricata


Ficinia nodosa


Gastrolobium capitatum


Grevillea crithmifolia


Hakea prostrata


Hemiandra pungens


Hibbertia hypericoides


Hovea pungens


Hypocalymma robustum


Kennedia prostrata


Melaleuca huegelii


Melaleuca seriata


Patersonia occidentalis


Pultenaea reticulata

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Near map from http://maps.au.nearmap.com/

Slope percentage to degrees conversion from https://www.calcunation.com/calculator/slope-percent-conversion.php

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Appendix 4: Transport Impact Statement

Transcore

transcore 20 years anniversary

transport planning
traffic engineering
modelling

Proposed Structure Plan

Lot 28 Barfield Road, Hammond Park

Transport Impact Statement

PREPARED FOR:
Condor Nominees

December 2022

Document history and status

Author	Revision	Approved by	Date approved	Revision type
M Rasouli	r01	B Bordbar	12/11/2021	Draft
M Rasouli	r01a	B Bordbar	19/11/2021	Final
K Dai	r01b	M Rasouli	5/12/2022	Revised Final

File name: t21.191.jd.01b

Author: Mohammad Rasouli

Project manager: Mohammad Rasouli

Client: Condor Nominees

Project: Lot 28 Barfield Road, Hammond Park

Document revision: r01b

Project number: t21.191

TABLE OF CONTENTS

REPORT FIGURES

1 Introduction

This Transport Impact Statement (TIS) has been prepared by Transcore on behalf of Condor Nominees with regard to the proposed Structure Plan for Lot 28 Barfield Road, Hammond Park, in City of Cockburn.

The subject site is located within the City of Cockburn's Southern Suburb District Structure Plan (SSDSP). A copy of the SSDSP is provided in **Appendix A**. Clause 7.4 of the City of Cockburn's 2012 District Structure Plan for "Southern Suburbs Stage 3" states that:

"The SSDSP3 shows the broad allocation and location of land use activities and will form the basis of assessing detailed proposals for individual properties. The District Structure Plan is a "guiding document" adopted by the Council and is not a structure plan adopted pursuant to section 6.2.9 of the City's TPS No. 3. Therefore, land uses and zones are not given the full effect as though they are part of TPS No.3. To progress the subdivision and development of a land holding it will be necessary for landowners or groups of small landowners to prepare and submit a detailed LSP and supporting reports for their land. Each structure plan should be generally in accordance with the SSDSP3, and should show details including the proposed road and lot layout, detail areas of POS, R-Codes and other information set in the Development Area provisions of TPS No. 3. Any significant departures from the SSDSP3 would need to be identified and justified. All LSP's are to be adopted by Council and endorsed by the WAPC in accordance with the Development Area provisions of the Scheme".

The Transport Impact Assessment Guidelines (WAPC, Vol 4 – Individual Developments, August 2016) states: *"A Transport Impact Statement is required for those developments that would be likely to generate moderate volumes of traffic*[1] *and therefore would have a moderate overall impact on the surrounding land uses and transport networks".*

Section 6 of Transcore's report provides details of the estimated trip generation for the proposed development. Accordingly, as the total peak hour vehicular trips are estimated to be less than 100 trips, a TIS is deemed appropriate for this development.

This TIS is prepared in accordance with WAPC Guidelines with consideration given to the Clause 7.4 of the City of Cockburn's SSDSP. Key issues that will be addressed in this report include the traffic generation and distribution of the proposed Structure Plan and access and egress movement patterns.

The land subject to this Structure Plan (the subject site) is located to the eastern side of Barfield Road and has frontage to Barfield Road and the western boundary of the Kwinana Freeway as shown in **Figure 1**. The location of the subject site within the Metropolitan Region Scheme (MRS) context is illustrated in **Figure 2**.

[1] *Between 10 and 100 vehicular trips per hour*

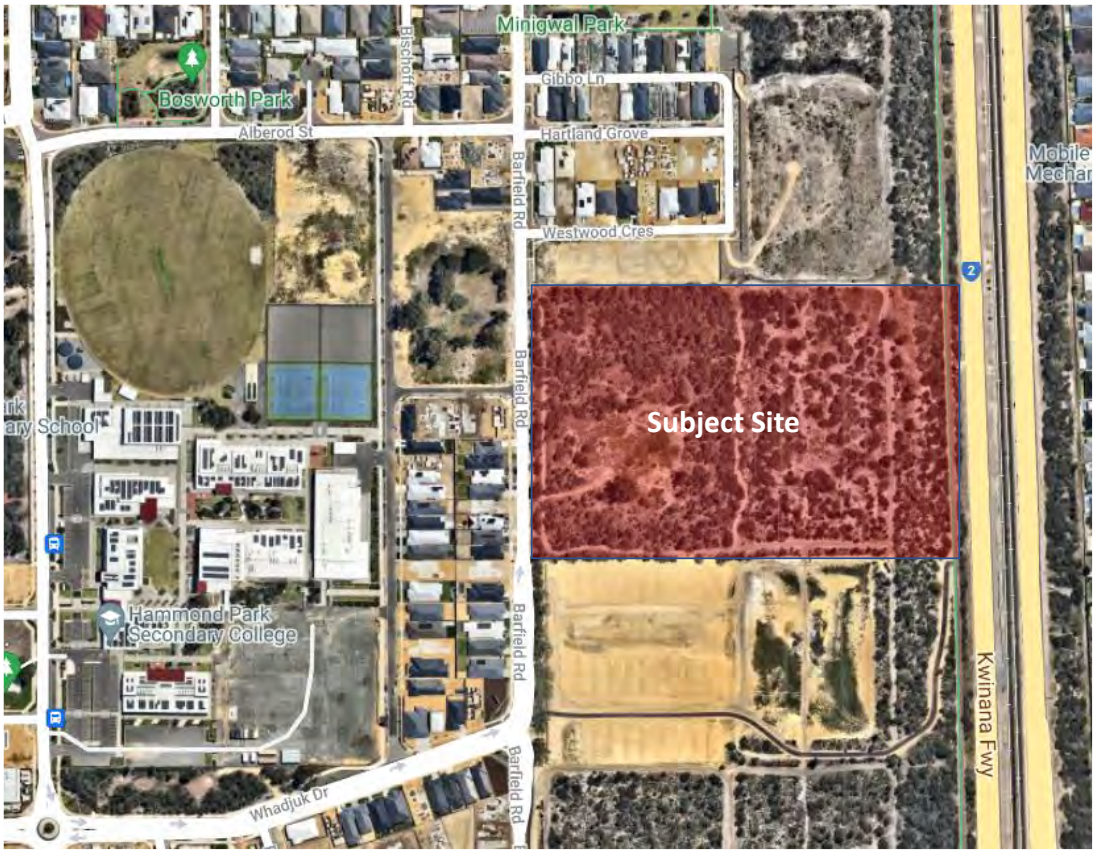


Figure 1: Location of subject site

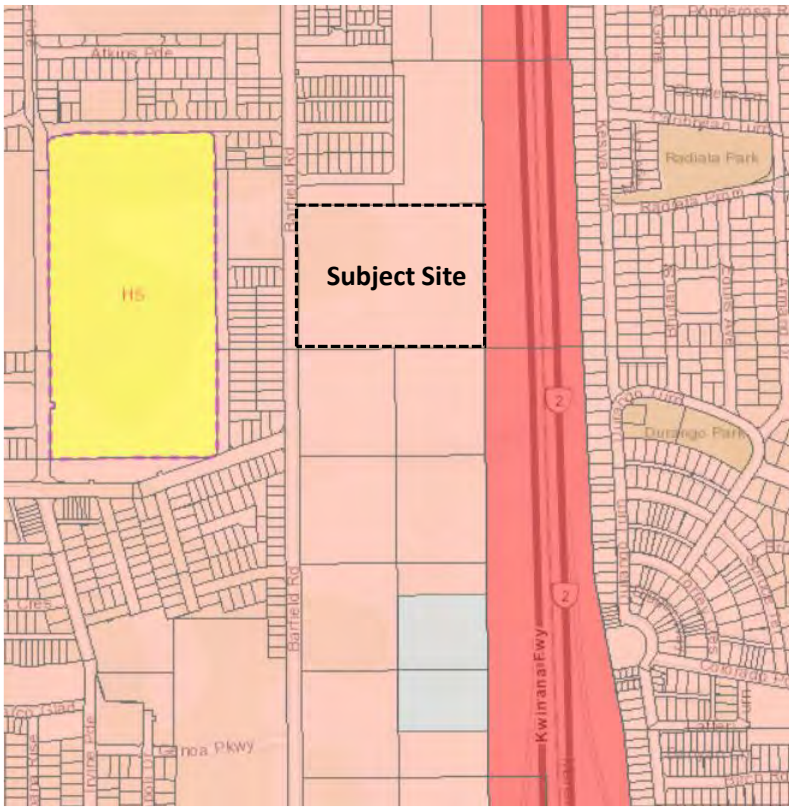


Figure 2: Location of the subject site in MRS

2 Proposed Structure Plan

The proposed Structure Plan (Appendix B) is based on an Indicative Subdivision Layout for 46 residential lots (Appendix C) within the western part of the subject site. The eastern half of the site is affected by an easement in favour of Western Power associated with 330KV power line infrastructure which traverses this portion of the site from north to south parallel to the Kwinana Freeway to the east.

The subject site is identified in the City of Cockburn Southern Suburbs District Structure Plan as Medium Density Residential. As indicated on the proposed Structure Plan, the location of the required public open space differs from its location on the SSDSP (refer **Figure 3**) has been agreed with the City of Cockburn for the advertising of the Structure Plan documents.

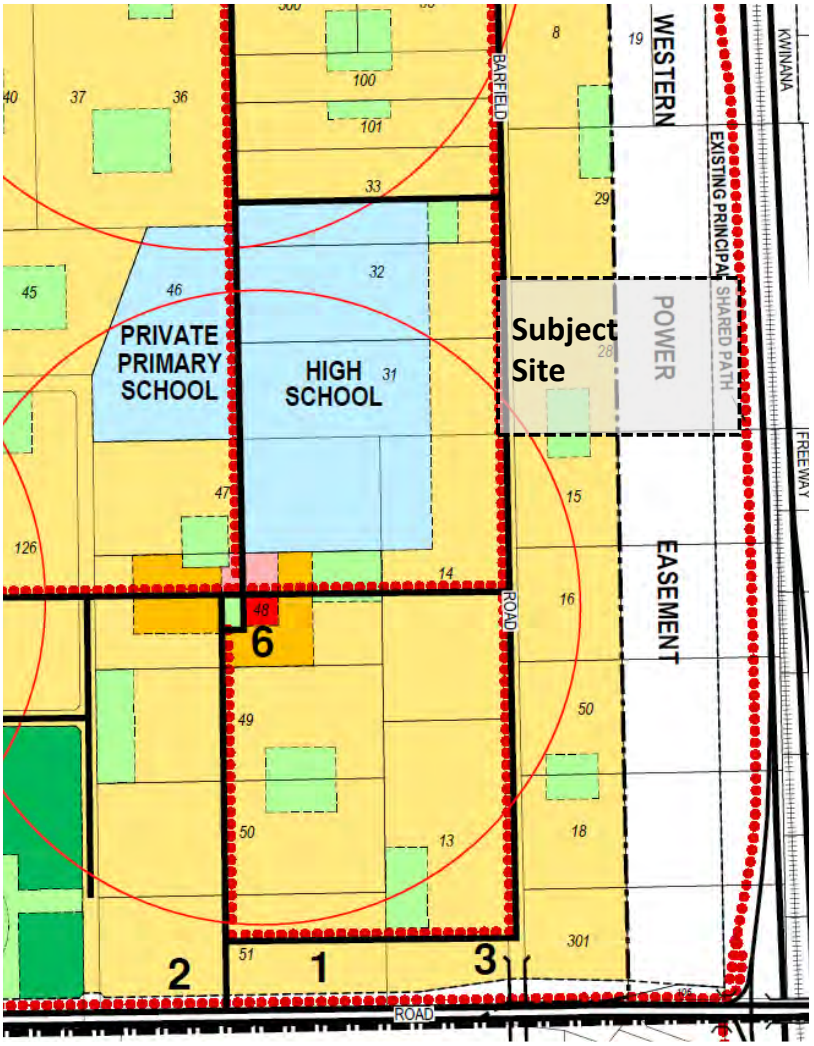


Figure 3: Location of the site within the City of Cockburn Southern Suburbs District Structure Plan

3 Vehicle Access

3.1 Access

The proposed SP has direct road frontage to Barfield Road with two full movement priority-controlled access intersections on Barfield Road on both sides of the existing Boota Way (opposite of the subject site) as illustrated in **Figure 4.**

The SP also provides a connection to the adjacent Lot 15 to the south via a 20m road reserve located within the Western Power easement as has been approved and constructed within the development of Lot 29 to the north and approved on the subdivision plan for Lot 15.

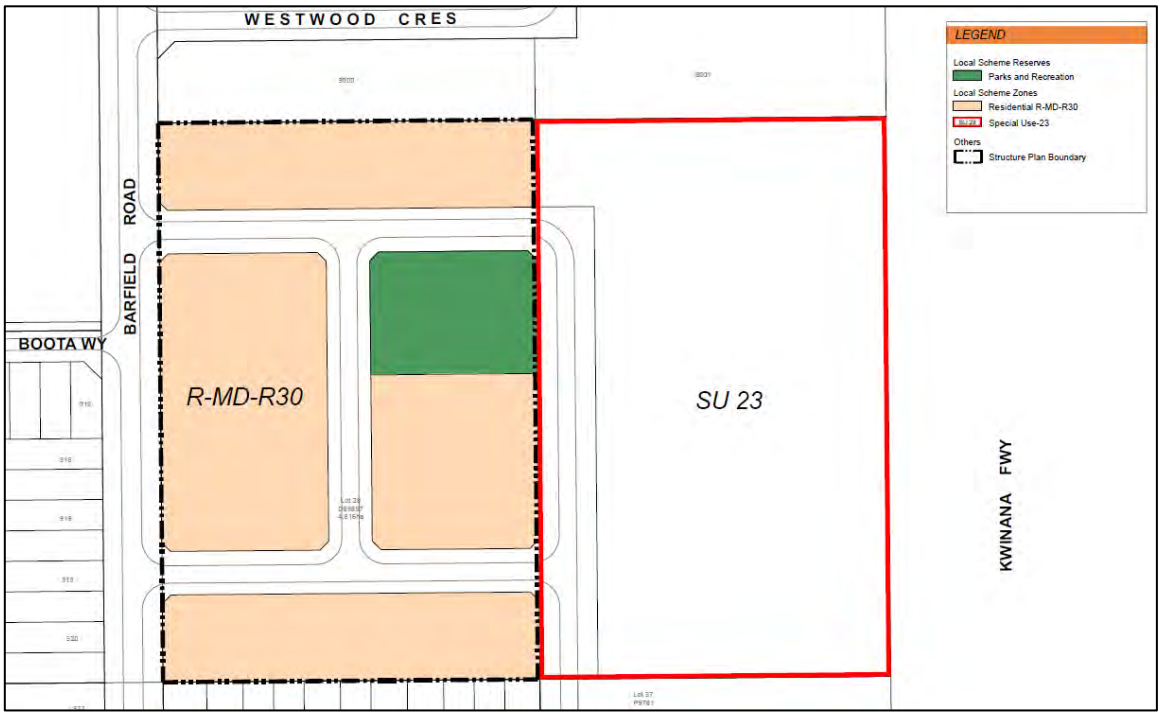


Figure 4: Proposed access arrangements

4 Provision for Service Vehicles

The internal SP road network will be designed to accommodate suitable service vehicles. Waste collection for the proposed SP will be as per the standard arrangement for residential developments throughout the City of Cockburn. This consists of rubbish bins wheeled out by the residents for verge collection on the designated collection day.

5 Hours of Operation

The proposed SP is for residential dwellings.

6 Daily Traffic Volumes and Vehicle Types

6.1 Existing Trip Generation

The subject site is currently vacant and does not generate any traffic.

6.2 The Proposed Development Trip Generation

The proposed SP is expected to yield 46 residential lots. The traffic generation rate used for the proposed subdivision is 8 vehicle trips per day (vpd) per dwelling, which corresponds to peak hour trip generation rates of 0.8vph per dwelling recommended in the Western Australian Planning Commission (WAPC) Transport Impact Assessment Guidelines (2016).

Accordingly, it is calculated that the daily and peak hour traffic generation for the proposed SP is:

- Daily Vehicle Trips: 8 x 46 (dwellings) = 368 vpd; and,
- Weekday Peak Hour Trips: 0.8 x 46 (dwellings) = 37 vph.

Therefore, it is estimated that the proposed SP would generate about 368 vehicular trips per day with approximately 37 trips during the typical weekday peak hour. These figures include both inbound and outbound vehicle movements.

6.3 Traffic Flow

With respect to the location of the SP, permeability and layout of the surrounding road network, the assumed traffic distribution as a result of the proposed development is assumed as follows:

- 50% to/ from north on Barfield Road; and,
- 50% to/ from south on Barfield Road;

The trip distribution of the development-generated traffic is illustrated in **Figure 5**. As evident some vehicular interaction between Lot 15 and Lot 28 would be expected through the proposed southern connection.

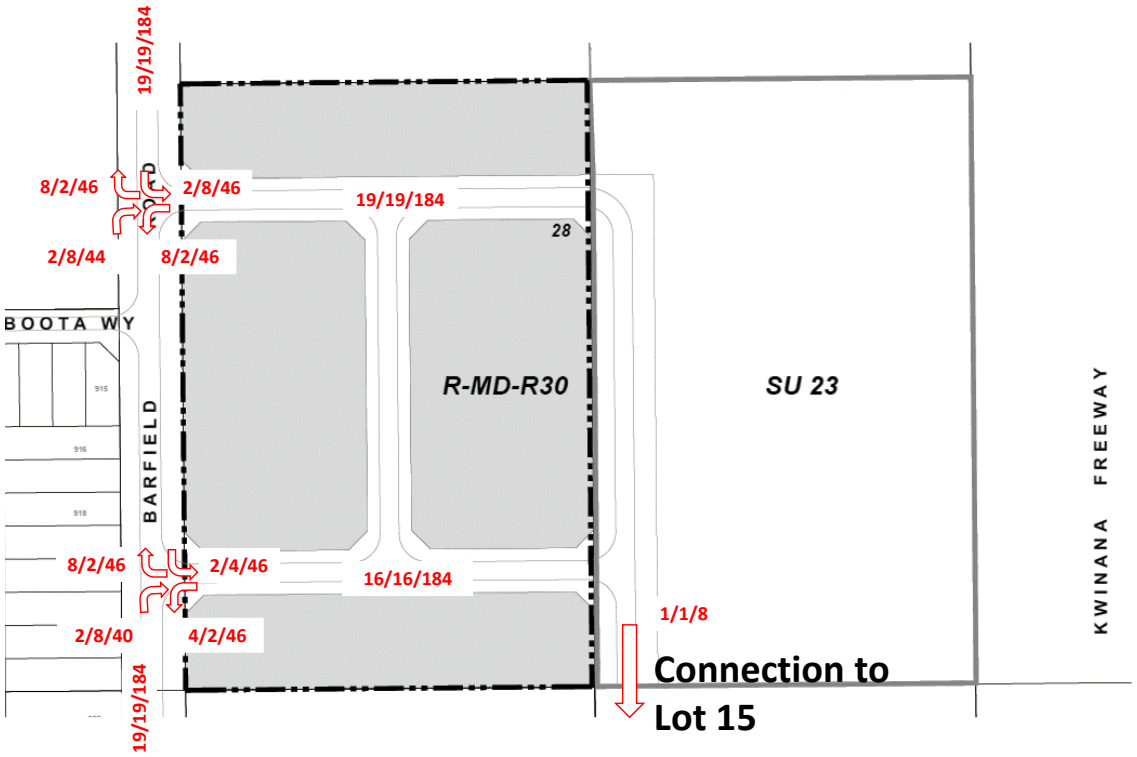


Figure 5: Estimated traffic movements for AM/PM/Daily traffic

6.4 Impact on Surrounding Roads

The WAPC Transport Impact Assessment Guidelines (2016) provides guidance on the assessment of traffic impacts:

"As a general guide, an increase in traffic of less than 10 per cent of capacity would not normally be likely to have a material impact on any particular section of road but increases over 10 per cent may. All sections of road with an increase greater than 10 per cent of capacity should therefore be included in the analysis. For ease of assessment, an increase of 100 vehicles per hour for any lane can be considered as equating to around 10 per cent of capacity. Therefore, any section of road where development traffic would increase flows by more than 100 vehicles per hour for any lane should be included in the analysis."

It is clear that the traffic increase from the proposed SP would be significantly less than the critical threshold (100vph per lane). As detailed in **Section 6.2**, the proposed SP will not increase traffic on any lanes on the surrounding road network by more than 100vph, therefore the impact of the development traffic on the surrounding road network will not be significant and does not require further detailed assessment.

7 Traffic Management on the Frontage Streets

Barfield Road is constructed as a 6.2m wide single carriageway two-way road with no pedestrian footpaths fronting the subject site (Refer to **Figure 6**). A shared path and a footpath are provided to the west and east side of Barfield Road respectively for the recently developed areas immediately to the north and south of the SP area (Refer **Figure 7**).

Barfield Road connects to Baler Crescent and Rowley Road to the north and south respectively. Currently the intersection of Barfield Road and Rowley Road is in the form of a priority-controlled T-intersection. It is Transcore's understanding that once Rowley Road is upgraded to 4-lanes this intersection will be terminated at Rowley Road.

Figure 6: Barfield Road looking north

Figure 7: The recently developed areas to the north of the SP area

8 Public Transport Access

Figure 8 illustrates the existing bus routes in the vicinity of the subject site. Currently, there is no bus services along Barfield Road. The closest bus route is bus route 536 which provides connection between Aubin Grove Train Station and Hammond Park Secondary College.

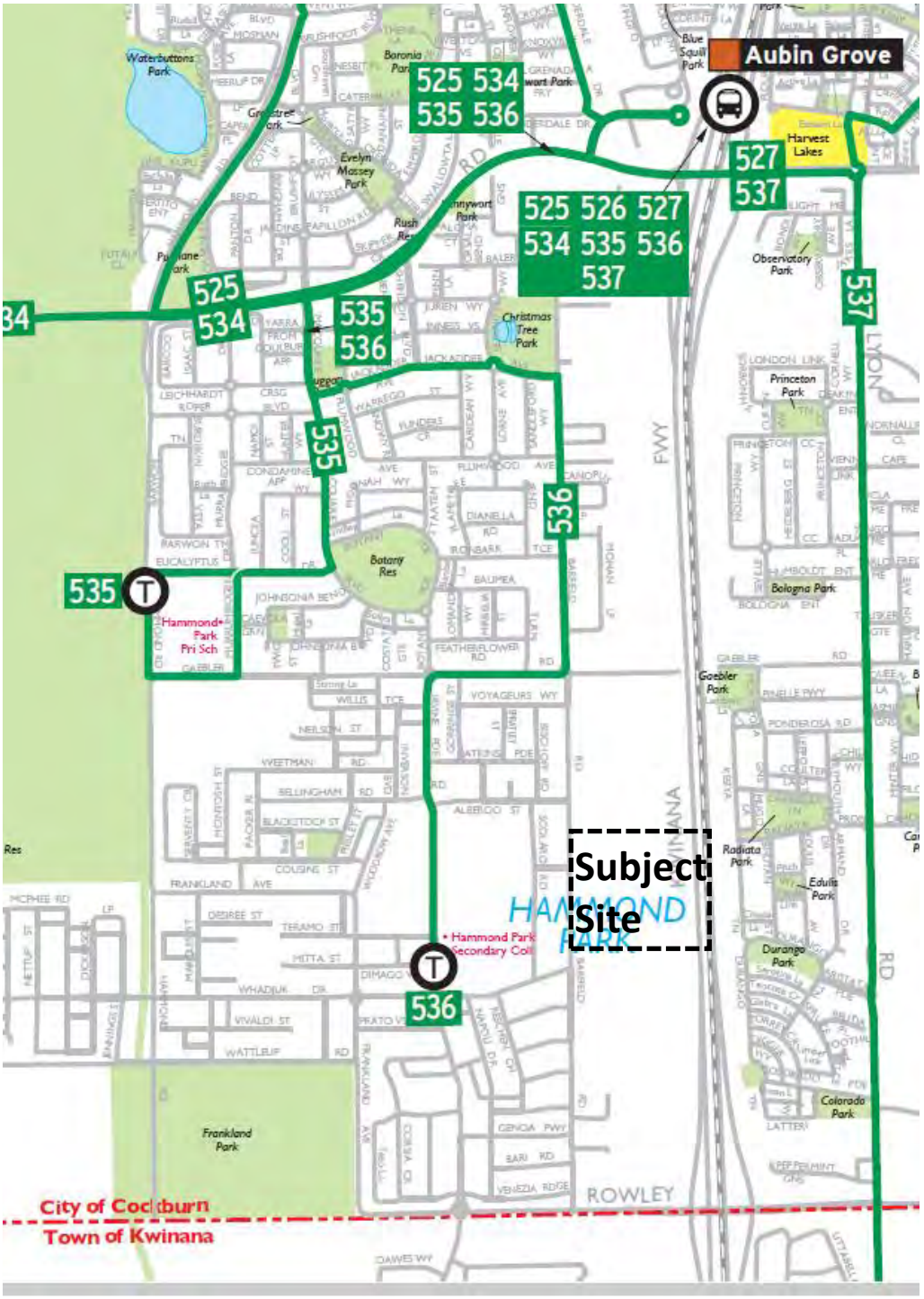


Figure 8:Existing bus routes

9 Pedestrian and Cycle Access

Pedestrian access would be provided via the existing and proposed paths along Barfield Road. Currently there is a shared path and a footpath to the west and east side of Barfield Road respectively immediately north of the subject site which has been constructed as part of the development of Lot 29 (the northern Lot). It is expected that similar paths would be provided along Barfield Road fronting the subject site (and the other vacant Lots in this vicinity) as they develop progressively.

In accordance with the requirements of Liveable Neighbourhoods, footpaths will be provided on at least one side of every street within the SP area.

10 Site Specific Issues

The proposed Structure Plan is located within the City of Cockburn's Southern Suburb District Structure Plan (SSDSP). A copy of the SSDSP is provided in Appendix A. The proposed Structure Plan is generally in accordance with the SSDSP, and shows various details including the proposed road and lot layouts.

The traffic modelling and analysis undertaken indicates that the projected traffic volumes on all SP internal Roads would be less than 1,000vpd and therefore the internal roads of the SP would be classified as Access Street D in line with Liveable Neighbourhood Guidelines. The basic standard of Access Street D roads is a 6m wide carriageway in a 15m road reserve in accordance with Liveable Neighbourhoods guidelines.

11 Safety Issues

No safety issues were identified within the scope of this assessment.

12 Conclusions

This Transport Impact Statement (TIS) has been prepared by Transcore on behalf of Condor Nominees with regard to the proposed Structure Plan for Lot 28 Barfield Road, Hammond Park, in City of Cockburn.

The proposed Structure Plan is located within the City of Cockburn's Southern Suburb District Structure Plan (SSDSP). The proposed Structure Plan is generally in accordance with the SSDSP.

The proposed Structure Plan entails up to 46 residential dwellings within the western part of the subject site. The eastern half of the site is affected by an easement in favour of Western Power associated with 330KV power line infrastructure.

The proposed SP has direct road frontage on Barfield Road with two proposed full movement priority-controlled access intersections on Barfield Road and a connection to the adjacent Lot to the south (Lot 15).

The traffic analysis undertaken in this report shows that the traffic generation of the proposed SP is relatively low and would not have any significant impact on the surrounding road network.

The traffic modelling and analysis undertaken indicates that the projected traffic volumes on all SP internal Roads would be less than 1,000vpd and therefore the internal roads of the SP would be classified as Access Street D in line with Liveable Neighbourhood Guidelines. The basic standard of Access Street D roads is a 6m wide carriageway in a 15m road reserve in accordance with Liveable Neighbourhoods guidelines.

Currently there is a shared path and a footpath to the west and east side of Barfield Road respectively immediately north of the subject site which has been constructed as part of the development of Lot 29 (the northern Lot). It is expected that similar paths would be provided along Barfield Road fronting the subject site (and the other vacant Lots in this vicinity) as they develop progressively. In accordance with the requirements of Liveable Neighbourhoods, footpaths will be provided on at least one side of every street within the SP area.

No particular safety issues have been identified for the proposed SP.

Accordingly, it is concluded that the traffic related issues should not form an impediment to the approval of the proposed SP.

Appendix A

SOUTHERN SUBEURB DISTRICT STRUCTURE PLAN

PLAN NOTES

1. FUTURE RESIDENTIAL DEVELOPMENT SHALL NOT DIRECTLY ABUT ROWLEY ROAD. FUTURE LOCAL STRUCTURE PLANNING IS TO DEMONSTRATE A SUITABLE INTERFACE TREATMENT (E.G. ENLARGED SERVICE ROAD DESIGN WITH FRONTING RESIDENTIAL DEVELOPMENT AS A MINIMUM) BEING PROVIDED TO THE FUTURE ROWLEY ROAD FREIGHT ACCESS ROUTE.

2. FUTURE ACCESS ROAD TO BE PROVIDED AS A FULL INTERSECTION UNTIL ROWLEY ROAD IS UPGRADED AND CONSTRUCTED TO A REGIONAL ROAD AT WHICH TIME THE INTERSECTION WILL BE CONVERTED AND MAINTAINED AS LEFT IN/LEFT OUT ACCESS ONLY. (SUBJECT TO MAIN ROADS WA APPROVAL).

3. AS PART OF THE UPGRADING OF ROWLEY ROAD, GRADE SEPARATED PEDESTRIAN AND VEHICULAR ACCESS IS TO BE PROVIDED AS A CONTINUATION OF BARFIELD ROAD, IN ORDER TO MAINTAIN CONNECTIVITY BETWEEN FUTURE DEVELOPMENT TO THE SOUTH OF ROWLEY ROAD.THIS MAY BE FURTHER RATIONALISED THROUGH SUBSEQUENT LOCAL STRUCTURE PLANNING TO DETERMINE HOW THIS SPECIFIC ACCESS IS CREATED.

4. FUTURE STRUCTURE PLANNING OF THE CELL SOUTH OF WATTLEUP ROAD MUST PROVIDE AN APPROPRIATE INTERFACE WITH RESIDENTIAL DEVELOPMENT NORTH OF WATTLEUP ROAD. THIS IS TO HAVE PARTICULAR REGARD TO THE POSITION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION IN RESPECT OF ITS POSITION ON THE ACCEPTABILITY (OR OTHERWISE) OF RESIDENTIAL DEVELOPMENT SOUTH OF WATTLEUP ROAD, AND ALTERNATIVE (NON-RESIDENTIAL) LAND USES THAT MAY BE REQUIRED. ANY IMPACTS ASSOCIATED WITH THE FUTURE DEVELOPMENT OF NON-RESIDENTIAL LAND USES IN THE CELL SOUTH OF WATTLEUP ROAD MUST BE FULLY CONTAINED WITHIN THE CELL BOUNDARIES.

5. NEIGHBOURHOOD CENTRE-THE DESIGN AND FUNCTION OF THE PROPOSED NEIGHBOURHOOD CENTRE SHALL BE BASED ON 'MAIN STREET' PRINCIPLES AND RELEVANT PROVISIONS OF LIVEABLE NEIGHBOURHOODS. ANY ASSOCIATED LOCAL STRUCTURE PLAN MUST ADEQUATELY DEMONSTRATE THROUGH CONCEPT PLANS AND OR DETAILED AREA PLANS THE MANNER IN WHICH THE CENTRE ADDRESSES THE REQUIREMENTS OF THE RELEVANT SECTIONS OF THE SOUTHERN SUBURBS DISTRICT STRUCTURE PLAN - STAGE 3 REPORT, AND PARTICULARLY THE NEIGHBOURHOOD CENTRE CONCEPT PLAN PROVIDED WITHIN THE REPORT DOCUMENT.

6. NEIGHBOURHOOD NODES - THE DESIGN AND FUNCTIONALITY OF THE NEIGHBOUR- HOODNODES SHALL BE DISTINCTLY DIFFERENT TO THE PRIMACY OF THE NEIGHBOUR- HOOD CENTRE THESE LOCATIONS ARE TO PROVIDE FOR ARANGE OF MORE LOCALLY FOCUSSED ACTIVITIES AND FUNCTIONS. WHERE RETAIL IS PROPOSED, THESE ARE TO NOT EXCEED A MAXIMUM RETAIL FUNCTION OF 3000SQM, WITH SUCH FUNCTION BASED UPON A 'CONVENIENCE STORE' TYPE USE.

7. CENTRAL PRECINCT - A COMPREHENSIVE LOCAL STRUCTURE PLAN WILL BE REQUIRED FOR THE CENTRAL NEIGHBOURHOOD OCENTRE AND ADJACENT DEVELOPMENT. THE CITY WILL NOT CONSIDER INDIVIDUAL STRUCTURE PLANS IN THIS LOCATION DUE TO THE NEED TO ENSURE THE SUITABLE INTEGRATION OF DEVELOPMENT.

GENERAL NOTES

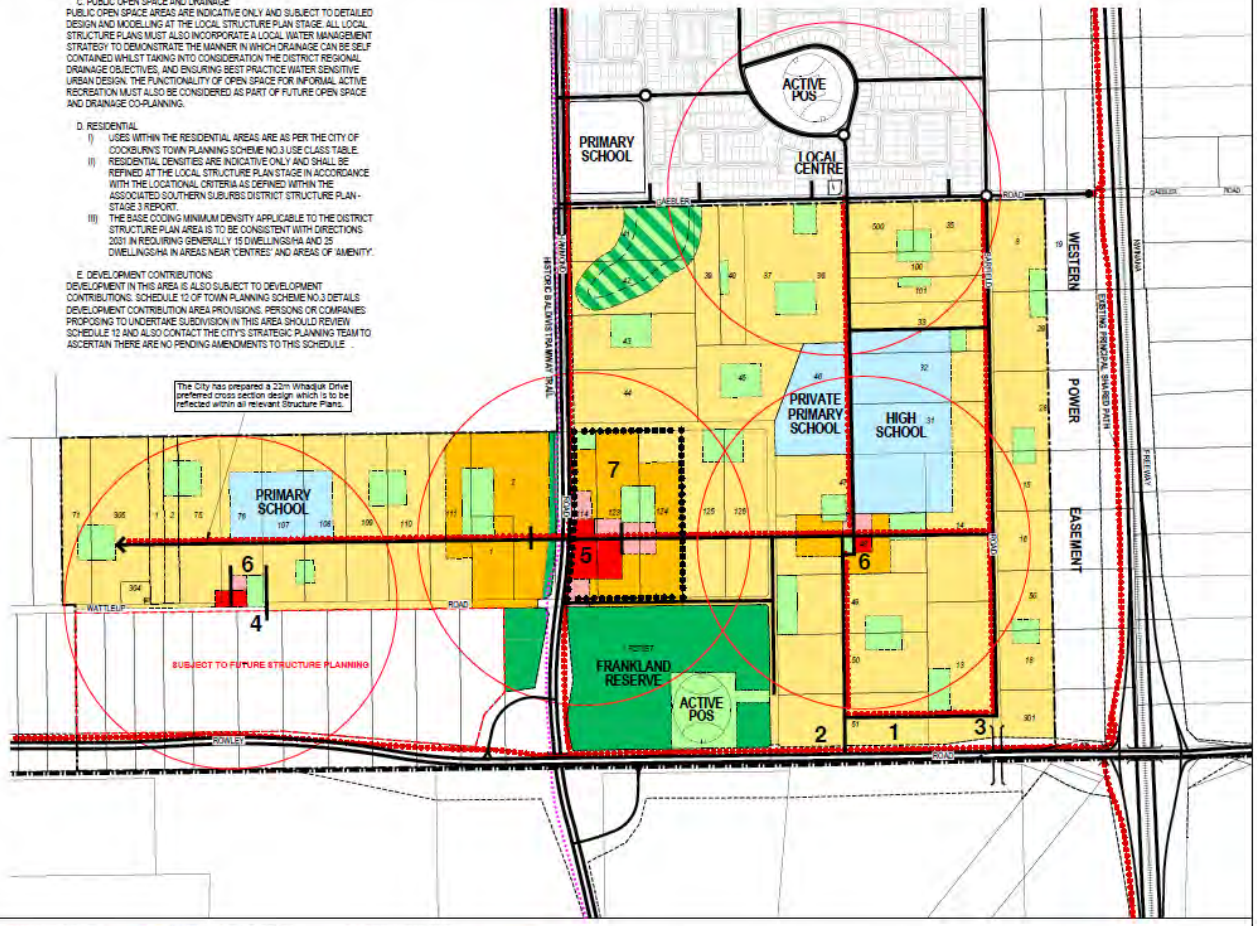
A. ALL LOCAL STRUCTURE PLANS MUST INCLUDE AND BE INFORMED BY:
- I) DETAILED LWMS BASED UPON REGIONAL DRAINAGE STUDY,
- II) DETAILED NOISE MANAGEMENT STRATEGY WHERE LSPAD JOINS ROWLEYROAD,
- III) FIRE MANAGEMENT PLAN WHERE LSP IS LOCATED NEAR ROS OR SIGNIFICANT POS,
- IV) FLORA AND FAUNA MANAGEMENT PLAN,
- V) TRAFFIC MANAGEMENT PLAN,
- VI) CONTAMINATED SITES & ACID SULPHATE SOILS MANAGEMENT PLAN WHERE REQUIRED,
- VII) HERITAGE STUDY WHERE LSP INCLUDES FORMER HISTORIC TRAMWAY,
- VIII) TRANSITION AND/OR INTERFACE STRATEGY IN RESPECT OF EXISTING RURAL USES,
- IX) NEIGHBOURHOOD CENTRE CONCEPT PLAN AND DETAILED AREA PLAN WHERE INCLUDED WITHIN LSP AREA,
- X) NEIGHBOURHOOD NODE CONCEPT PLAN AND DETAILED AREA PLAN.

B. LOCAL STRUCTURE PLANS
SUBDIVISION AND DEVELOPMENT OF THE SUBJECT AREA IS TO BE IN ACCORDANCE WITH AN ENDORSED APPLICABLE LOCAL STRUCTURE PLAN.

C. PUBLIC OPEN SPACE AND DRAINAGE
PUBLIC OPEN SPACE AREAS ARE INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN AND MODELLING AT THE LOCAL STRUCTURE PLAN STAGE. ALL LOCAL STRUCTURE PLANS MUST ALSO INCORPORATE A LOCAL WATER MANAGEMENT STRATEGY TO DEMONSTRATE THE MANNER IN WHICH DRAINAGE CAN BE SELF CONTAINED WHILST TAKING INTO CONSIDERATION THE DISTRICT REGIONAL DRAINAGE OBJECTIVES, AND ENSURING BEST PRACTICE WATER SENSITIVE URBAN DESIGN. THE FUNCTIONALITY OF OPEN SPACE FOR INFORMAL ACTIVE RECREATION MUST ALSO BE CONSIDERED AS PART OF FUTURE OPEN SPACE AND DRAINAGE CO-PLANNING.

D. RESIDENTIAL
- I) USES WITHIN THE RESIDENTIAL AREAS ARE AS PER THE CITY OF COCKBURN'S TOWN PLANNING SCHEME NO.3 USE CLASS TABLE.
- II) RESIDENTIAL DENSITIES ARE INDICATIVE ONLY AND SHALL BE REFINED AT THE LOCAL STRUCTURE PLAN STAGE IN ACCORDANCE WITH THE LOCATIONAL CRITERIA AS DEFINED WITHIN THE ASSOCIATED SOUTHERN SUBURBS DISTRICT STRUCTURE PLAN - STAGE 3 REPORT.
- III) THE BASE CODING MINIMUM DENSITY APPLICABLE TO THE DISTRICT STRUCTURE PLAN AREA IS TO BE CONSISTENT WITH DIRECTIONS 2031 IN REQUIRING GENERALLY 15 DWELLINGS/HA AND 25 DWELLINGS/HA IN AREAS NEAR 'CENTRES' AND AREAS OF 'AMENITY'.

E. DEVELOPMENT CONTRIBUTIONS
DEVELOPMENT IN THIS AREA IS ALSO SUBJECT TO DEVELOPMENT CONTRIBUTIONS. SCHEDULE 12 OF TOWN PLANNING SCHEME NO.3 DETAILS DEVELOPMENT CONTRIBUTION AREA PROVISIONS. PERSONS OR COMPANIES PROPOSING TO UNDERTAKE SUBDIVISION IN THIS AREA SHOULD REVIEW SCHEDULE 12 AND ALSO CONTACT THE CITY'S STRATEGIC PLANNING TEAM TO ASCERTAIN THERE ARE NO PENDING AMENDMENTS TO THIS SCHEDULE .



City of Cockburn

GNA 1 /1/2015

0 200m
Scale

Residential Density
- High
- Medium

- Local Centre (Pedestrian Based Retail)
- Mixed Business/Commercial/ Home Based Business
- Community Facilities/ Schools etc
- Conservation Category Wetland* **In accordance with DEC Geomorphic Wetlands Swan Coastal Plain dataset*

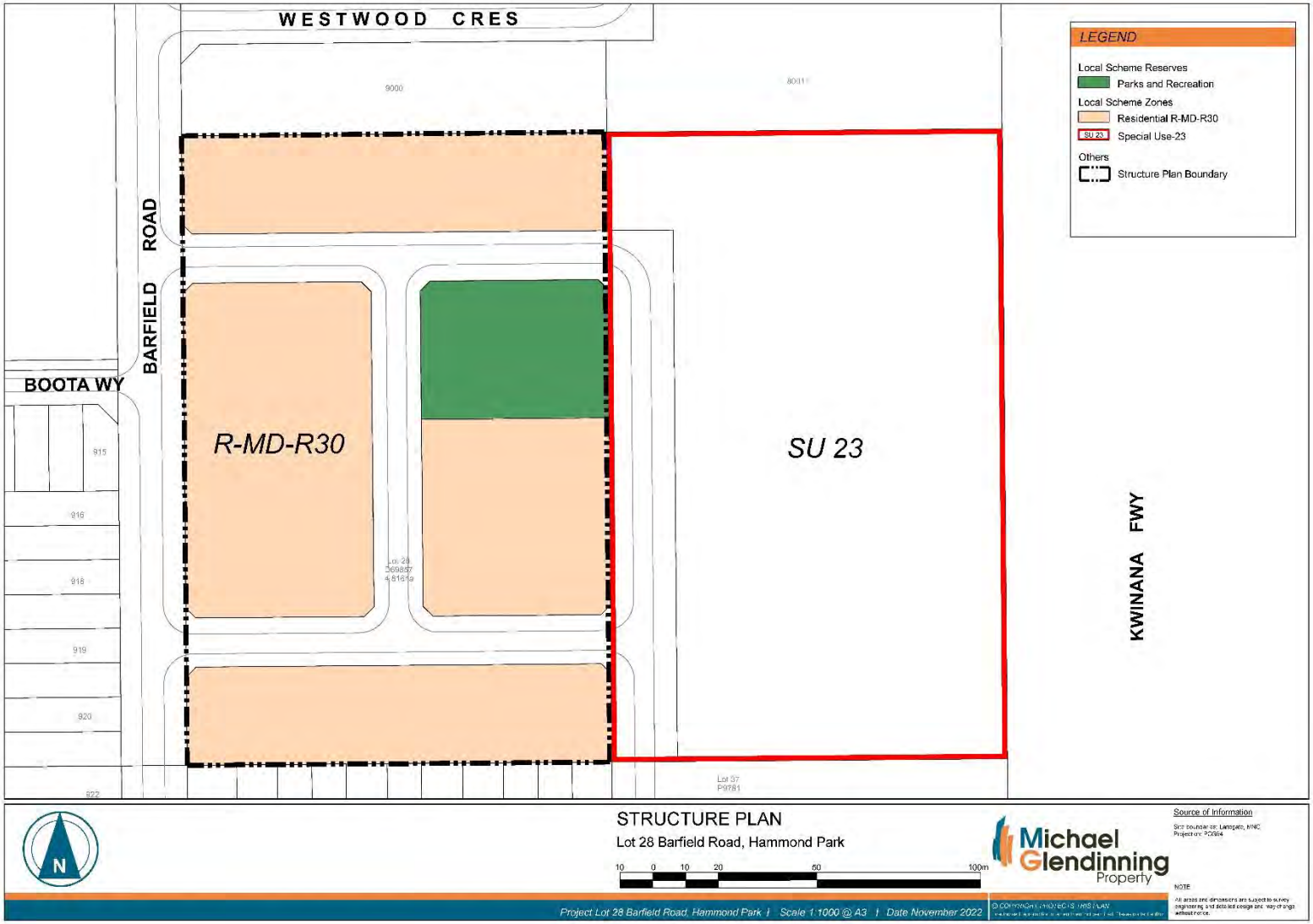
Key Open Space Areas:
- Public Open Space
- Regional Open Space

- Key Road Structure (Existing and Proposed)
- Major Shared Path
- Historic Baldivis Tramway Trail
- 400m Walkable Catchment
- Central Precinct

SOUTHERN SUBURBS DISTRICT STRUCTURE PLAN
- STAGE 3, HAMMOND PARK / WATTLEUP

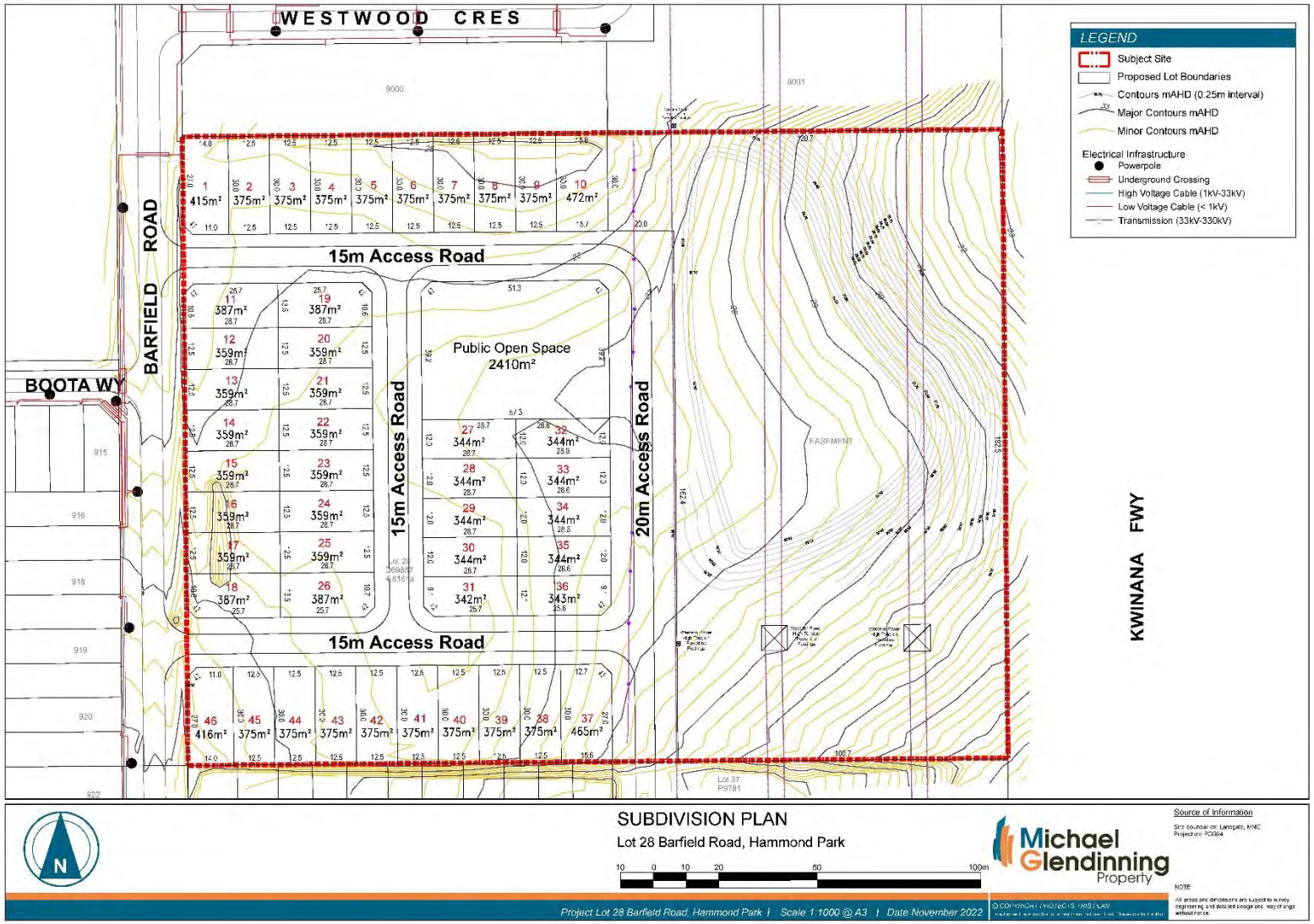
Appendix B

PROPOSED STRUCTURE PLAN


WESTWOOD CRES
BARFIELD ROAD
BOOTA WY
R-MD-R30
SU 23
KWINANA FWY
LEGEND
Local Scheme Reserves
Parks and Recreation
Local Scheme Zones
Residential R-MD-R30
SU 23
Special Use-23
Others
Structure Plan Boundary
STRUCTURE PLAN
Lot 28 Barfield Road, Hammond Park
10 0 10 20 50 100m
Michael Glendinning Property
Source of Information
NOTE
Project Lot 28 Barfield Road, Hammond Park | Scale 1:1000 @ A3 | Date November 2022

Appendix C

INDICATIVE SUBDIVISION LAYOUT


WESTWOOD CRES
BARFIELD ROAD
BOOTA WY
15m Access Road
15m Access Road
15m Access Road
20m Access Road
Public Open Space
2410m²
KWINANA FWY
EASEMENT
LEGEND
Subject Site
Proposed Lot Boundaries
Contours mAHD (0.25m interval)
Major Contours mAHD
Minor Contours mAHD
Electrical Infrastructure
Powerpole
Underground Crossing
High Voltage Cable (1kV-33kV)
Low Voltage Cable (< 1kV)
Transmission (33kV-330kV)
N
SUBDIVISION PLAN
Lot 28 Barfield Road, Hammond Park
10 0 10 20 50 100m
Michael Glendinning Property
Source of Information
NOTE
Project Lot 28 Barfield Road, Hammond Park | Scale 1:1000 @ A3 | Date November 2022

Appendix 5: Engineering Services Report

Development Engineering Consultants

DEVELOPMENT
ENGINEERING
CONSULTANTS

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Pro1022ServRep301122.doc

CONDOR NOMINEES PTY LTD
LOT 28 BARFIELD ROAD, HAMMOND PARK
ENGINEERING SERVICES REPORT

1. General:

The subject site is approximately 4.8 hectares in size and is located on the eastern side of Barfield Road and abuts the western side of the Kwinana Freeway in the suburb of Hammond Park

The western portion of Lot 28, comprising approx. 2.5ha which is zoned 'Development' under the City of Cockburn's TPS No.3 is to be ultimately developed into up to 46 residential lots. The eastern portion of Lot 28 is zoned Special Use and is subject to a Western Power easement which accommodates transmission lines abutting the freeway.

This report covers existing and proposed services, plus proposals for earthworks, retaining walls, roads, drainage, groundwater, water supply, sewerage, power supply, gas, telecommunication as required for current urban development standards.

2. Executive Summary

The land the subject of this report is located on the eastern side of Barfield Road in the City of Cockburn, some 750m north of Rowley Road and just north of the intersection between Whadjuck Drive and Barfield Road and opposite the intersection of Boota Way. It can be easily developed immediately by extending all required services from the abutting road.

In the mid to late 1980's the front portion of the lot was cleared and a house and outbuildings were constructed. Having purchased Lot 28 in 2005, Condor Nominees demolished the house and outbuildings in 2017. That area remains cleared and the area beneath the power lines has been "parkland cleared". In December 2021 an EPBC referral proposing further clearing of remnant vegetation was deemed "not a controlled action" by the federal Department of Agriculture, Water and the Environment, thereby allowing development to proceed in due course.

The land is currently vacant. The eastern portion of the site accommodates a large Western Power transmission easement which is occupied by a single 132KV power line and two 330KV double circuit lines. Limited development can occur within the easement subject to Western Power's approval and compliance with their easement conditions which limit the height of any structures higher than the natural ground levels can be erected and vegetation.

Barfield Road abuts the site on its western boundary. The road is currently unkerbed on its eastern side and on both sides north of Boota Way and has been kerbed on its western side as part of the adjoining "Vivente" development. Although it is in good condition it

will required to be upgraded, kerbed on its eastern side and "urbanized" as part of the development works.

The development will entail earthworks largely via a cut to fill balance to provide level, free draining building blocks with low to medium height retaining walls. It is proposed to shape the area beneath the power lines to level to potentially create an area of recreation space subject to negotiations with the City of Cockburn and the WAPC. Permission has been granted from Western Power Transmission Section for this to occur.

No drainage function is proposed, as the adjoining development has a large drainage basin and significant unused area occupied by the power lines which has spare capacity to accommodate drainage.

According to the measured levels and comparison with surrounding, the groundwater level at the site generally has a peak level at RL23.3m AHD at the Barfield Road rising to around RL23.7m AHD at the western side of the power easement. The site levels rise from RL25.5m AHD in the north west corner of the site to around RL34mAHD in the south eastern corner of the site abutting the Kwinana Freeway providing a minimum clearance to peak groundwater of some 2.1m.

The land can be connected to all services, either by extension and upgrading from existing infrastructure in Barfield Road. Power, telephone, gas, sewer and water services already pass along the site frontage.

It is proposed that all road stormwater from the development up to and including the 1% AEP (1 in 100yr) event will be conveyed to the existing drainage basin to the north of the site. Houses will discharge roof stormwater into on site soakwells.

There is some 3-4 m fall across the western portion of the site where development is proposed hence retaining wall be required to terrace the allotments to suit the terrain and provide level building blocks.

3. Site

The land the subject of this report is located on the eastern side of Barfield Road and west of the Kwinana Freeway in the City of Cockburn, some 750m north of Rowley Road and just north of the intersection between Whadjuck Drive and Barfield Road. The site levels rise from RL25.5m AHD in the north west corner of the site to around RL34mAHD in the south eastern corner of the site abutting the Kwinana Freeway.

The geology of the land is described by the Environmental Geology Map of the Geological Survey of WA, as "S8 Bassendean sand".

The site is adjacent Water Corporation sewer and scheme water, as well as telephone, gas and power. Access is from the existing abutting sealed road being Barfield Road. Historically, the site had its driveway off Barfield just north of its southern boundary. Baldivis Road and Fifty Road abutting the site are both constructed to rural standard, and are of fair quality, having been built many years ago. A path is located along the western verge of Barfield Road where the land to the west has been developed.

A major fibre optic cable is located on the western side of the power easement which will be incorporated within the future road. All existing services are available for

connection, including a 110PE High Pressure gas, 150mm water main and 150mm sewer on the western side of Barfield Road.

Aerial power lines are located along the on the opposite side of the road to the site.

4. Development Proposal

It is proposed to develop the western portion of Lot 28 ultimately as up to 46 residential lots with an average area of some 390sqm in accordance with its "Development" zoning and compliance with the City of Cockburn's "Southern Suburbs District Structure Plan" which prescribes a minimum density of 15 dwellings/ha, with the proposed 46 lots delivering a density of 18.4 dwellings/ha.

Access to the proposed subdivision will be by way of two new subdivisional roads off Barfield Road, with the centrelines of each road being 37.5 metres from the southern and northern boundary of the site. All lots on Barfield Road currently have direct frontage and as such, some 8 lots of this development with front directly to Barfield Road.

The development will be provided with all normal services, with links to abutting developments for sewer, water, power, roads, gas and telephone services, with all drainage to be disposed on site via soakage.

5. Earthworks & Retaining Walls

The development will entail earthworks largely via a cut to fill balance to provide level, free draining building blocks with low to medium height retaining walls. It is proposed to shape the area beneath the power lines to level to potentially create an area of recreation space subject to negotiations with the City of Cockburn and the WAPC . Permission has been granted from Western Power Transmission Section for this to occur.

Earthworks will essentially cut from the eastern portion of the site and fill the western portion of the site and terrace between the high level to the south-east to the lower level at the north-west.

Some medium height retaining walls will be required to terrace the levels and ensure level building blocks.

All retaining walls will be subject to Council building approval.

Earthworks on site will entail removal of topsoil, cut and fill. No import of fill is likely to be required.

6. Roads

All new subdivisional roads will be constructed to City of Cockburn standards and approval, including kerbing and piped drainage plus provision of footpaths as required. Access to the site will be by way of new subdivisional roads off Barfield Road, located approximately 40 metres north and 80 metres south of Boota Way.

The existing Barfield Road is an 6.5m wide asphalt road. The western part of the road south of Boota Way has been developed and kerbed and the whole of the road in fair condition. The upgrading is envisaged to involve kerbing and drainage for the eastern side of the road and the whole of the portion north of Boota Way.

7. Drainage

Drainage from the whole site will be wholly contained within the proposed drainage basin located in the existing basin east of Westwood Crescent in the northern development.

Lot drainage will be self-contained in soakwells. The known soil characteristics of the site will allow site soakage.

Stormwater design will be done to the standards of the City of Cockburn, and as detailed in the Local Water Management Strategy (LWMS) submitted with the structure plan documentation, and the Urban Water Management Plan (UWMP) which will be done in conjunction with the detailed subdivision design.

8. Groundwater

The groundwater level at the site is expected to peak at a maximum RL21m AHD, based on peripheral groundwater investigations plus on site measurements. This is not expected to impinge in any way on the development of the site, being some 4.5 metres below the expected lowest lot level at RL25.8mAHD.

9. Power

Sufficient power supply exists in the area to supply the development. A high and low voltage aerial power line is located along the eastern verge Barfield Road. Underground cables have been installed as part of the development west of Barfield Road which provide opportunity for extension.

Any existing aerial lines along Barfield Road are likely to be removed. No connections will be permitted from the existing HV power lines in the power easement.

All subdivisional power reticulation lines and transformer installations will be constructed at the cost of the developer. Transformer sites will be determined at the detailed subdivision design stage.

10. Water Supply

Sufficient water supply exists in the area to service this development.

At present there is a 150mm reticulation water main located along the western verge of Barfield, to which the development will be connected.

11. Sewer

The site is not currently connected to sewer, although a reticulation sewer main is located along the eastern verge of Barfield Road, to which it is proposed to connect.

The 250mm “Darling Chase” sewer pressure main is located along the eastern verge of Barfield Road abutting the development.

The site sewer connection will be made by connecting a 150mm reticulation sewer under Barfield Road to the existing sewer scheme. Internal sewers will allow for future extensions to abutting properties as required.

12. Telephone & NBN

Telstra underground infrastructure services exist adjacent to the site along the frontage to the site in Barfield Road. This will be extended or upgraded to service this proposed development.

OPTUS Fibre Optic cables are located to the east of the site in the Western Power easement, which will be incorporated within the future road reserve. Caution will need to be taken with subdivisional services connections and road construction where the road and services are constructed in close proximity to this cable.

Telstra has advised that its network has the capacity to absorb the likely incremental customers from this proposal, there are no known quality issues at the site with the Telstra network, and there are no identified Telstra Wireless upgrade needs in the immediate area.

In accordance with recent requirements, the developer is required to install NBN "pipe and pit" to allow for future installation of cables for the NBN. The design of the "pipe & pit" is the responsibility of the developer, and will be designed in conjunction with the underground power network, and installed during the construction phase of the development.

13. Gas

An existing 150mm high pressure gas main is located on the western side of Barfield Road. It is expected that reticulated gas services will be extended into this development by ATCO in the normal way, with trenching done by the developer.

DEVELOPMENT ENGINEERING CONSULTANTS PTY LTD

THIS REPORT IS DATED 30TH NOVEMBER 2022.

Appendix 6: Transportation Noise Assessment

Lloyd George Acoustics

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Transportation Noise Assessment

Lot 28 (#157) Barfield Road, Hammond Park

Reference: 21056361-02b

Prepared for:
Condor Nominees Pty Ltd

Report: 21056361-02b

Lloyd George Acoustics Pty Ltd

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Date:	Rev	Description	Prepared By	Verified
10-Nov-21	0	Issued to Client	Terry George	Matt Moyle
2-Dec-21	A	Updated with additional wording in Conclusion	Terry George	-
1-Dec-22	B	Updated subdivision plan	Terry George	-

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Appendices

1 INTRODUCTION

It is proposed to subdivide Lot 28 (#157) Barfield Road, Hammond Park into residential lots. The location of the overall lot is shown in *Figure 1-1*, with the proposed subdivision plan shown in *Figure 1-2*. This report considers the impact of future road traffic noise from the Kwinana Freeway to the proposed subdivision.

Figure 1-1 Proposed Subdivision Location

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

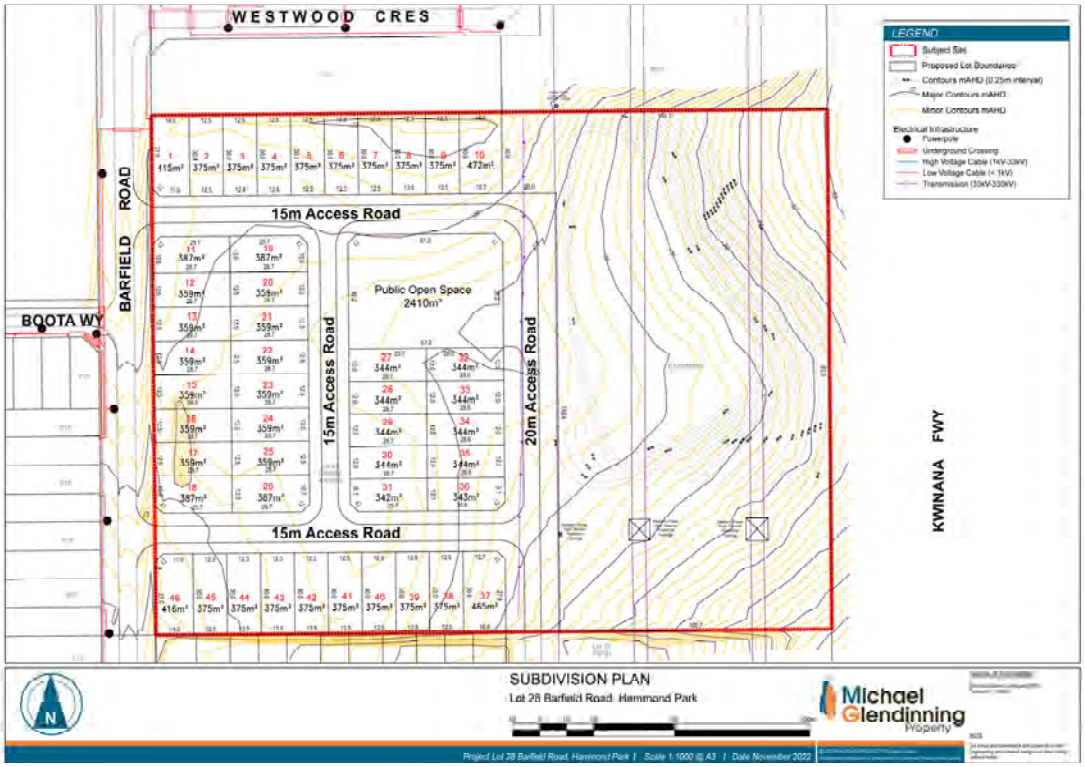


Figure 1-2 Proposed Subdivision

2 CRITERIA

The criteria relevant to this assessment 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). 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

Outdoor Noise Target		Indoor Noise Target	
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 the 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 is undertaken.

In the application of the noise targets, the objective is to achieve:

- indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses and school classrooms); and
- a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and childcare centres, the design of outdoor areas should take into consideration the noise target.

It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets. Where transport noise is above the noise targets, measures are expected to be implemented that balance reasonable and practicable considerations with the need to achieve acceptable noise protection outcomes.

[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 generally in accordance with the requirements of SPP 5.4 and associated Guidelines[2] as described in *Section 3.1* and *Section 3.2*.

3.1 Site Measurements

Noise monitoring was undertaken alongside Kwinana Freeway in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instrument used was an ARL Type 316 noise data logger (S/N: 15-301-468), located 25 metres from the edge of the northbound on-road, with the microphone 1.4 metres above ground level (refer *Figure 3-1*). This monitoring was undertaken for a subdivision to the south, however is still valid for this site as a point of calibration. The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument 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 also holds current laboratory calibration certificate for the loggers.

Figure 3-1 Photograph and Location of Noise Logger

[2] Road and Rail Noise Guidelines, September 2019

3.2 Noise Modelling

The computer programme *SoundPLAN 7.3* 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 Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered;
- Note that a -8.0 dB correction is applied to the exhaust and -0.8 dB to the engine (based on Transportation Noise Reference Book, Paul Nelson, 1987), so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;
- Adjustments of -0.8 dB and -1.7 dB have been applied to the predicted levels for the 'free-field' and 'at facade' 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 m above ground floor level, representing single storey houses. The noise is predicted at 1.0 metre from an assumed building facade resulting in a +2.5 dB correction due to reflected noise.

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed in the following sections.

3.2.1 Ground Topography

Topographical and road design data for this project was on file from the previous projects in the area.

Buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. All buildings are assumed to be single storey with a height of 3.5 metres.

Indicative design levels were provided in May 2021 by Development Engineering Consultants and have been incorporated into the noise model.

3.2.2 Traffic Data

Traffic data includes:

- Road Surface – The noise relationship between different road surface types is shown in *Table 3-1*.

Table 3-1 Noise Relationship Between Different Road Surfaces

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 and future road surface for Kwinana Freeway is open graded asphalt and is expected to remain unchanged into the future.

- Vehicle Speed – The existing and future posted speeds for the main carriageways of Kwinana Freeway are 100km/hr.

- Traffic Volumes – Existing (2016) and forecast (2041) traffic volumes were provided by Main Roads WA (Thomas Ng, Traffic Modelling Analyst, Reference: #42030). More recent traffic data was also obtained from the Main Roads WA Traffic Map site. *Table 3-2* provides the traffic volume input data in the model.

Table 3-2 Traffic Information Used in the Modelling

Road	Scenario			
	Existing - 2020/21		Future - 2041	
	Northbound	Southbound	Northbound	Southbound
Kwinana Freeway – north of ramps	50,773 (16.0)	49,803 (12.5)	78,300 (11.0)	82,700 (10.0)
Kwinana Freeway – south of ramps	45,428 (13.6)	45,614 (13.1)	72,400 (9.0)	74,100 (9.0)
Ramps – north of Rowley Road	5,345 (36.4)	4,189 (6.0)	5,900 (25.0)	8,600 (20)

Numbers in brackets are % heavy vehicles.

3.2.3 Ground Attenuation

Ground absorption values vary from 0 to 1, with 0 representing hard, reflective surfaces such as water or bitumen and 1 representing absorptive surfaces such as grass. The ground attenuation has been assumed to be 0.2 (20%) within the road reserve, and 0.6 (60%) elsewhere across the study area, except for public open space, which was set to 1.00 (100%).

4 RESULTS

4.1 Noise Measurements

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

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Wednesday 13 October 2021	*72.0*	*70.5*	*70.9*	*69.7*
Thursday 14 October 2021	70.4	68.3	69.1	66.4
Friday 15 October 2021	70.9	68.7	69.6	65.9
Saturday 16 October 2021	*69.7*	*66.7*	*67.8*	*63.0*
Sunday 17 October 2021	*69.0*	*66.1*	*67.5*	*60.5*
Monday 18 October 2021	69.9	67.7	68.6	65.4
Tuesday 19 October 2021	*72.9*	*70.8*	*71.4*	*69.5*
Wednesday 20 October 2021	*72.1*	*69.5*	*70.3*	*67.1*
Thursday 21 October 2021	70.6	68.6	69.2	67.3
Weekday Average	**70.4**	**68.3**	**69.1**	**66.2**

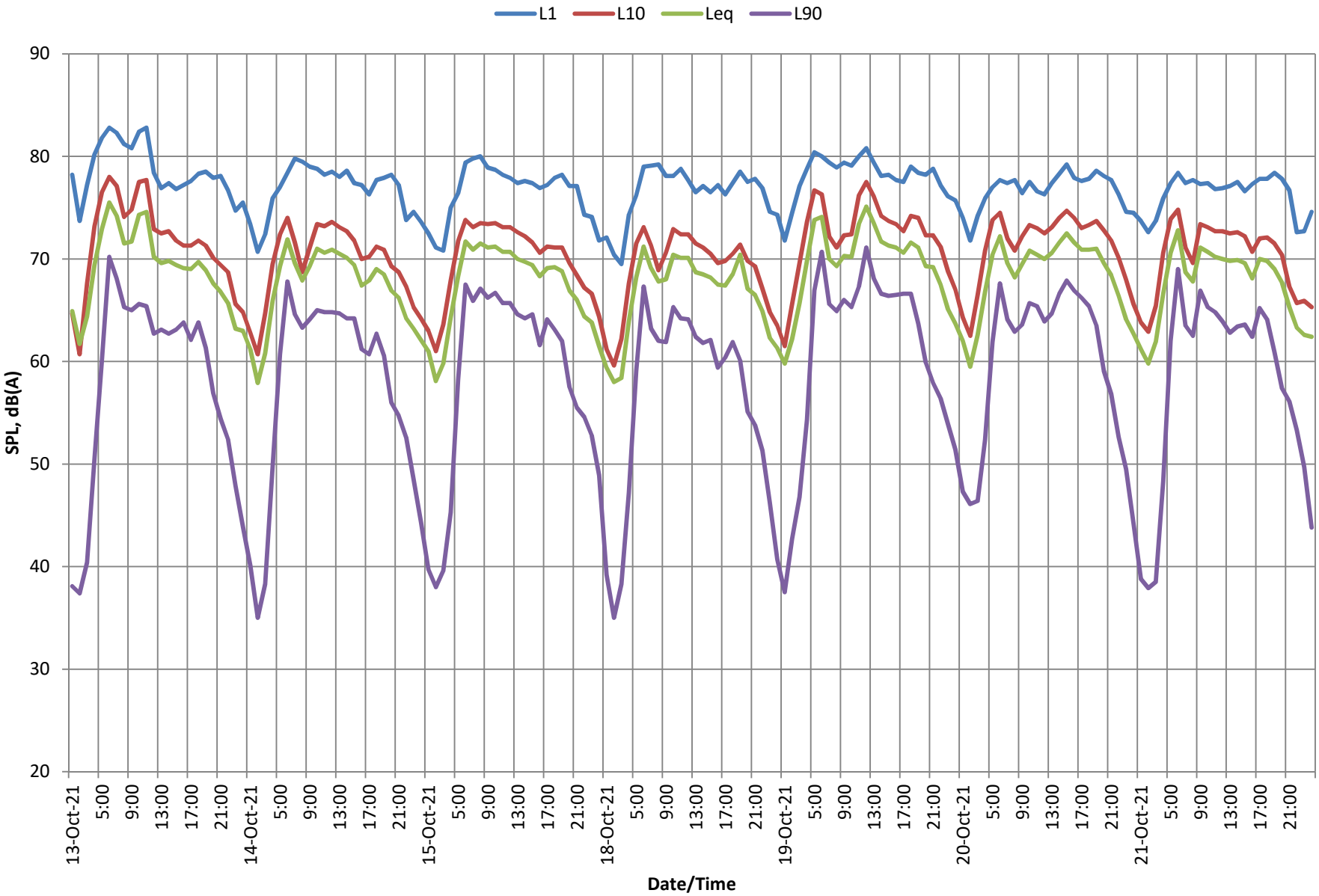
* Those shown in shaded italics are not used in average due to poor weather or not being a weekday.

The average difference between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 2.9 dB and this conversion has been used in the modelling. This same difference has been assumed to exist in future years. As such, it is the $L_{Aeq(Night)}$ noise levels that will dictate compliance, since these are within 5 dB of the daytime levels.

4.2 Noise Modelling

The noise model is initially set-up and calibrated for existing conditions. It is then updated to reflect future conditions incorporating the proposed development and future traffic volumes with the results provided in *Figure 4-2* as an $L_{Aeq(Night)}$ noise level contour plot.

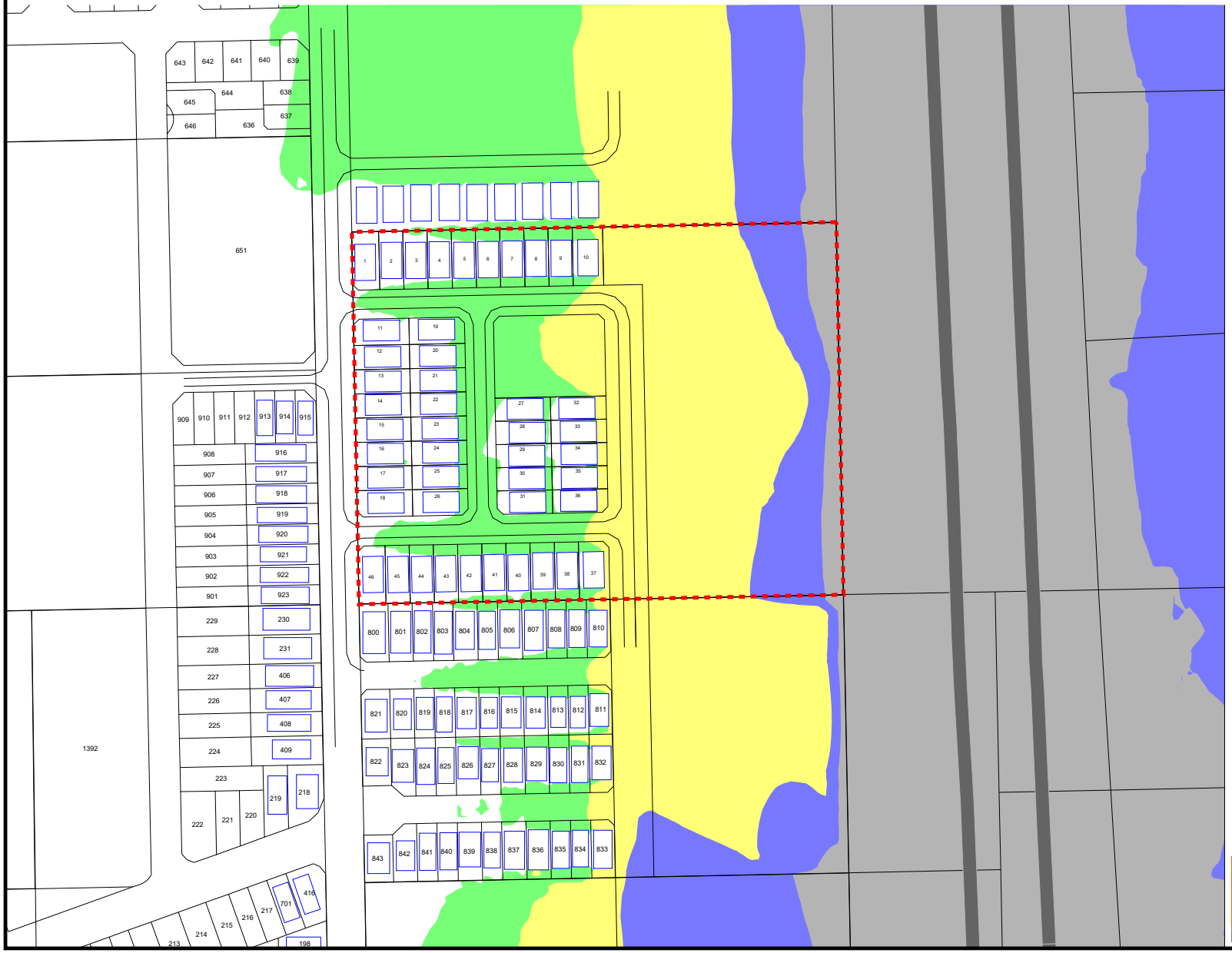
Figure 4-1: Noise Monitoring Alongside Kwinana Freeway



Lot 28 Barfield Road, Hammond Park - Proposed Subdivision

LAeq(Night) Noise Level Contours - Future

Figure 4-2



Noise levels

$L_{Aeq(night)}$ dB

<= 50		
<= 51		Exposure A
<= 52		
<= 53		
<= 54		Exposure B
<= 55		
<= 56		
<= 57		
<= 58		Exposure C
<= 59		
<= 60		
<= 61		
> 61		Exposure D+

N

Signs and symbols

- Road Lanes
- Building
- Subject Site

1 December 2022

Length Scale 1:3000

0 15 30 60 90 120 m

Lloyd George Acoustics
by Terry George
terry@lgacoustics.com.au
(08) 9401 7770

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 school classrooms); 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 controls are necessary.

With reference to the predicted noise levels in *Section 4.2*, it is evident the outdoor noise target will be exceeded at some lots. As such, the following is recommended:

- Where lots are above the outdoor noise target (refer *Figure 5-1*), the following Packages (refer *Appendix A*) are required:
    - Package A where noise levels are between 51 dB and 53 dB $L_{Aeq(Night)}$;
    - Package B where noise levels are between 54 dB and 57 dB $L_{Aeq(Night)}$;

      Alternative constructions from the deemed to satisfy packages may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant (member from of the Association of Australasian Acoustical Consultants (AAAC)), once the lots specific building plans are available.
- All affected lots are to have notifications on lot titles as per SPP 5.4 requirements – refer *Appendix A*.
- Where a dwelling is to be more than one storey, a specific house assessment is to be undertaken by a suitably qualified acoustical consultant.

With regard to the northeast and southeast most lots, these are within Exposure B and therefore will be required to:

- Provide an outdoor living area that is screened by the house from the road (i.e. outdoor living area on west side); or
- Screen the outdoor living area using a 2.4 metre high wall. Wall to be of a material having a minimum surface mass of 15 kg/m^2.

The lots between the northeast and southeast most lots that are also Exposure B, front the local road so will naturally have their outdoor living area on the side of the house opposite the corridor.

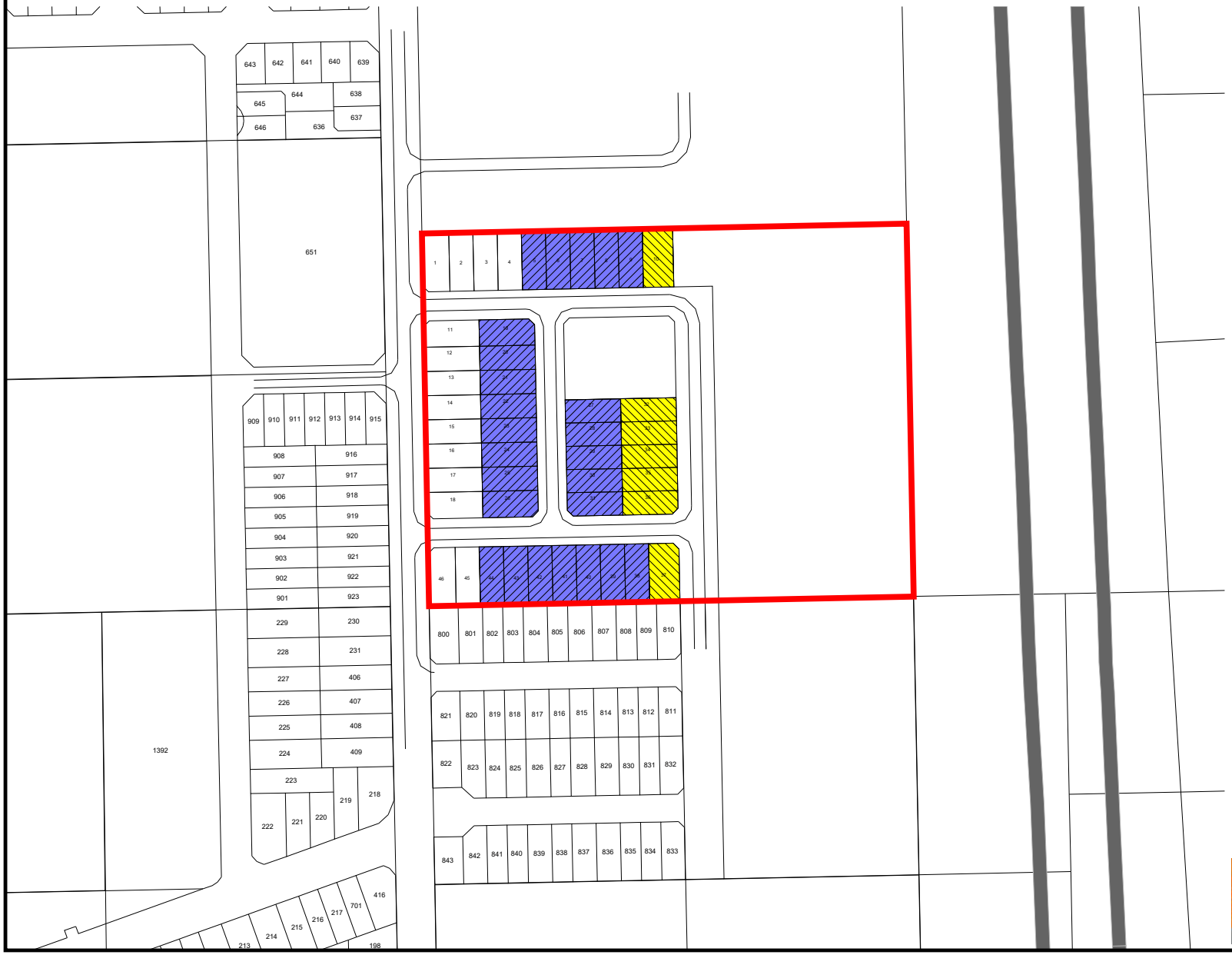
With regard to Lots within Exposure A, noise levels are only marginally above the outdoor noise target and therefore, whilst preference can be given to locating the outdoor living area on the opposite side of the dwelling to the corridor, this is not considered mandatory.

For all affected houses, it is recommended that purchasers be encouraged to undertake a house specific assessment. This is undertaken once the plans become available for the proposed dwelling. The advantage of this is the costs associated with the Package A and Package B upgrades can be significantly minimised. For instance, the Package B lots that face towards the Freeway will have a garage and likely one room at the front. Whilst the construction requirements to this front room will unlikely change from that nominated in Package B, it's likely that the requirements to the sides and rear of the dwelling would be significantly less due to additional screening from neighbouring dwellings not envisaged in the default packages. For the Package A lots, it is likely that only 1 or 2 façades are resulting in the dwelling being noise affected and hence, the construction requirements could again be reduced once the house plans are available.

Lot 28 Barfield Road, Hammond Park - Proposed Subdivision

Proposed Noise Mitigation

Figure 5-1



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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.

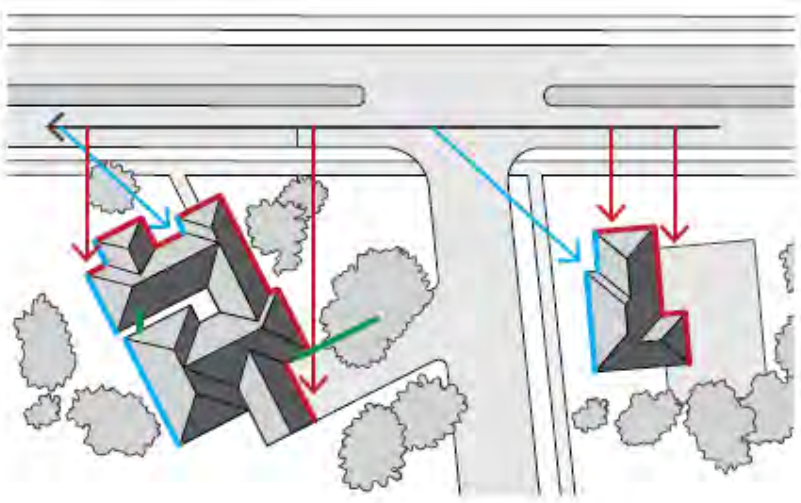
The quiet house packages are not the only solution to achieving acceptable internal transport noise levels. A suitably qualified acoustical engineer or consultant may also determine more tailored acoustic design requirements for buildings in a transport noise corridor by carrying out acoustic design in accordance with relevant industry standards. This includes the need to meet the relevant design targets specified in AS/NZS 2107:2016 for road traffic noise.

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 Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): o Sliding or double hung with minimum 10mm single or 6mm-12mm-10mm double insulated glazing; o Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$): o Sealed awning or casement windows with minimum 6mm glass.	• Up to 40% floor area ($R_w + C_{tr} \geq 25$): o 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 $R_w + C_{tr} \geq 25$: o 35mm Solid timber core hinged door and frame system certified to R_w 28 including seals; o 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	• $R_w + C_{tr} \geq 45$: o Two leaves of 90mm thick clay brick masonry with minimum 20mm cavity; or o Single leaf of 150mm brick masonry with 13mm cement render on each face; or o 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 11kgkg/m^3; and ▪ 2 x 16mm fire-rated plasterboard to inside.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: o Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard.	
Outdoor Living Areas		Where practicable, located outdoor living area on side of house opposite to corridor.	

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 Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): o Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): o Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): o Sliding or double hung with 6mm-12mm-10mm double insulated glazing; o 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 $R_w + C_{tr} \geq 28$: o 40mm Solid timber core hinged door and frame system certified to R_w 32 including seals; o 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	• $R_w + C_{tr} \geq 50$: o Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester (24kg/m^3). Resilient ties used where required to connect leaves. o Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m^3). o Single leaf of 220mm brick masonry with 13mm cement render on each face. o 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. o 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/m^3) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: o 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 and/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

In implementing the acceptable treatment packages, the following mechanical ventilation / air-conditioning considerations are required:

- Acoustically rated openings and ductwork to provide a minimum sound reduction performance of R_w 40 dB into sensitive spaces;
- Evaporative systems require attenuated ceiling air vents to allow closed windows;
- Refrigerant based systems need to be designed to achieve National Construction Code fresh air ventilation requirements;
- 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 and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

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

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

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

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

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.

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.

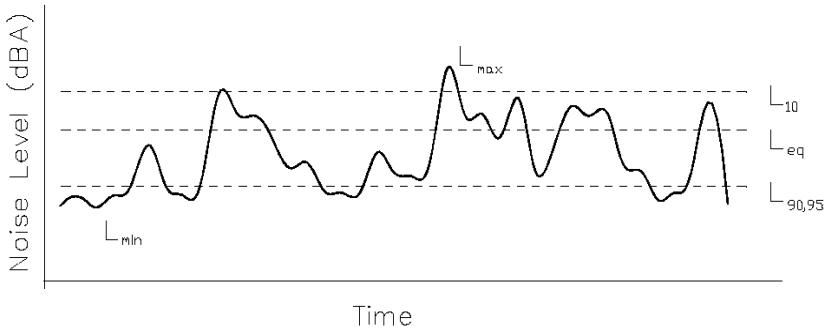
R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. 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.

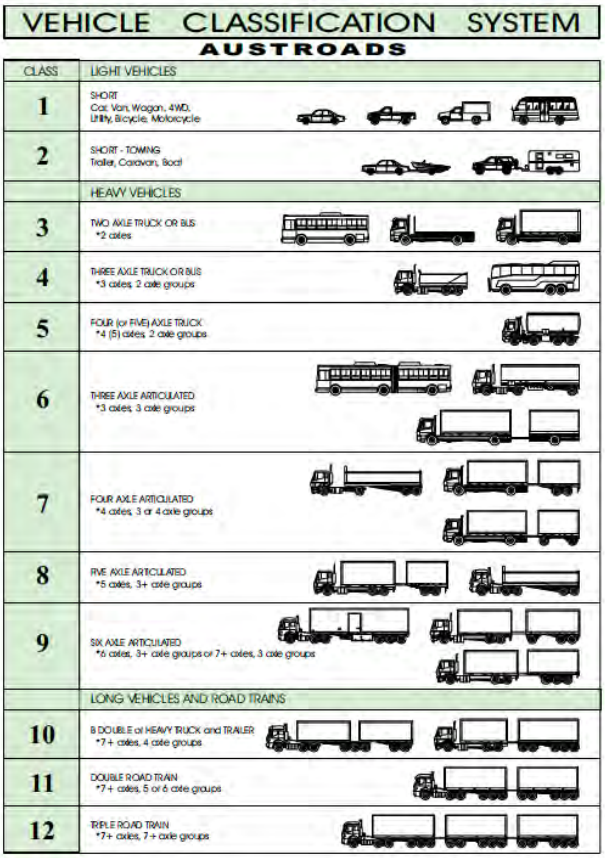
C_{tr}

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 -14 dB.

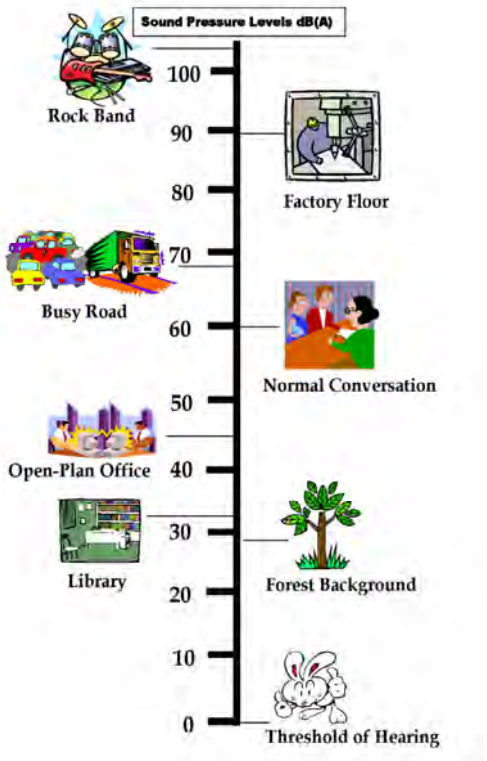
Chart of Noise Level Descriptors



Austroads Vehicle Class



Typical Noise Levels



Appendix 7: Public Open Space Landscape Concept

Plan E Landscape Architects

LEGEND

01 ROADSIDE EMBAYMENT PARKING

02 1500MM PEDESTRIAN FOOTPATH

03 2500MM PEDESTRIAN AND SERVICE ACCESS PATHS

04 SAND PLAY WITH FORT & RECYCLED SITE LOGS

05 RETAINED AND RESTORED BUSHLAND WITH WEED MANAGEMENT

06 SHELTER, BARBECUE & TABLE SETTING

07 IRRIGATED TURF

08 TIPUANA TIPU STREET TREES

09 PYRUS EDGEWOOD PARKLAND TREES

10 BUSHLAND SERVICE GATE AND FENCING

11 INSTU CONCRETE MOWING KERB

12 BENCH SEATING AND SITE FURNITURE

13 LOW SHRUB & GROUNDCOVER PLANTING


06


10


05


04


04


08


09

LOT 28 BARFIELD ROAD HAMMOND PARK

LANDSCAPE CONCEPT PLAN
OCTOBER 2023

JOB NO. 2303901
1:300 @ A3

C1.101

REV C

PLAN E
LANDSCAPE ARCHITECTS
L1, 278 RAILWAY PDE WEST LEEDERVILLE WA 60
T: (08) 9388 9566 E: mail@plane.com.au

Appendix 8: Western Power Easement Revegetation Plan and Methodology Statement

Coterra Environment

Lot 28 (157 Barfield Road) Revegetation Methodology

Revegetation Areas

It is proposed to undertake revegetation works over a 1.09 hectare area within the easement adjacent to Lot 28.

The area proposed for earthworks will be revegetated by the proponent to the requirements of the City of Cockburn as a condition of subdivision approval for the residential development. These revegetation works must also comply with conditions imposed on revegetation within easements by Western Power.

Revegetation Strategy and Completion Criteria

Baseline Flora and Vegetation Data

The site is historically representative of Beard Vegetation Association 1001, which is described as 'medium very sparse woodland; Jarrah, with low woodland; Banksia or Casuarina' (Beard et al, 2005) and the Bassendean Complex – Central and South (Heddle et al, 1980). The Bassendean Complex – Central and south is described as "woodland of jarrah (*Eucalyptus marginata*), *Allocasuarina fraseriana, Banksia attenuata, B. grandis* and *B. menziesii* on the sand dunes to low woodland of *Melaleuca preissiana, B. ilicifolia* and *B. littoralis* and sedgelands on the low-lying moister sites. This area includes the transition of jarrah to coastal blackbutt (*E. todtiana*) in the Perth vicinity and jarrah to marri (*Corymbia calophylla*) on the moister soils. Other plant species include *Kunzea ericifolia, Hypocalymma angustifolium, Adenanthos obovatus* and Verticordia species (Heddle et al, 1980).

A detailed vegetation and flora survey was undertaken on the site (Coterra, 2017) in accordance with relevant government guidance (EPA, 2016a). Two vegetation types were observed on the site, as follows:

- An Open Low Forest of *Banksia attenuata, B. ilicifolia* and *B. menziesii* with scattered *Allocasuarina fraseriana* over Open Tall Shrubland to Tall Shrubland of *Xanthorrhoea preissii*, with occasional pockets of *Kunzea glabrescens* tall shrubs, over Open Shrubland to Shrubland of *Stirlingia latifolia* over Open Low Shrubland of *Hibbertia hypericoides* or *Hypocalymma robustum* and *Bossiaea eriocarpa* or over a mixed Sedgeland/Herbland including *Phlebocarya ciliata*, and/or *Desmocladus flexuosus* and *Lepidosperma squamatum* on midslope flats, on loamy sands, was recorded predominantly in the western portion of the subject area.
- Scattered *Banksia menziesii* and *B. ilicifolia* over Shrubland to tall Shrubland of *Adenanthos cygnorum* over Open Grassland of introduced species **Ehrharta calycina* with scattered native low shrubs, on midslope sandy flats was recorded predominantly in the eastern portion of the subject area.

Current Site Condition

The proposed revegetation area comprises vegetation in 'Completely Degraded' to 'Degraded' condition, representative of the 'Scattered Banksia Shrubland, detailed above. The proposed revegetation area is not representative of Banksia Woodland.

Plate 1: Vegetation and weed presence

Plate 2: Typical vegetation within easement

Bushfire Management

Given the site is in a bush fire prone area, a Bushfire Management Plan has been prepared for the site by Smith Bushfire Consultants, in accordance with the following:

- State Planning Policy 3.7 – Planning in Bushfire Prone Areas (WAPC, 2015b)
- Guidelines for Planning in Bushfire Prone Areas (WAPC, 2021).

Reference should be made to the Bushfire Management Plan for specific bushfire management details. In relation to the revegetation area, the following key components should be noted:

- The revegetation area within the easement area has been classified as Class D - Scrub as per the Australian Standard 3959 Construction of Buildings in Bushfire-Prone Areas (AS 3959).
- The species that will be chosen for revegetation will meet the AS 3959 criteria for Scrub and that no more than 10% of the overstorey vegetation is accommodated.
- As per the Bushfire Management Plan, the City of Cockburn have agreed to accept responsibility for the future management of the scrub vegetation and its height maintenance.
- The land directly east and north (both abutting the 20m road reserve) will be grassed and managed as low threat vegetation as per AS 3959.

Revegetation Methodology

The proposed revegetation methodology will generally comprise the following:

Clearing and Topsoil Removal

Clearing will be undertaken within the easement to facilitate development on Lot 28.

Clearing activities will be undertaken in accordance with engineering requirements for the site.

Topsoil will be removed and stored on site, for re-use in revegetation areas. It should be noted that topsoil may produce native germinates that grow above the 3 m height limitation, and as such, these may need to be destroyed.

Slope and Surface Stabilisation

Slope and surface stabilisation will be conducted using either of the following:

- collection of in-situ (cleared and felled) mulched vegetation will be undertaken prior to earthworks on the site
- installation of coir netting, if required
- application of a dust suppression product (such as Gluon).

The actual methodology may involve a combination of the above techniques. These actions will be undertaken after clearing.

Species Selection

The Western Power Transmission Easement Notice, states that no vegetation exceeding 1 m in height from the natural surface of the land should be grown, cultivated or maintained within the easement (Western Power, undated).

Given the easement will be excavated, Western Power has provided written consent (dated 17 April 2023) for the revegetation height restriction to be lifted to 3m. Appendix 1 presents the proposed revegetation species list which is based on vegetation within the general location, reflective of Banksia Woodland and the application of a 3m height restriction within the Western Power easement.

Site Preparation

Soils within the revegetation area will be ripped to 500 mm prior to planting, if possible, depending on slope. If the site has steep batters, ripping may not be possible in these locations, and alternative methods for site preparation will be implemented.

Planting Techniques

Tubestock planting will be undertaken at a rate of 1.6 plants/m^2.

Tubestock will be sourced from accredited Dieback-free local nurseries. Where possible, local provenance material (within 50 km of the site) will be used.

Where revegetation areas cannot be fenced (below), corflute tree guards will be installed after planting. Tree guards will be removed in the first summer after planting, only if it is determined that the rabbit population will not severely impact planting (pers. comm James Lawton, 7 December 2021).

Weed Control

It is proposed that weed control works be undertaken in areas of retained vegetation to improve the quality and condition of vegetation. Weed control works will be implemented in all areas of retained vegetation as follows pre- and post-planting.

Pre-planting weed control will comprise:

- initial spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in autumn, 2-4 weeks prior to winter planting.

Post-planting weed control will comprise:

- spot-spraying of broad spectrum herbicide application (i.e. Glyphosate) in late winter/spring following planting to allow for additional removal of weeds prior to flowering and seed propagation
- broad spectrum herbicide application (i.e. Glyphosate) in summer, to coincide with summer active weeds
- annual winter/spring broad spectrum herbicide application (i.e. Glyphosate), as required
- annual summer broad spectrum herbicide application (i.e. Glyphosate), as required.

Access and Fencing

Suitable fencing (1.2 m high with rabbit netting) will be installed around revegetation areas to manage inadvertent access to the areas. In accordance with the Transmission Easement Notice, this fence must be earthed to the satisfaction of Electricity Networks Corporation in the case of a metallic fence or trellis (Western Power, undated). Fencing will not be installed to the detriment of access to Western Power infrastructure.

Signage

Signage will be installed adjacent to revegetation areas to advise "No Entry – Revegetation Area".

Bushfire management

The proposed revegetation area will have no more than 10% of the overstorey vegetation within the revegetation area located in the easement. The Revegetation Plan, which will be prepared following subdivision approval, will provide further detail on the planting regimes and how this will be accomplished.

Completion Criteria

Completion criteria for the revegetation areas has been determined on the basis of revegetation guidelines developed by the neighbouring City of Cockburn (2017; Table 1).

Table 1: Success Criteria for Revegetation Works

Assessment Parameter	Method	Completion Criteria
Seedling survival	5 m x 5 m quadrats Photo points/monitoring	1.6 plants/m^2 for dryland species
Species representation	5 m x 5 m quadrats/transects Photo points/monitoring	75% of dryland species
Weed cover	5 m x 5 m quadrats Photo points/monitoring	5%
Declared weeds	5 m x 5 m quadrats Photo points/monitoring	No declared weeds to be present.

Note: The completion criteria will be assessed via averaging the results from the monitoring locations.

Monitoring and Reporting

Monitoring will be undertaken to assess weed cover and plant survival rates within the revegetation area against completion criteria (Table 1). These monitoring events will occur annually commencing in:

- autumn following the year that planting was undertaken, to measure plant survival. This will inform the need for any infill planting for the upcoming winter
- spring to measure to measure plant density/success.

5 m x 5 m quadrats and photo points will be established within each revegetation area, to allow for consistency of monitoring over time. Exact locations of these quadrats and photo point locations will be provided in the first monitoring report prepared for the revegetation program.

Monitoring is to be ongoing for at least 2 years post-revegetation and shall continue until completion criteria have been met. Monitoring will also make note and include photos of any signs of erosion or storm damage to revegetation areas to enable appropriate management measures.

Once initial revegetation actions have been completed, a report will be prepared and submitted to the City of Cockburn within 30 days.

Thereafter, revegetation monitoring reports, comprising results of revegetation works, monitoring results for autumn and spring and any contingency actions that were implemented, will be prepared, and submitted to the City of Cockburn on an annual basis, and within 30 days after the completion of Spring monitoring events.

Contingency Actions

If monitoring indicates that the success criteria are not being met, contingency actions may be undertaken:

- infill planting (30% infill after Year 1 monitoring, then 15% infill after Year 2 monitoring) to increase plant numbers, plant species, ground coverage and / or replace damaged or dead seedlings
- additional broad spectrum herbicide application, or manual weed control to reduce weed coverage, as required, in winter, spring and autumn
- installation of additional corflute tree guards for protection to exclude pests.

References

City of Cockburn (2017). *Guidelines for Revegetation and Maintenance of Natural Bushland/Wetland Areas.* City of Cockburn, Perth, Western Australia.

Heddle E. M., Loneragan O. W. and Havel J. J. (1980). 'Vegetation of the Darling System'. In: Department of Conservation and Environment (1980). *Atlas of Natural Resources, Darling System, Western Australia.* Department of Conservation and Environment, Perth, Western Australia.

Western Power (undated). *Transmission Easement Notice*. Western Power, Perth, Western Australia.

Appendix 1 Revegetation Species List

Proposed Vegetation Species List within Easement (up to 2 m in height)

Species	Growth Form	Approximate Height (m)
Acacia pulchella	Shrub	0.3-3
Allocasuarina humilis	Shrub	0.2-2
Anigozanthos manglesii	Herb / groundcover	0.2-1.1
Astartea scoparia		1.8
Atriplex cinerea		0.2-1.5
Banksia attenuata	Shrub	0.4-10 **0.4-2 (often a shrub in drier areas)**
Banksia menziesii	Shrub	1.3-7 **1-3 (lower spreading shrub in the more northern parts of its range)**
Beaufortia elegans		0.3-1
Bossiaea eriocarpa		0.2-1
Calothamnus quadrifidus 'Little Ripper'		0.2-0.4
Conostylis aculeata	Herb / groundcover	0.06-0.5
Conostylis candicans		0.05-0.4
Daviesia physodes	Shrub	0.4-1.8
Dianella revoluta var divaricata	Herb / groundcover	0.3-1.5
Ficinia nodosa		Up to 1
Gastrolobium capitatum	Shrub	to 1
Grevillea crithmifolia 'Green Carpet'		0.6-0.8
Hakea prostrata	Shrub	1-3
Hemiandra pungens		0.05-1
Hibbertia hypericoides		0.2-1.5
Hovea pungens	Shrub	0.2-1.8
Hypocalymma angustifolium	Shrub	to 1.5
Hypocalymma robustum		0.4-1.5
Kennedia prostrata	Herb / groundcover	0.1
Melaleuca huegelii Prostrate		0.2
Melaleuca seriata	Shrub	0.25-1
Patersonia occidentalis	Herb / groundcover	1.5
Pultenaea reticulata	Shrub	0.5-2

Source: Coterra, 2017; City of Cockburn, undated (https://www.cockburn.wa.gov.au/Street-Trees-Pruning-and-Planting); Tranen (pers. comm J. Lawton, 2 December, 2021).

Acacia pulchella

Allocasuarina humilis

Anigozanthos manglesii

Astartea scoparia

Atriplex cinerea

Banksia attenuata

Banksia menziesii

Beaufortia elegans

Bossiaea eriocarpa

Calothammus quadrifidus

Conostylis aculeata

Conostylis candicans

Daviesia physodes

Dianella revoluta var divaricata

Ficinia nodosa

Gastrolobium capitatum

Grevillea crithmifolia

Hakea prostrata

Hemiandra pungens

Hibbertia hypericoides

Hovea pungens

Hypocalymma robustum

Kennedia prostrata

Melaleuca huegelii

Melaleuca seriata

Patersonia occidentalis

Pultenaea reticulata