Lots 2, 3 and 6 Midland Road Helena Valley Structure Plan (Amendment No.1)

June 2026

We acknowledge the custodians of this land, the Whadjuk Nyoongar and their Elders past, present and emerging. We wish to acknowledge and respect their continuing culture and the contribution they make to the life of this city and this region.

Document ID:					
Issue	Date	Status	Prepared by	Approved by	
			Name	Name	Signature
1	21.10.24	Final	Hannah Lee	Justin Page	
2	23.06.26	Rev 1.0	Hannah Lee	Justin Page	

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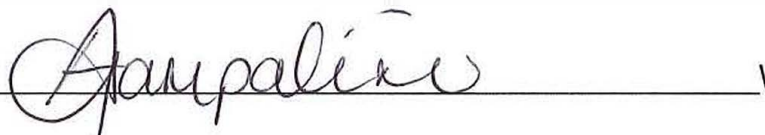
This structure plan is prepared under the provisions of the Shire of Mundaring Local Planning Scheme No.4

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON: 3 November 2016

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

3 November 2016

Date

Date of Expiry: 3 November 2031

element.

Table of Amendments to Structure Plan

Amendment No.	Description of Amendment	Amendment Type	Dated Endorsed by WAPC
1	Inclusion of central portion of land previously excluded from structure plan boundary as 'Residential R20' and 'Residential R30'. Transfer of central portion of land from 'Public Open Space / Drainage' to 'Residential R30. Transfer of western portion of land from 'Public Open Space / Drainage', 'Development' and 'Rural Residential' to 'Recreation', 'Residential R15' and subject to future planning. Transfer portion of 'Development' in south-west area to 'Recreation' to accommodate the Kadina Brook foreshore area with balance area as 'Subject to Future Planning'.	Major	23 September 2026

Executive Summary

The *Lots 2, 3 & 6 Midland Road Helena Valley Structure Plan* (approved LSP) was endorsed by the Western Australian Planning Commission (WAPC) on 3 November 2016, of which provides guidance for the planning and use of the land within the structure plan area. The approved LSP provides for a mix of low-density residential land use, areas of public open space for recreation and natural areas set aside as foreshore for the protection of Kadina Brook.

Amendment No. 1 to the approved LSP seeks to include the central portion of land, previously excluded from the structure plan, as 'Residential R20 and R30' and to change the central portion of land designated for 'Public Open Space / Drainage' to 'Residential R30'. A portion in the north-west of the structure plan land is proposed to be amended from 'Public Open Space / Drainage', 'Development' and 'Rural Residential' to 'Recreation', 'Residential R15'. The portion in the south-west of the structure plan area will remain as 'subject to future planning', given this area potentially can be included in the development of neighbouring lots.

The amendment is the result of two planning considerations, the first being a completion of geotechnical investigations in relation to the central portion of land, which now identifies the land as being suitable for urban development following remediation. The second is the rezoning of the north-western portion of the structure plan area under the Metropolitan Region Scheme (MRS) under Amendment 1379/57 from 'Rural' to 'Urban' zone.

The amended structure plan area incorporates the recent MRS urban zoned land and the central portion that was previously subject to further investigation (i.e. geotechnical and remedial studies). These are now proposed for urban development. The following is a summary of the proposed structure plan.

Executive Summary Table

Item	Data	Structure Plan Reference
Total area covered by Structure Plan	13.233 ha	Section 4
Area of each land use proposed: - Residential	4.849 ha	Section 4
Total estimated lot yield	92	Section 4
Estimated number of dwellings	92	Section 4
Estimated residential site density	19 dwellings per hectare[1]	Section 4
Estimate population (@2.8 persons/dwelling)	258 persons	Section 4
Estimated Public Open Space: - Regional Open Space (ROS) - Public Open Space (POS)	3.281 ha 1.26 ha (~ 16%)	Section 5
Kadina Brook and foreshore reserve	1.596 ha	Section 5

Notes:
1. 'Residential Site Hectare' refers to the definition under Element 1 of WAPC's *Liveable Neighbourhoods*. Calculation excludes roads and public open space.

Part One – Implementation

1. Structure Plan Area

The Structure Plan is identified as the *Lots 2, 3 and 6 Midland Road Helena Valley Structure Plan*, (plan reference 20-088 CP-5). This structure plan shall apply to the land contained within the inner edge of the line denoting the structure plan boundary on the Structure Plan Map.

2. Operation

The structure plan is in effect from the date it is approved by the Western Australian Planning Commission as stated on the approval page and for a period of 10 years.

3. Staging

Future staging of the structure plan area will be from east to west with the final stages likely to be adjacent to the Kadina Brook foreshore area and in the north-west of the structure plan area. The staging and creation of residential lots will be subject to market forces.

4. Subdivision and Development Requirements

4.1 Land Use and Permissibility

4.1.1 Zones

The structure plan outlines the Zones and Reserves applicable within the structure plan area and these will guide future subdivision and development of the land. Land use permissibility within the structure plan area shall generally be in accordance with the corresponding Zone and/or Reserve under the Shire of Mundaring Local Planning Scheme No. 4 (LPS 4).

4.1.2 Road Reserves

The Structure Plan Map identifies the main internal road network, whereby roads are proposed to intersect with the existing and planned adjacent road network, to provide key access and egress points for the development. Access Streets shall make up the lower order roads in the road hierarchy. All road reserve widths shall be consistent with the requirements of Liveable Neighbourhoods.

4.1.3 Public Open Space

A minimum of 10% public open space in accordance with WAPC Liveable Neighbourhoods is required at the time of subdivision and/or development. The location for public open space is generally shown in the structure plan map. The final design of public open space is subject to detailed design.

Public Open Space Schedule

	Ha	Ha
Total Site Area (ha)		13.233
Deductions Kadina Brook Foreshore Reserve Dedicated Drainage MRS Regional Open Space Balance Lot (SW corner)	 1.600 0.429 3.297 0.174	
Total Deductions		5.500
Gross Subdivisible area		7.733
Required POS (10%)		**0.773**
Breakdown of POS Provided May comprise: - minimum 80 per cent unrestricted POS - Maximum 20 per cent restricted use POS	 0.618 0.155	
Restricted Public Open Space provided Nil		
Total Restricted POS Credited to a maximum of 20%		0.0
Unrestricted Public Open Space provided		
Lot 8002 - Local Park area adjacent to Kadina Brook foreshore		0.968
Total Unrestricted POS		0.968
Provided POS (12.5%)		**0.968**

4.1.4 Area Subject to Future Planning

The Structure Plan does not apply to the area identified as 'Subject to Future Planning' on the Structure Plan Map. This area forms part of the balance area of the main urban development. The future use of this land will be subject to further investigations and will likely form part of development of neighbouring land.

4.2 Residential Density

The following provisions shall apply in relation to residential density:

a) Residential densities applicable to the Structure Plan area shall be those residential densities shown on the Structure Plan map.

b) The maximum number of residential lots permitted in this structure plan area shall not exceed the average dwelling yield achievable at the R20 Residential Density Code. This requirement applies to areas affected by the 20 and above ANEF aircraft noise exposure levels for 2026. This is to enable small pockets of diversity whilst having regard to the density requirements of the State Planning Policy 5.1 'Land Use Planning in the Vicinity of Perth Airport'.

c) Density is to be consistent with the R-Codes 'Table D'. A density summary shall be provided with each stage of subdivision to demonstrate that the residential density cap of R20 is being complied with for the entire residential area of the Structure Plan.

4.3 Notifications on Title

In respect of applications for the subdivision of land the Shire of Mundaring shall recommend to the Western Australian Planning Commission that a condition be imposed on the grant of subdivision approval for a notification to be placed on the Certificate(s) of Title(s) to advise of the following:

a) Land or lots deemed to be affected by a Bushfire Hazard.

b) Lots affected by Aircraft Transport noise

5. Local Development Plans

Local Development Plan(s) are required to be prepared and implemented pursuant to the provisions of the Planning and Development (Local Planning Schemes) Regulations 2015, for lots with the following site attributes:

a) Lots abutting areas of Public Open Space;

b) Corner lots so as to determine the suitable location of vehicular access and garage(s).

6. Other Requirements

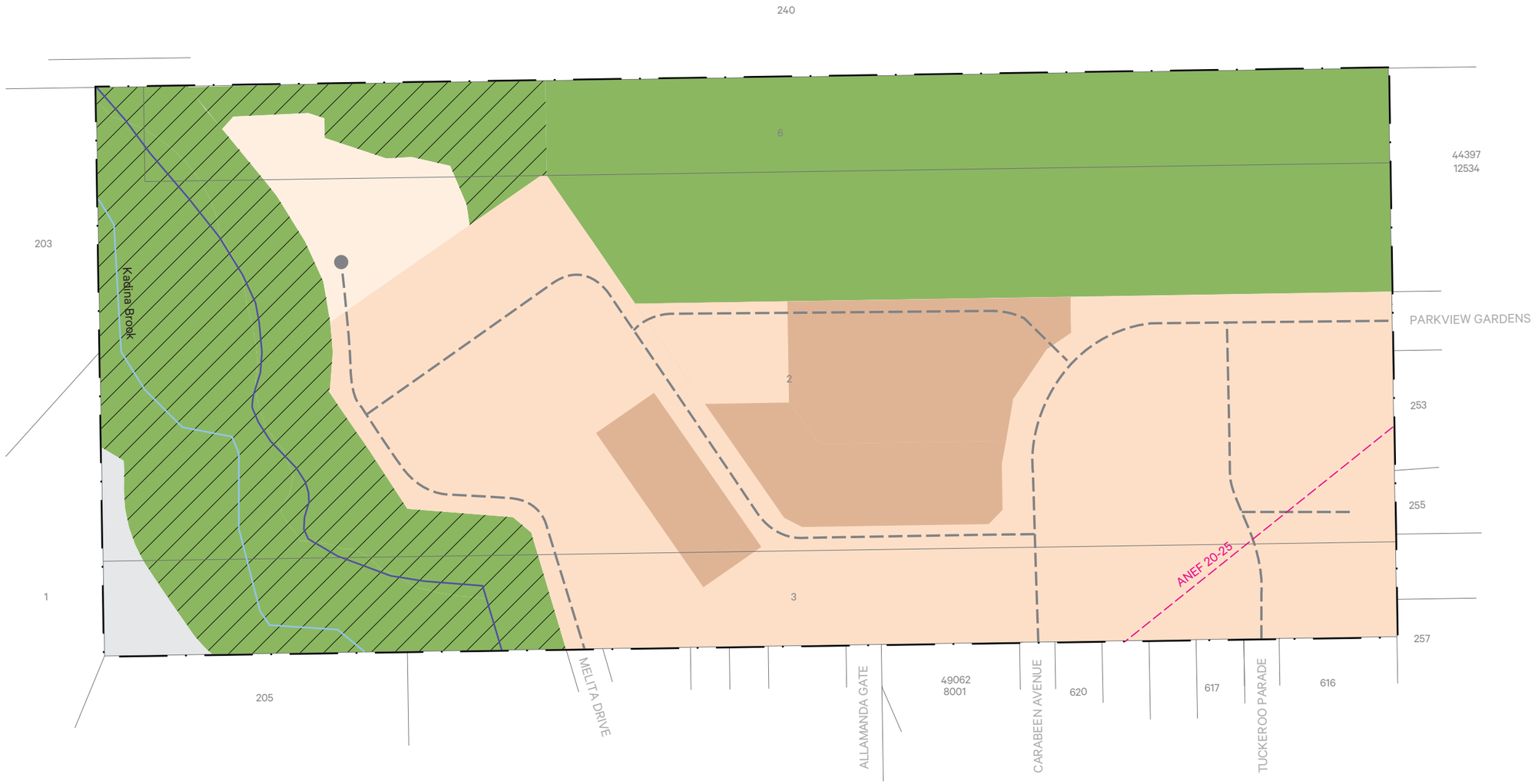
6.1 Additional Details

The following additional details for subdivision/development shall be submitted at later stages of planning.

6.1.1 Information to be submitted with an application

Additional Information/purpose	Approval Stage	Responsible Authority (consultation required)
Bushfire Management Plan	Subdivision	Shire of Mundaring

Conditions of subdivision/development approval	Responsible Authority
Preliminary Site Investigation (PSI) and if required a Detailed Site Investigation (To address any potential contamination from historical land use)	Shire of Mundaring Department of Environment and Regulation
Bushfire Management Plan	Shire of Mundaring
Foreshore Management Plan	Shire of Mundaring Department of Biodiversity and Attractions
Local Development Plan(s)	Shire of Mundaring
Urban Water Management Plan	Shire of Mundaring Department of Environment and Regulation
Mosquito Management Plan	Shire of Mundaring



Legend

Structure Plan Boundary

Metropolitan Region Scheme Reserves

Regional Open Space

Local Scheme Reserves

Recreation and Drainage

Local Scheme Zones

Residential R15

Residential R20

Residential R30

Other

Indicative Future Local Road

ANEF 20-25 Airport Noise Control

Creek Line

Resource Enhancement Wetland (REW)

Subject to Future Planning

Typ

Lots 2, 3 and 6 Midland Road Structure Plan

0 20 40m

Date: 22 Jun 2026 Scale: 1:2000@ A3 1:1000 @ A1 File: **20-088 CP-5** Staff: JP MT GW JK Checked: JP

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Part Two – Explanatory Section

1. Introduction

The *Lots 2, 3 & 6 Midland Road Helena Valley Structure Plan* was originally endorsed by the Western Australian Planning Commission (WAPC) on 3 November 2016 to guide the residential subdivision and development of the land. The development is known as Allamanda Vista, a residential estate set in Perth's foothills located approximately half an hour from Perth CBD.

Subdivision and development has occurred within original Lots 2 & 3 since the approval of the structure plan. The Western Australian Planning Commission endorsed subdivision WAPC 156909, which has led to the creation of the first stages of residential lots in the eastern portion of the structure plan and balance lots for the original Lots 2 & 3. Further subdivision stages are under construction west of the initial first stage area. Residential single dwellings have been constructed on the first stage lots in the west – refer to Figure 1.



Figure 1. Aerial showing first stage of subdivision completed in western portion with dwellings constructed on the new lots.

Amendment No. 1 to the Structure Plan seeks to include the central portion of land, previously excluded from structure plan, as 'Residential R20 and R30' and to change the central portion of land designated for 'Public Open Space / Drainage' to 'Residential R30'. A portion in the north-west of the Structure Plan land is proposed to be amended from 'Public Open Space / Drainage', 'Development' and 'Rural Residential' to 'Recreation', 'Residential R15'. The portion in the south-west of the structure plan area will remain as 'subject to future planning', given this area potentially can be included in the future urban development of neighbouring lots.

Figure 2 shows the areas of the original structure plan proposed in Amendment No. 1.

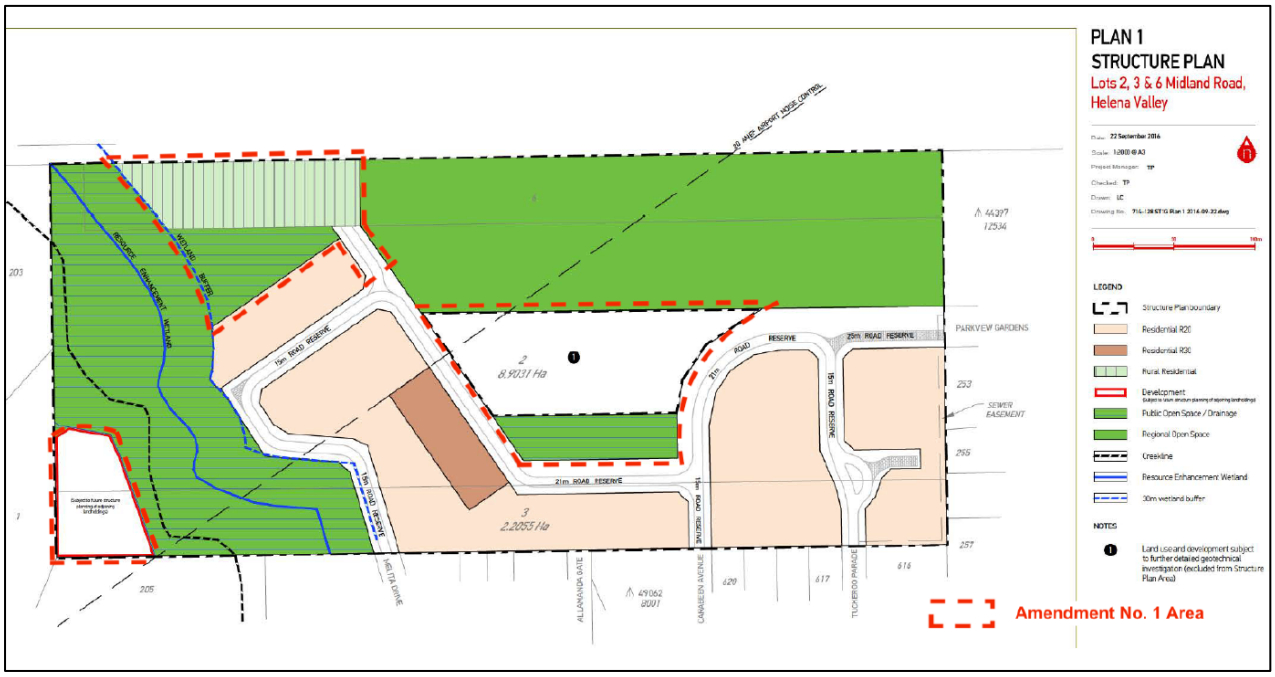


Figure 2. Amendment No. 1 areas (shown dotted red) of the existing approved structure plan

The structure plan (as amended) will continue to provide the primary statutory framework for determining future land uses, design and implementation of the desired planning outcomes. These will inform the planning decision making for future subdivision and development approvals for the structure plan area.

2. Amendment No. 1

The amendment follows the completion of detailed geotechnical investigations by the landowner in relation to the central portion of land and the rezoning of the north-western portion of the structure plan area under Metropolitan Region Scheme *Amendment 1379/57*.

The structure plan amendment is the result of two planning outcomes, the first being a completion of geotechnical investigations in relation to the central portion of land, which now identifies the land as being suitable for urban development. The second is the rezoning of the north-western portion of the structure plan area under the MRS Amendment 1379/57 from 'Rural' to 'Urban' zone. The amended structure plan area incorporates the recently MRS urban zoned land and the central portion previously subject to further investigation and proposes a consolidated urban development.

The original approved structure plan was supported by various technical reports and planning justification, which were provided in the approved original 2016 structure plan documentation. Rather than duplicate this information, which remains relevant in part, the WAPC approved *Lots 2, 3 & 6 Midland Road Helena Valley Structure Plan 2016* (refer to Appendix 1 – Original Approved Structure Plan) should be read in conjunction with this Amendment 1 structure plan rationale and information.

3. Planning Framework

Zoning and Reservations

Metropolitan Region Scheme

Lot 3 Midland Road, Helena Valley is wholly located within the 'Urban' zone of the *Metropolitan Region Scheme* (MRS). The majority of Lot 2 Midland Road, Helena Valley is also zoned 'Urban', including the north-western portion which was recently transferred from 'Rural' under Proposal 10 of Amendment 1379/57 to the MRS. Similarly, the western portion of Lot 6 Midland Road, Helena Valley has been rezoned from 'Rural' to 'Urban' under Proposal 10 of Amendment 1379/57 to the MRS. The remaining portions of Lot 2 and 6 are reserved for 'Parks and Recreation'.

Shire of Mundaring Local Planning Scheme No. 4

Under the Shire of Mundaring Local Planning Scheme No. 4 ('LPS 4'), the subject site is zoned 'Development'. The portion of the structure plan area that was rezoned under the MRS to urban is currently zoned 'Rural Residential' under LPS 4. As this area was originally part of the structure plan, pursuant to Clause 5.17.2.1(c) of LPS 4, this area is included in the structure plan and is identified for Residential and Recreation use. The portion of the 'Flood Fringe' mapping affecting the structure plan area in the northern portion is within the Recreation use and does not impact residential land.

A local scheme amendment to LPS 4 is being progressed concurrent with this structure plan amendment. The scheme amendment will rationalise the LPS 4 'Rural Residential' zone to 'Development - DA1' zone.

4. Residential Yield and Densities

A Concept Plan (refer to **Figure 3** and enlarged version in **Appendix 2 – Indicative Subdivision Concept Plan**) provides an indicative lot layout for potential urban development of the subject site under the Structure Plan. The concept plan shows a mix of lot sizes which can potentially accommodate 92 single dwellings. Lots sizes range from 1,440m^2 (R15 density) to 300m^2 (R30 density).

The central portion contains R20 and R30 density lots which will provide for generally 450m^2 lots at 15m x 30m. Lots are orientated towards the regional open space with a road interface. This is consistent with the principles of Liveable Neighbourhoods, whereby residential interaction is desirable around areas of high amenity, such as public open space.

A lower density (R15) is proposed in the north-west portion due to the steep natural topography and desire to create larger lots which transition towards the rural residential land use neighouring to the west.

Two large lots in the central portion with a density of R30 are provided with the final subdivision design to be determined at the subdivision approval stage. A battleaxe configuration has been indicatively shown in the technical reports as one example of how these lots could be developed. However, under the R30 density potential dwelling typologies that could be considered at the detailed subdivision stage for these two large lots include:

- Grouped dwellings (strata with a common property accessway); or
- Aged accommodation; or
- Green title or survey strata battleaxe lots with reciprocal easement shared driveways.

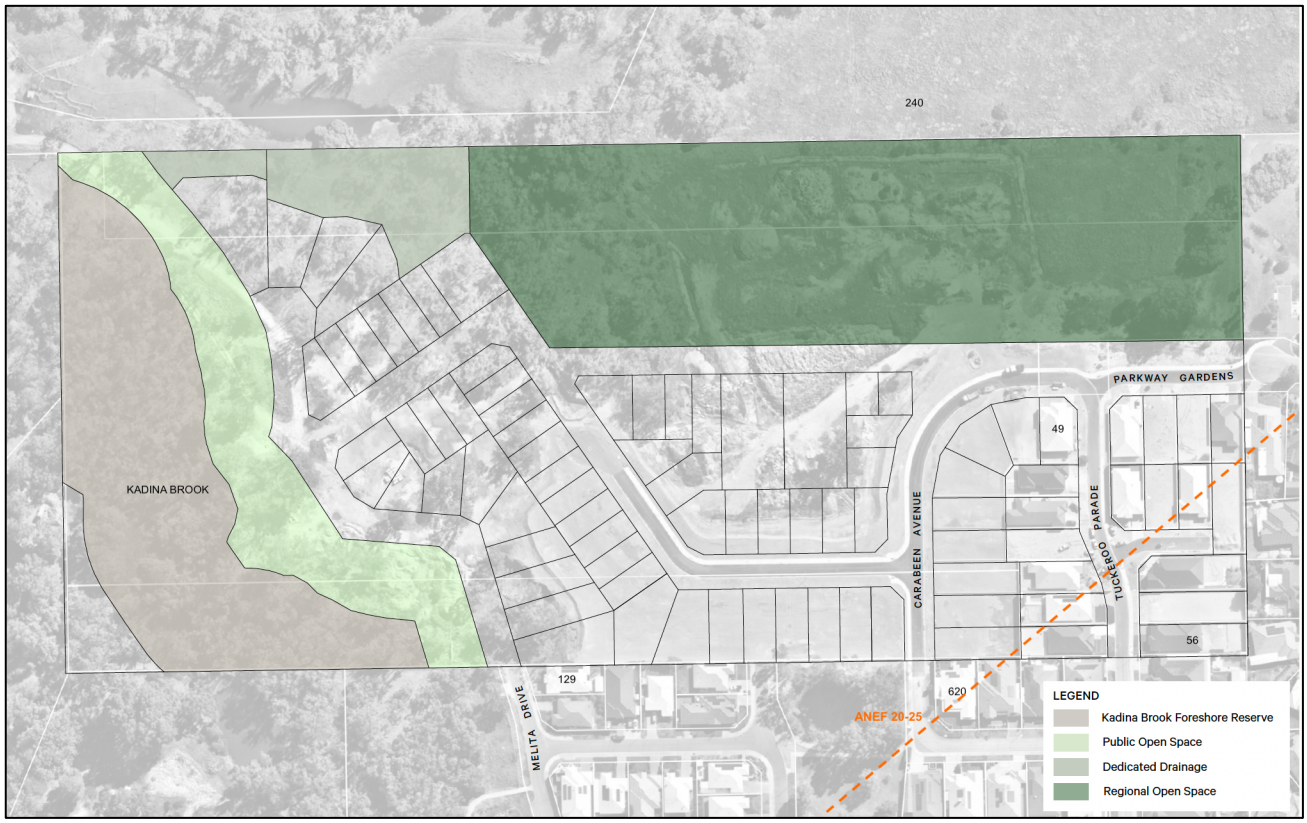


Figure 3. Indicative subdivision concept plan noting that lots shown are indicative only and subject to final detailed design and WAPC subdivision approval, except for lots already constructed (refer to Appendix 2 for enlarged version).

The development concept plan could accommodate up to approximately 258 people, based on an average household of 2.8 persons for 92 lots, with '4-packs' being developed for each of the two large R30 lots in the central area. The final lot yield and design would be determined as part of detailed subdivision at later stages of planning, including the dwelling typologies.

Table 1 provides an overview of development statistics based on the concept plan. Although the concept plan is indicative only at this structure plan level of planning (and not the subject of approval), the structure plan technical reports have been based on the concept plan. The concept plan provides a point of reference to demonstrate the capability of the proposed structure plan design over the subject site.

Table 1 demonstrates that the structure plan design can deliver approximately 19 dwellings per site hectare, which meets the Liveable Neighbourhoods density expectations for the site's locational context.

The actual density of 7 dwellings per gross urban hectare does not meet the target density of 15 dwellings per gross urban hectare primarily due to the large areas of land in the structure plan set aside for regional open space and Kadina Brook foreshore (conservation) areas.

Table 1. Development Statistics (based on the Concept Plan)

	Site Outcomes	Target Density
Total Structure Plan Area	132,332m^2	-
Area set aside for foreshore, public open space, roads & drainage	83,837m^2 (approximate)	-
Balance area for residential development	48,495m^2 (approximate)	-
Estimated number of dwellings	92 dwellings	-
Estimated number dwellings per site hectare	19 dwellings per site hectare	Liveable Neighbourhoods 12 – 20 dwellings per site hectare for standard lot layouts; or 20 – 30 dwellings per site hectare for areas within 400m of neighbourhood centres
Estimated number dwellings per gross urban hectare	7 dwellings per site hectare	Density target of 15 dwellings per hectare as per Perth and Peel@3.5 million

Directions 2031 and *Liveable Neighbourhoods* prescribe minimum dwelling/lot targets for the purpose of meeting the needs of forecast population growth. Each of the strategic and policy documents set the following targets:

Directions 2031	15 dwellings per gross urban hectare
Liveable Neighbourhoods	20 dwellings per site hectare

1. 'Gross Urban Hectare' means the gross area available for urban development.
2. 'Site Hectare' means the area available for residential development, excluding roads, non-residential uses, public open space, and drainage areas.

5. Public Open Space

The structure plan makes provision for 12.5% public open space (POS), which is more than the minimum 10% requirement under Liveable Neighbourhoods. The POS adjacent to the Kadina Brook foreshore provides for the majority of the POS requirement. The original structure plan made allowance for Kadina Brook as a Resource Enhancement Wetland (REW) with its associated wetland buffer. Kadina Brook is no longer considered a wetland but instead is a waterway requiring a foreshore reserve – refer to Figure 4.

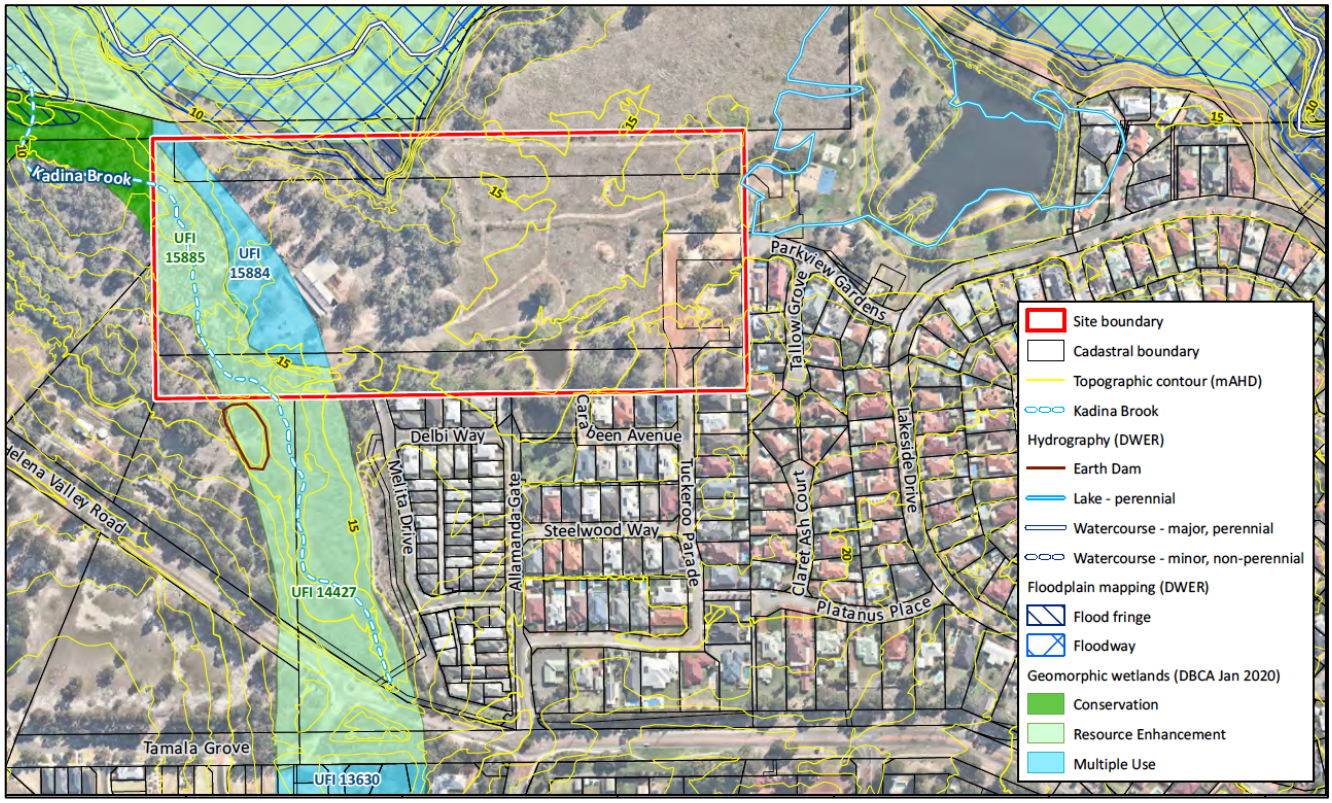
This has implications for the provision of POS, whereas in the original structure plan the REW did not form part of the POS. Kadina Brook and its foreshore reserve has now been determined and set aside as a dedicated area for conservation. The balance area outside of the Kadina Brook foreshore reserve is therefore potentially developable as POS. Approximately 16% POS is therefore provided in the current subdivision concept plan, resulting in a surplus of 6% POS. Modifications to the future lot layout could be considered at subdivision stage to refine the amount of POS being provided.

Table 2 sets out the POS schedule for the amended structure plan under the original structure plan REW open space requirements.

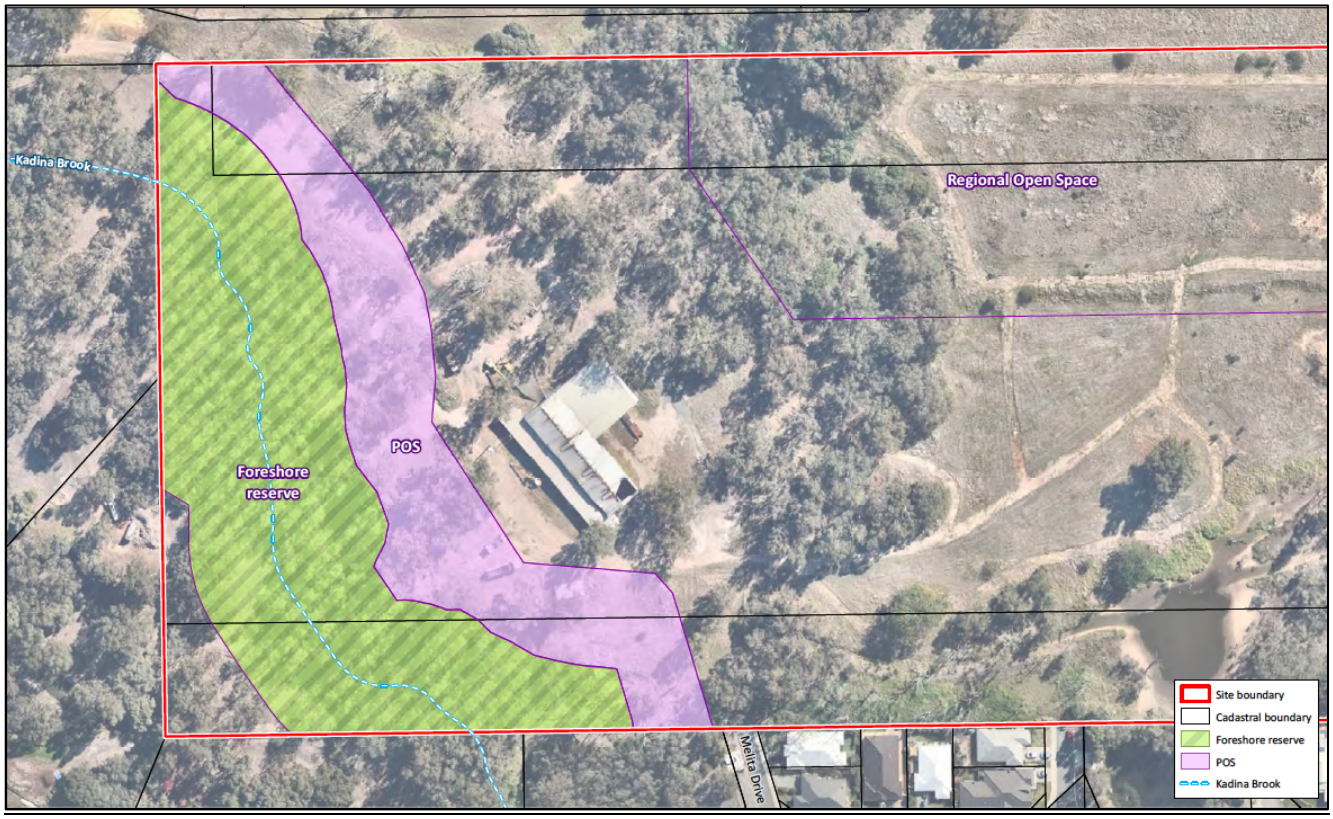
As part of the initial stages of subdivision, a Foreshore Management Plan has been prepared, which includes a Landscaping Concept Plan of the Kadina Brook foreshore area and adjacent POS (refer to Figure 5 and Appendix 3 – Foreshore Management Plan).

The portion of the LPS 4 'Flood Fringe' mapping affecting the structure plan area in the northern portion of Lot 6 is located within the public open space adjacent to the regional open space. The Flood Fringe mapping can be seen in the Urban Water Management Plan Appendix B – Drainage Strategy Plans (refer to Appendix 4 – Urban Water Management Plan).

Deductions in the calculation of the POS include the Kadina Brook foreshore area, regional open space and 1;1yr ARI drainage infrastructure (basin area).



(Source: Emerge Foreshore Management Plan - modified, 2022)



(Source: Emerge Foreshore Management Plan - modified, 2022)

KADINA BROOK FORESHORE RESERVE

FIGURE 4

Table 2. Public Open Space Schedule based on Concept Plan

	Ha	Ha
Total Site Area (ha)		13.233
Deductions Kadina Brook Foreshore Reserve Dedicated Drainage MRS Regional Open Space Balance Lot (SW corner)	 1.600 0.429 3.297 0.174	
Total Deductions		5.500
Gross Subdivisible area		7.733
Required POS (10%)		**0.773**
Breakdown of POS Provided May comprise: - minimum 80 per cent unrestricted POS - Maximum 20 per cent restricted use POS	 0.618 0.155	
Restricted Public Open Space provided Nil		
Total Restricted POS Credited to a maximum of 20%		0.0
Unrestricted Public Open Space provided		
Lot 8002 - Local Park area adjacent to Kadina Brook foreshore		0.968
Total Unrestricted POS		0.968
Provided POS (12.5%)		**0.968**

Notes:

1) Final POS calculations will be subject to WAPC subdivision approval, detailed survey and an approved Urban Water Management Plan. A minimum of 10% POS land contribution is to be provided at Survey Deposited Plan final approval stage.

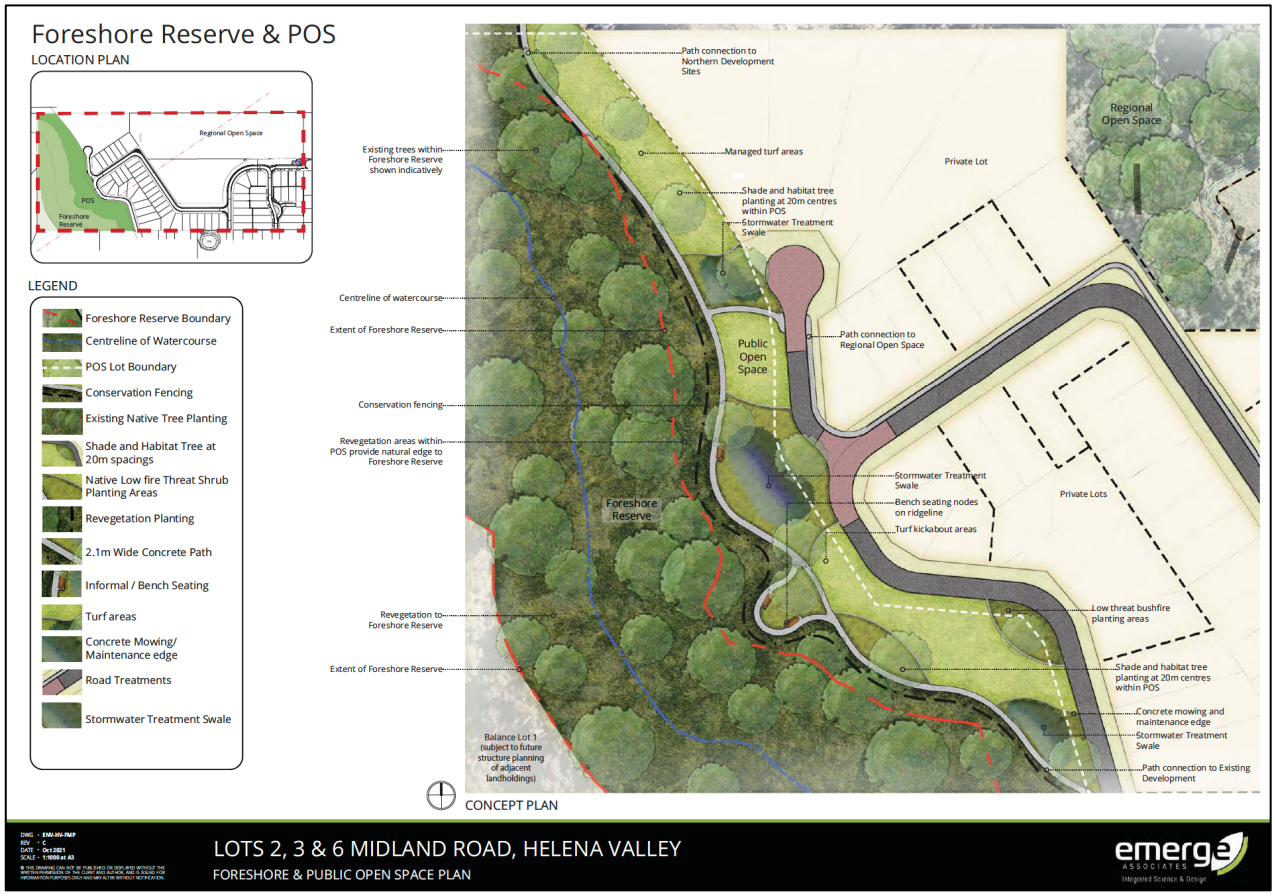


Figure 5. Landscape Concept Plan of Kadina Brook Foreshore and adjacent POS – refer to Appendix 3 for enlarged version. (Source: Emerge, 2024)

6. Bushfire Management

An updated Bushfire Management Plan (**Appendix 5 – Bushfire Management Plan**) has been prepared which demonstrates that the structure plan amendment is consistent with the bushfire framework. No proposed residential lots are affected by a Bushfire Attack Level (BAL) greater than BAL-29. The structure plan area has access and egress in two different directions through connection with the local road network to the south and east. The proposed foreshore 'hard edge' road will improve the bushfire access to the Kadina Brook foreshore area.

7. Stormwater Management

An Urban Water Management Plan (**Appendix 4**) has been prepared which demonstrates that the proposed structure plan amendment can satisfy best practice urban stormwater management. The key drainage considerations for the proposed structure plan amendment include:\

- Kadina Brook will remain in its present natural form.
- All roads will be kerbed and drained to the Shire's satisfaction, with all piped drainage designed to accommodate the 20% AEP rainfall event.
- The main detention basin will be designed and landscaped to manage all storm events, including the 1% AEP event.

8. Servicing

Preliminary servicing investigations, including earthworks and drainage, indicate that there are no significant constraints to the creation of the roads and residential lots as proposed by the structure plan amendment. Further consultation at the detailed design stage will be required with service providers to coordinate the extension and upgrading of the necessary services to create the lots.

9. Staging

An indicative staging plan is provided in **Figure 6** which shows staging generally progressing from east to west. The timing for the acquisition and development of the regional open space by the Western Australian Planning Commission is not known at this stage. Notwithstanding, the land within the regional open space would form the balance of the subject site upon completion of subdivision and would be maintained by the developer, particularly for bushfire management.

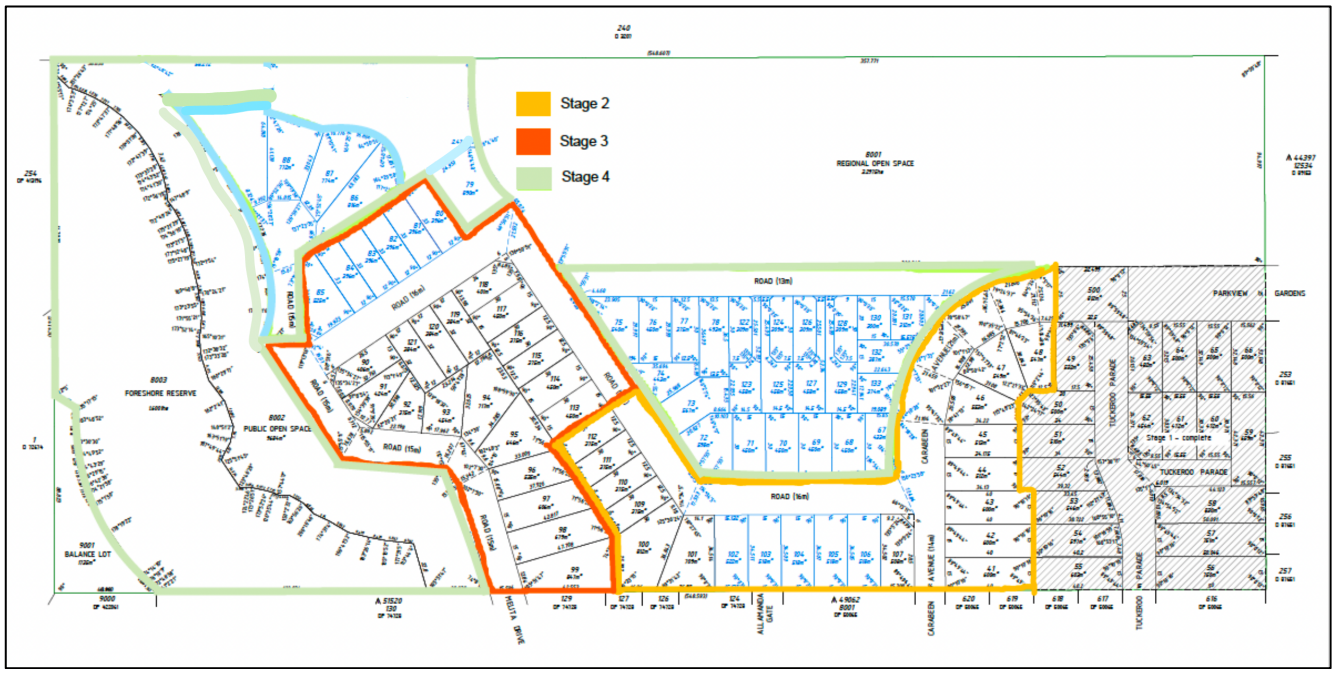


Figure 6. Indicative staging plan.

APPENDIX 1

Original Approved Structure Plan



LOTS 2, 3 AND 6 MIDLAND ROAD, HELENA VALLEY

PART ONE - IMPLEMENTATION

LOCAL STRUCTURE PLAN - SEPTEMBER 2016

tpg PLACE MATCH

Table of Modifications to Part One and Structure Plan Map

Modification no.	Description of modification	Date endorsed by Council	Date endorsed by WAPC

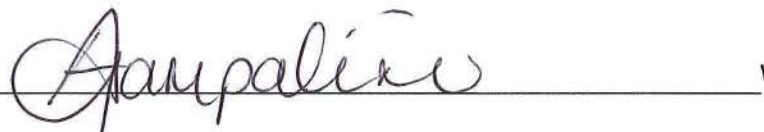
This structure plan is prepared under the provisions of the Shire of Mundaring Local Planning Scheme No.4

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON: 3 November 2016

Signed for and on behalf of the Western Australian Planning Commission



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



Witness

3 November 2016

Date

Date of Expiry: 3 November 2026

Local Structure Plan

PART ONE – IMPLEMENTATION

Lots 2, 3, and 6 Midland Road, HELENA VALLEY

SEPTEMBER 2016

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Executive Summary

Overview

This local structure plan (LSP) has been prepared to guide the subdivision and development of land totalling 11.1086 hectares in area and comprising Lots 2, 3, and 6 Midland Road, Helena Valley within the Shire of Mundaring.

The structure plan has been prepared on behalf of the landowners J and J Stefanelli and N Di Candilo and has been informed by investigations undertaken by the following consultant team:

- TPG Town Planning, Urban Design and Heritage – urban design, town planning
- Emerge Associates – environmental investigations, local water management, bushfire management
- Bushfire Safety Consulting – bushfire hazard assessment and management
- McDowall Affleck – Servicing and civil engineering
- Worley Parsons – Geotechnical

Purpose

This local structure plan provides a statutory framework to guide and facilitate the future subdivision of the land into predominantly residential lots with land also to be set aside for regional open space, conservation and public open space. The structure plan is to be implemented in accordance with Clause 5.17 of the Shire of Mundaring Local Planning Scheme No. 4.

Design Approach

The design of the structure plan is a product of a multidisciplinary approach which was predicated on the need to respond to a number of site issues and constraints in order to deliver a balanced and better environmental outcome for the site to that currently documented. Listed below is a summary of the design response to these issues:

1. Creation of a 30 metre buffer from the mapped Resource Enhancement Wetland (REW) to provide an appropriate buffer between the ecological values of the wetland and proposed development. The Kadina Brook and associated wetland buffer will be the focus of extensive revegetation works to improve the ecological linkage to the Helena River reserve and the over all environmental functionality of this watercourse feature.
2. Ultimate remediation of the structure plan area in accordance with the process and requirements of the *Contaminated Sites Act 2003* in order to resolve pre-existing landfill and contamination issues.
3. Preparation of a Local Water Management Strategy (Emerge Associates 2014) in accordance with *Better Urban Water Management* (BUWM) (WAPC 2010) to integrate and improve drainage within the structure plan area, including the philosophy of directing waterflow to the Kadina Brook to improve the creeks function.
4. Preparation of a Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2014) and placement of a road reserve to interface with the Resource Enhancement Wetland (REW) buffer to accommodate a 20 m Bushfire Protection Zone (BPZ) required to manage bushfire threats resulting from retained vegetation within the REW area and "Parks and Recreation" reserve.
5. Transfer of the "Parks and Recreation" reserve into State management for integration with the wider Helena River catchment reserve.
6. Integration with the surrounding local road network.

Executive Summary Table

Item	Data
Total area covered by the structure plan	13.2332 ha
Area of residential land use proposed	3.3089 ha (residential) 0.5472 ha (rural-residential)
Estimated lot yield	67
Estimated number of dwellings	67
Estimated residential site density	19.64 dw/ha[1] calculate based on residential zoned land only, exclude roads and POS
Estimated population	186 persons[2]
Estimated number and % of public open space: • Regional Open Space (ROS) • Resource Enhancement Wetland (REW) • Wetland Buffer (REW Buffer) • Local Public Open Space (Local POS) • Restricted Open Space	 ROS = 3.3259 ha REW = 1.3907 ha REW Buffer = 0.9605 ha Local POS = 0.6244 ha Restricted Open Space = 0.1597 ha
Estimated number and area of natural area and biodiversity assets	REW area = 1.3909 ha REW buffer = 0.9605 ha Local Natural Areas within open space = 0.3700 ha[3]

NOTES:

[1] 'Residential Site Hectare' refers to the definition under Element 1 of WAPC's Liveable Neighbourhoods.

[2] based on average household size of 2.83 (Source: Shire of Mundaring Community Profile, 2011).

[3] this figure relates to Local Natural Areas accommodated within open space outside of the Resource Enhacement Wetland and buffer.

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1. Structure Plan Area

This Structure Plan shall apply to Lots 2, 3, and 6 Midland Road, Helena Valley, being the land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan Map (**Plan 1**).

2. Structure Plan Content

The Structure Plan comprises:

a) Part 1 – Statutory Section

   This section contains the structure plan map and statutory planning provisions and requirements.

b) Part 2 – Explanatory Report

   This section is to be used as a reference guide to interpret and justify the implementation of Part 1.

c) Appendices – Detailed Technical Reports and supporting plans and maps.

3. Interpretation and relationship with the Scheme

3.1 Interpretations

a) Unless otherwise specified in this part, the words and expressions used in this Structure Plan shall have the respective meaning given to them in the Shire of Mundaring Local Planning Scheme No. 4 (the Scheme) including any amendments gazetted thereto.

3.2 Relationship with the Scheme

a) A decision-maker for an application for development or subdivision approval within the Structure Plan area is to give due regard to the provisions and requirements of this Structure Plan (Part 1 and Part 2).

b) The Structure plan map (Plan 1) outlines land use, zones and reserves applicable within the structure plan area. The zones and reserves designated under this structure plan are to guide future land use and development.

4. Operation

a) In accordance with Clause 5.17.12 of the Scheme, this Structure Plan shall come into operation on the day on which it is endorsed by the Western Australian Planning Commission (WAPC).

5. Land Use and Subdivision Requirements

a) The Structure Plan Map (**Plan 1**) outlines land use, zones, reserves and the residential density codes applicable within the Structure Plan area. The zones, reserves and residential density codes designated under this Structure Plan apply to the land within it as if the zones, reserves and residential density codes were incorporated into the Scheme.

5.1 Land Use Permissibility

a) Land use permissibility within the Structure Plan area shall be in accordance with the corresponding zone or reserve under the Scheme.

5.2 Residential

5.2.1 Dwelling Target

a) Objective

To provide for a minimum of 60 dwellings within the structure plan area.

b) Subdivision is to be generally in accordance with this structure plan to facilitate a desirable residential dwelling yield.

5.2.2 Residential Density

a) Plan 1 defines the broad residential density ranges that apply to specific areas within the Structure Plan. Lot specific residential densities, within the defined residential density ranges, are to be subsequently assigned in accordance with a Residential Code Plan approved by the WAPC.

b) A Residential Code Plan is to be submitted at the time of subdivision to the WAPC and shall indicate the R-Codes applicable to each lot within the subdivision and shall be consistent with the Structure Plan, and the Residential Density Ranges identified on Plan 1.

c) The Residential Code Plan is to include a summary of the proposed dwelling yield of the subdivision.

d) Approval of the Residential Code Plan shall be undertaken at the time of determination of the subdivision application by the WAPC. The approved Residential Code Plan shall then form part of the Structure Plan and shall be used for the determination of future development applications.

e) Variations to the Residential Code Plan will require further approval of the WAPC, with a revised Residential Code Plan submitted generally consistent with the approved plan of subdivision issued by the WAPC. The revised Residential Code Plan shall be consistent with Residential Density ranges identified on Plan 1.

f) A revised Residential Code Plan, consistent with Clause 5.2.2 (e) will replace, wholly or partially, the previously approved residential density code plan, and shall then form part of the Structure Plan as outlined in Clause 5.2.2 (d).

g) Residential Code Plans are not required if the WAPC considers that the subdivision is for one or more of the following:

i) the amalgamation of lots;

ii) consolidation of land for "superlot" purposes to facilitate land assembly for future development;

(iii) the purposes of facilitating the provision of access, services or infrastructure; or

(iv) land which by virtue of its zoning or reservation under the Structure Plan cannot be developed for residential purposes.

5.3 Public Open Space

a) The provision of a minimum of 10 per cent public open space being provided in accordance with the WAPC's Liveable Neighbourhoods. Public open space is to be provided generally in accordance with **Plan 1** (and **Table 1**), with an updated public open space schedule to be provided at the time of subdivision for determination by the WAPC, upon the advice of the Shire of Mundaring.

Table 1: POS Schedule

Public Open Space Schedule	Sub Total	Total
Structure Plan Area		12.2586 ha
Less Deductions		
Regional Open Space	3.3259 ha	
Resource Enhancement Wetland	1.3907 ha	
Rural Residential Land	0.5472 ha	
Sub Total	**5.2638 ha**	
Net Residential Subdividable Area		6.9733 ha
Residential Public Open Space @ 10 percent		**0.6973 ha**
Net Rural Residential Land Area	0.5472 ha	
Rural Residential Public Open Space @ 5 percent		**0.0274 ha**
Total Public Open Space Requirement		**0.7247 ha**
Public Open Space Contribution		
Unrestricted Public Open Space		
POS (Area B)	0.2850 ha	
POS (Area C)	0.3394 ha	
Sub Total		0.6244 ha
Restricted Public Open Space		
Portion of Resource Enhancement Wetland Buffer (Area D)		0.1597 ha
Sub Total		0.1597 ha
Total POS Provision		**0.7841 ha**

5.4 Reports/Strategies Required Prior to Subdivision

a) Prior to the lodgement of an application for subdivision, the following investigations are to be prepared to the satisfaction of the relevant authority and provided with the application for subdivision:

   i) Preparation of a Sampling and Analysis Plan (SAP) and completion of a Detailed Site Investigation (DSI).

   ii) A Vegetation Survey that identifies vegetation for retention.

5.5 Conditions of Subdivision Approval

Table 2 prescribes the regulatory provisions of the Structure Plan pertaining to requirements and prerequisites for subdivision within the Structure Plan area.

a) At the time of subdivision, the Shire of Mundaring may recommend conditions to the WAPC, as applicable, requiring the preparation and/or implementation of the following approaches as outlined in **Table 2**.

Table 2 – Conditions of Subdivision

1. Soil and Groundwater Contamination and Investigation	1.1 Prior to commencement of subdivision works, investigation for soil and groundwater contamination is to be carried out to determine if remediation is required. 1.2 If required, remediation, including validation of remediation, of any contamination identified shall be completed prior to the issuing of titles to the satisfaction of the Western Australian Planning Commission on advice from the Department of Environment Regulation, to ensure that the lots created are suitable for the proposed use.
2. Bushfire Management	2.1 A bushfire management plan being prepared, approved and relevant provisions implemented during subdivisional works, in accordance with the WAPC's Guideline Planning for Bushfire Protection (Edition 2) to the specifications of the local government and/or the Department of Fire and Emergency Services Authority. (Department of Fire and Emergency Services Authority) OR (Local Government) 2.2 A notification, pursuant to Section 70A of the Transfer of Land Act 1893 is to be placed on the certificate/s of title of the proposed lot/s. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows: *"The lot/s is/are subject to a bushfire management plan." (Local Government)*
3. Foreshore Management	3.1 Prior to the commencement of subdivisional works a foreshore management plan for the Kadina Brook is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan (Department of Water) OR (Local Government).
4. Stormwater Management	4.1 Prior to the commencement of subdivisional works, an Urban Water Management Plan is to be prepared and approved, in consultation with the Department of Water, consistent with any approved Local Water Management Strategy. (Local Government)
5. Detailed Area Plans	5.1 Detailed Area Plans (DAPs), pursuant to Clause 5.17.15 of the Scheme, are to inform applications for subdivision and development in regard to the following: a) Lots with direct boundary frontage (primary or secondary) to an area of Public Open Space; and/or b) Lots identified as being bushfire prone within an approved Bushfire Management Plan relating to the subject lots.
6. Building Envelopes	6.1 Prior to the commencement of subdivisional works, a detailed plan identifying building envelope/s is to be prepared in consultation with the local government to ensure the appropriate siting of development, to the satisfaction of the Western Australian Planning Commission and shall be prepared and endorsed pursuant to Clause 5.7.2 of the Scheme.
7. Fencing	7.1 In relation to the future 'Rural-Residential' lot/s, the following condition relating to fencing may be imposed: *"The landowner/applicant installing suitable rural fencing of good standard to the satisfaction of the Western Australian Planning Commission."* (Local Government)
8. Control of mosquito breeding	8.1 Prior to the commencement of subdivisional works, a mosquito management plan shall be prepared to the satisfaction of the local government to put in place suitable measures to control mosquito breeding on wetland within the Structure Plan area.

6. Development Requirements

The Structure Plan (**Plan 1**) and **Table 3** forms part of the regulatory provisions of this structure plan and prescribe the land use permissibility, standards, requirements and prerequisites for development within the Structure Plan area.

Table 3 – Development Requirements

1. Dwelling Orientation	1.1 Dwellings must address the street and/or public reserve in terms of main entry, major openings, articulation, materials and detailing. Dwellings directly abutting a public reserve shall orientate as follows: i) If vehicle access is via a laneway, the public reserve is considered as the primary façade. ii) If vehicle access is via a street, the street shall be considered the primary façade, however the secondary façade overlooking the public reserve must be articulated and include at least one major opening.
2. Lots abutting Public Open Space	2.1 Dwellings on lots abutting public open space shall be oriented so that they provide passive surveillance over the open space. Major openings and habitable rooms should, where possible, be located to look onto the open space.
3. Corner Lots	3.1 Dwellings located on corner lots shall address both streets through their design by extending the primary elevation features onto the secondary street elevation where forward of a boundary fence. Exposed secondary street façade shall incorporate major openings.
4. Rural-Residential Zone	4.1 In addition to any requirement or provision of the Scheme, this Structure Plan or a planning policy; land use and development of the Rural-Residential land designated within this Structure Plan will be subject to any requirements or encumbrances contained within any restrictive covenant relating to that lot/s. 4.2 The local government may impose the following requirements on any land use and development of the 'Rural-Residential' lot: a) Preparation of a Dust Management Plan in relation to any future grazing activities; b) Consideration of the siting and location of any horse stables and other rural outbuildings in relation to residential dwellings and lots; and/or c) Preparation of a management plan in relation to any application for a 'Rural Pursuit' to address issues such as nutrient loading, pasture management, dust control, manure control including fly management and other issues.



PLAN 1
STRUCTURE PLAN
Lots 2, 3 & 6 Midland Road, Helena Valley

Date: 22 September 2016
Scale: 1:2000 @ A3
Project Manager: TP
Checked: TP
Drawn: LC
Drawing No. 714-128 ST1G Plan 1 2016-09-22.dwg

0 50 100m

LEGEND

- Structure Plan boundary
- Residential R20
- Residential R30
- Rural Residential
- Development (Subject to future structure planning of adjoining landholdings)
- Public Open Space / Drainage
- Regional Open Space
- Creekline
- Resource Enhancement Wetland
- 30m wetland buffer

NOTES

1. Land use and development subject to further detailed geotechnical investigation (excluded from Structure Plan Area)

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LOTS 2, 3 AND 6 MIDLAND ROAD, HELENA VALLEY

PART TWO - EXPLANATORY REPORT

LOCAL STRUCTURE PLAN - SEPTEMBER 2016

tpg
TOWN PLANNING
URBAN DESIGN AND HERITAGE

Table of Modifications to Part One and Structure Plan Map

Modification no.	Description of modification	Date endorsed by Council	Date endorsed by WAPC

Local Structure Plan

PART TWO – EXPLANATORY REPORT

LOTS 2, 3 AND 6 MIDLAND ROAD, HELENA VALLEY

SEPTEMBER 2016

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Abbreviations

AHD	Australian Height Datum
ARI	Average Recurrence Interval
AAMGL	Annual Average Maximum Groundwater Levels
BAL	Bushfire Attack Level
BPZ	Building Protection Zone
DAP	Detailed Area Plan
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DSI	Detailed Site Investigation
EPA	Environmental Protection Authority
LSP	Local Structure Plan
LWMS	Local Water Management Strategy
MRS	Metropolitan Region Scheme
POS	Public Open Space
PSI	Preliminary Site Investigation
SoM	Shire of Mundaring
UWMP	Urban Water Management Plan
WAPC	Western Australian Planning Commission

1. Planning Background

1.1 Introduction and Purpose

This local structure plan (LSP) has been prepared by TPG Town Planning, Urban Design and Heritage (TPG) on behalf of the landowner of Lots 2, 3 and 6 Midland Road, Helena Valley (the site or Structure Plan area).

This local structure plan provides a statutory framework for the residential subdivision of the site into 67 freehold lots and associated public open space.

The subject land is zoned Urban within the Metropolitan Region Scheme and is included within the Development zone of the Shire of Mundaring Local Planning Scheme No. 4. This LSP has been prepared to satisfy the requirements of the Development zone and prepare the site ready for subdivision and development.

A large portion of the site is set aside as public open space and conservation, to accommodate the resource enhancement wetland and other environmental features of the site.

Supporting documentation in the form of separate technical reports have been prepared to inform this LSP and are appended to this document. These documents include:

- Helena Valley LSIP Geotechnical and Environmental Assessment (2008) prepared by Worley Parsons;
- Servicing and Infrastructure report prepared by McDowell Affleck;
- Environmental Assessment and Management Strategy (EAMS) prepared by Emerge Associates; and
- Bushfire Management Plan.

This Structure Plan is addressed in two Parts.

Part One covers the Statutory Planning Report.

Part Two covers the Explanatory Report. **Section 1** provides an introduction to the Structure Plan area and outlines the planning framework. **Section 2** outlines the site conditions and constraints. **Section 3** outlines the land use and subdivision requirements.

1.2 Land Description

1.2.1 Location

The local structure plan comprises Lots 2, 3 and 6 Midland Road, Helena Valley (the site or Structure Plan area). The site is located approximately 16 kilometres east of Perth, 3.5 kilometres south east of the Midland Regional Centre within the Shire of Mundaring (SoM) and is also located approximately 530 metres east of the intersection of Helena Valley Road and Roe Highway. Roe Highway provides the area with good connectivity south and west via the Great Eastern Highway to the Perth CBD and Reid Highway.

The Helena River is located immediately to the north of the subject site within a Parks and Recreation reserve. Kadina Brook flows off from the Helena River and travels south through the western portion of the subject site.

Land immediately to the west of the site is identified for rural-residential subdivision and land to the east and south of the site is zoned residential, with a majority of the adjoining land having previously been subdivided at densities ranging from R10 to R20. A local road network has been established to the south and east of the Structure Plan area through this previous subdivision.

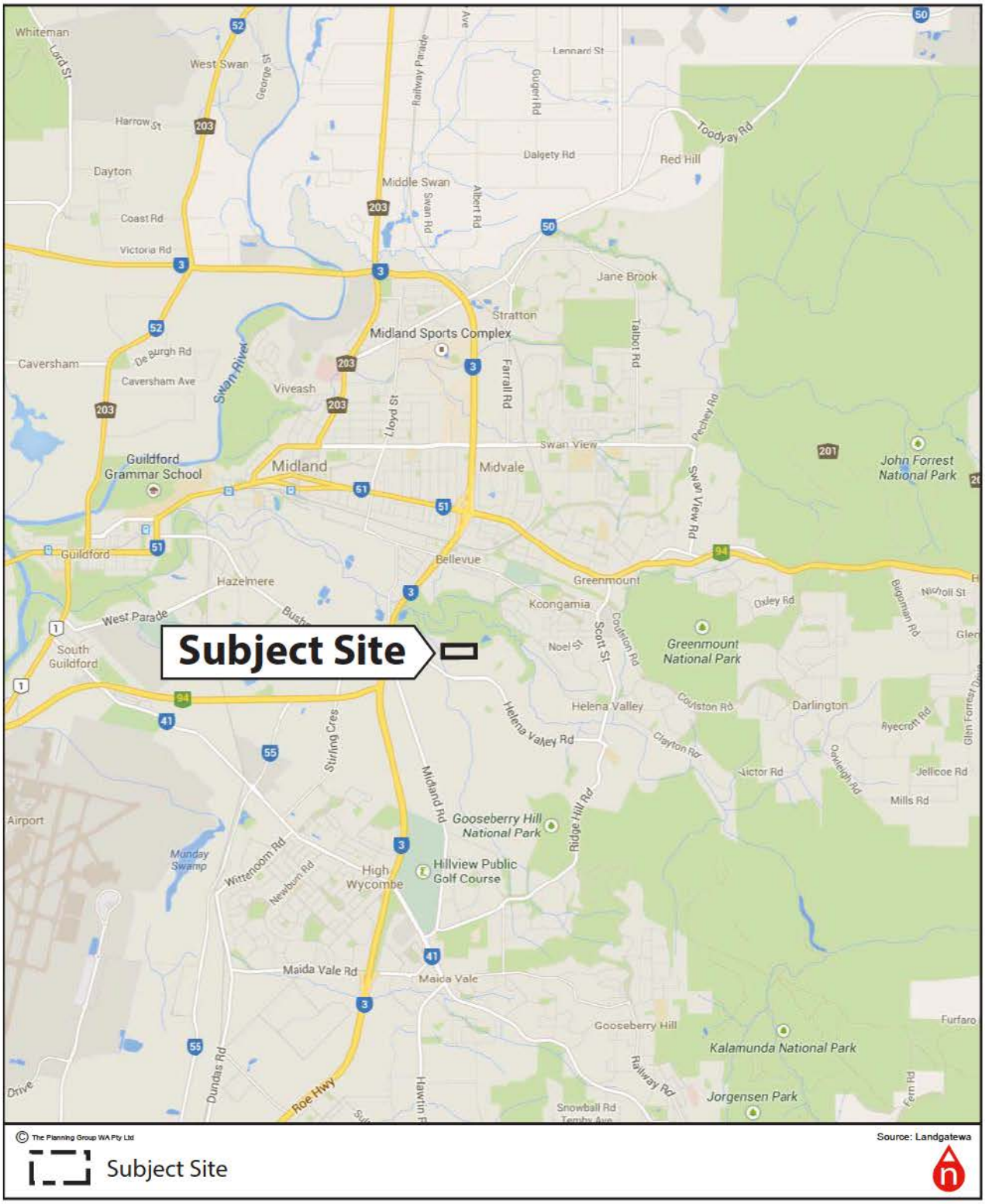
The site is also located within 480 metres of the Helena Valley Local Centre located to the south of the subject site on Helena Valley Road.

The Bushmead Rifle Range is located further to the south of the subject site on the Southern Side of Helena Valley Road.

Perth airport is also located in relatively close proximity to the subject site.

Refer to Figure 1 – Location Plan.

Figure 1 – Location Plan



1.2.2 Area and Land Use

The structure plan area comprises a total of 13.2332 ha of land.

Historically, it is understood that the north western portion of the structure plan area was previously used for the excavation of a clay deposit to supply a brick factory also located within the site boundary, from roughly 1979 until 1993 (Worley Parsons, 2008). The pit created as a result of the clay extraction was backfilled with uncontrolled fill and the clay pit within the confines of the sites boundaries is now completely backfilled. The landfill area has been capped with imported material.

A summary of the historical uses of the subject site is also listed below:

- Brickworks (including clay extraction and brick manufacture), salvage.
- Salvage yard.
- Construction of transportable buildings.
- Repair and renovation of buildings transported to the site.
- Recycling of dry demolition rubble and material for resale.
- Disposal of dry demolition rubble.

The brick factory infrastructure still remains in its current location, being a central portion of the structure plan area, but is no longer used for this purpose. The main sheds are predominantly used for the storage of parts, machinery, paints and miscellaneous items, or for vehicle maintenance and repair and the storage of oils, greases and mechanical fluids. The majority of the land surrounding the shed is in use as a laydown yard for material and machinery.

The subject site is also currently used for cattle grazing and as a base operations for a drilling contractor.

1.2.3 Legal Description and Ownership

The structure plan area comprises three separate land parcels being Lots 2, 3 and 6 Midland Road, Helena Valley. The details of the relevant Certificates of Title are provided in the table below.

Table 1 – Certificate of Title details

Lot No.	Street Address	Volume / Folio	Plan	Area
2	Lot 2 Midland Road, Helena Valley	1409/591	D3284	8.9031 ha
3	Lot 3 Midland Road, Helena Valley	1409/592	D3958	2.2055 ha
6	Lot 6 Midland Road, Helena Valley	1409/593	D3259	2.1246 ha

A copy of the Certificates of Title is included at Appendix A.

The site details are also illustrated in the Site Plan contained at Figure 2.

Refer to Figure 2 – Site Plan

1.3 Planning Framework

1.3.1 Zoning and Reservations

1.3.1.1 Metropolitan Region Scheme

Lot 3 Midland Road, Helena Valley is wholly located within the 'Urban' zone of the Metropolitan Region Scheme (MRS).

A majority of Lot 2 Midland Road, Helena Valley is also zoned 'Urban' however the north-western portion of the lot is zoned 'Rural' and the north eastern portion of the site is reserved for 'Parks and Recreation'.

The eastern portion of Lot 3 is reserved for 'Parks and Recreation' whereas the western portion is zoned 'Rural'.

Refer to Figure 3 – Metropolitan Region Scheme extract

1.3.1.2 Shire of Mundaring Local Planning Scheme No. 4

Lot 3 Midland Road, Helena Valley is wholly located within the 'Development' zone pursuant to the Shire of Mundaring Local Planning Scheme No. 4 (LPS4).

A majority of Lot 2 Midland Road, Helena Valley is also within the 'Development' zone of LPS4, however the western portion of the site is zoned 'Rural-Residential' which corresponds with the 'Rural' zoning under the MRS.

The western portion of Lot 3 is zoned 'Rural-Residential' under LPS4.

The portion of the site reserve for parks and recreation under the MRS is not zoned under LPS4.

Refer to Figure 4 – Local Planning Scheme No. 4 extract

Figure 2 - Site Plan

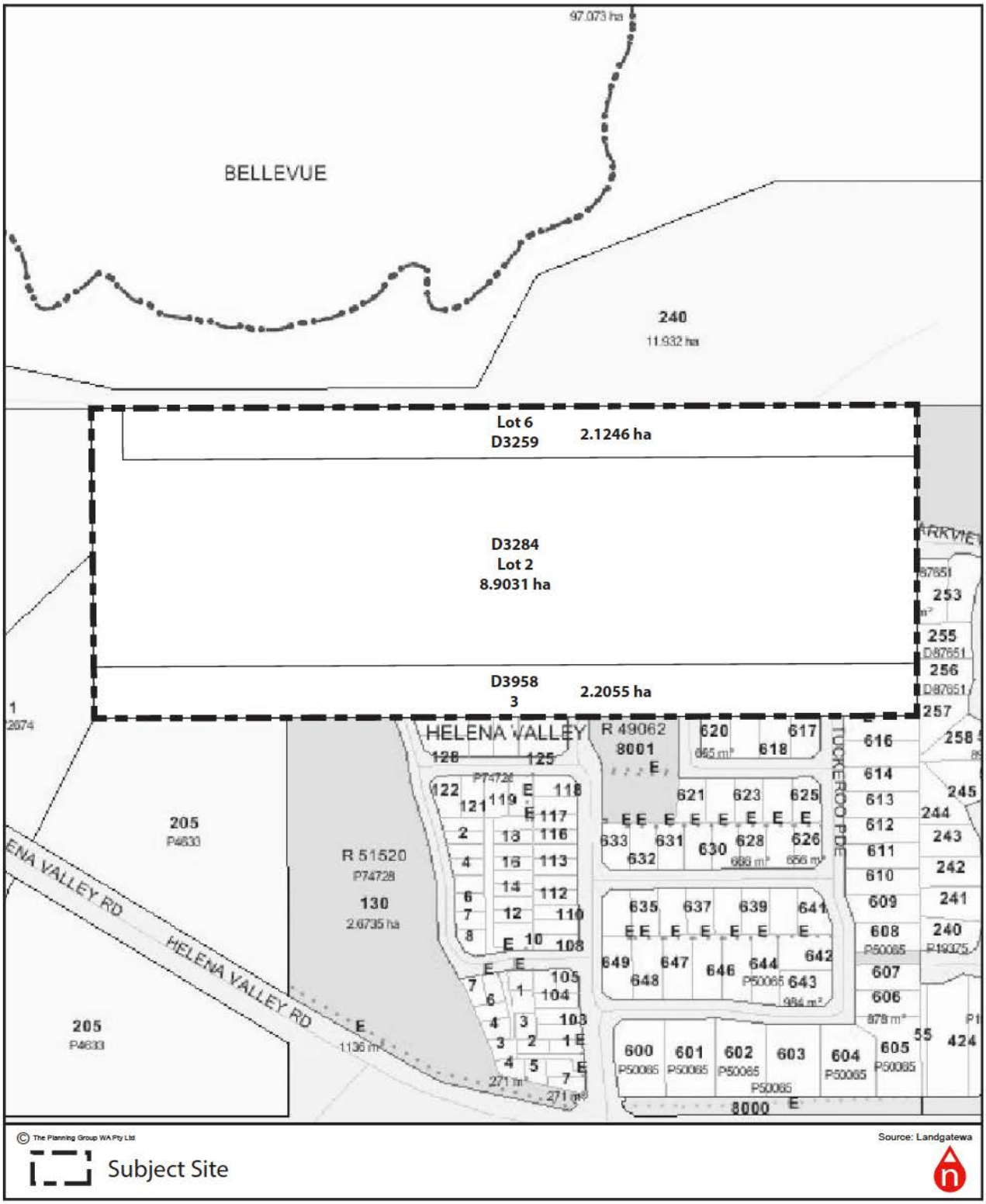


Figure 3- Metropolitan Region Scheme extract

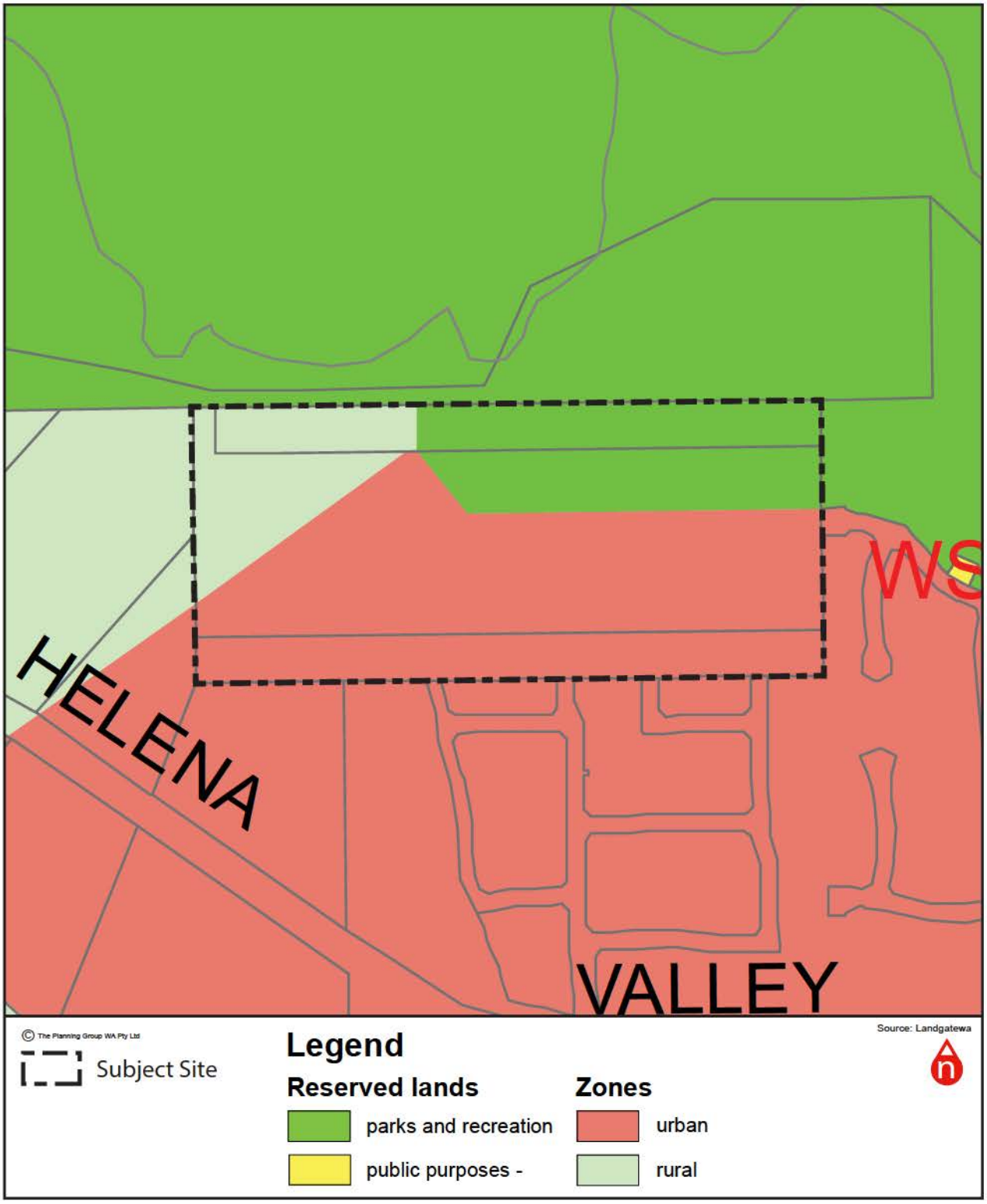
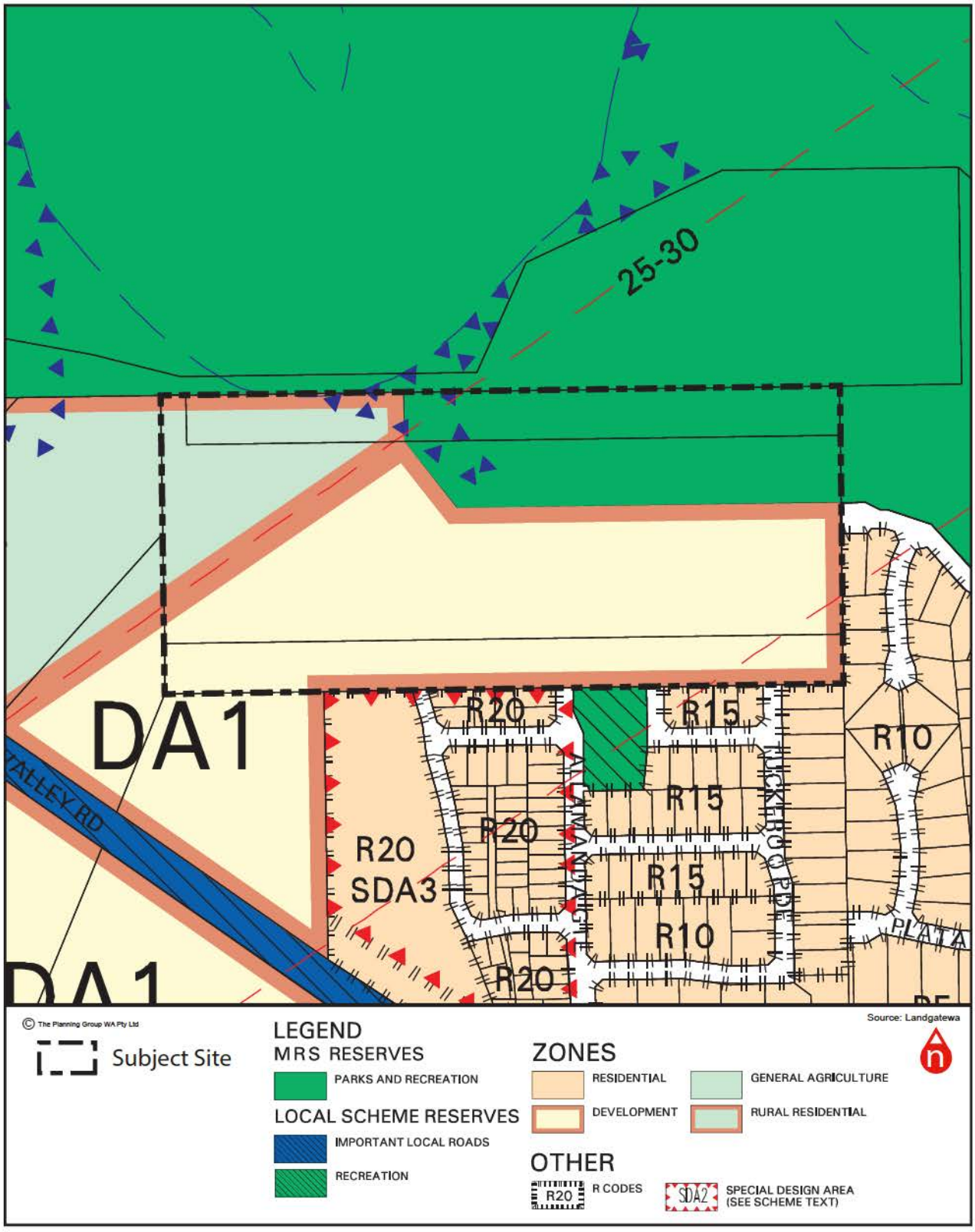


Figure 4 – Local Planning Scheme No. 4 extract



The objectives of the 'Rural-Residential' zone are:

- To provide for residential use in a rural setting, in suitable and appropriate locations in reasonable proximity to services.
- To conserve the natural environment as far as possible for the enjoyment of residents as well as the maintenance of ecological and landscape values, particularly by the protection of native vegetation (trees and understorey) and by water-sensitive development.
- To provide for other uses compatible with and complementary to rural living, subject to appropriate land capability and suitability and protection of residential amenity.

The portion of the site zoned 'Rural-Residential' has been set aside for open space to conserve and protect the resource enhancement wetland and associated buffer.

The objective of the 'Development' zone is to *'provide for the orderly planning of large areas of land for residential and other purposes through comprehensive structure planning which will provide the basis for future subdivision and development.'*

This structure plan has been prepared to address the requirements of the Development zone.

Watercourse Protection

Clause 5.7.5 of LPS4 relates to watercourse protection and establishes the following requirements:

(a) *"the setback specified for a particular watercourse in a watercourse hierarchy and protection strategy adopted by the Shire;*

(b) *in the absence of a specific setback for a particular watercourse in a watercourse hierarchy and protection strategy adopted by the Shire, 20 metres in the Residential zone and 30 metres in all other zones, or such greater distance as may be required by the Shire in the case of watercourses within the Middle Helena Catchment Area or the Mundaring Weir Catchment Area."*

The proposed structure plan proposes a 30 metre buffer to the Resource Enhancement Wetland which contains the Kadina Brook in the south-western portion of the subject site.

Local Natural Areas

Clause 5.7.13 of LPS4 deals with Local Natural Areas and establishes the following requirements with respect to LNA's:

(a) Where clearing of vegetation in a LNA is proposed or would be a consequence of a Scheme Amendment, Structure Plan, subdivision or development requiring planning approval, the Shire may require or recommend that the subdivider or landowner prepare, or cause to be prepared, a Native Fauna and Flora Report and Management Plan to the satisfaction of the Shire prior to supporting or approving the proposal, or prior to clearing the land.

(b) The Shire may recommend or impose conditions of approval requiring actions to protect and manage fauna or flora identified pursuant to the above clause.

The LNA's are addressed further on in this report.

Aircraft Noise Exposure Forecast Special Control Area

Clause 6.4 establishes an Aircraft Noise Exposure Forecast Special Control Area. All land subject to the 20 and 25 Australian Noise Exposure Forecast (ANEF) contours are subject to the provisions of the Special Control Area.

Land within the north-western portion of the Structure Plan area is located within the 20 and 25 ANEF countour.

The objectives of the Special Control Area are to:

(a) protect Perth Airport from unreasonable encroachment by incompatible development, particularly noise-sensitive development, to provide for its ongoing development and operation; and

(b) minimise the impact of airport operations on residents within the Shire of Mundaring.

The Shire shall also have regard to the provisions of State Planning Policy 5.1 and any advice received from the Westralia Airports Corporation in considering any application for planning approval.

Bushfire Hazard

Clause 6.5 of LPS4 establishes a Bush Fire Hazard Special Control Area. Portions of the subject site are identified as being subject to moderate bushfire hazard levels according to the bushfire hazard mapping contained on the scheme maps.

The objectives of the Bush Fire Special Control Area are:

(a) identify bush fire prone areas, where bush fires pose a significant threat to life and property;

(b) avoid any development of habitable buildings in areas where there is a significant risk to life and property from bush fires, except where such development rights existed prior to the gazettal of this Scheme and there is no alternative location for development on a particular land parcel that has a lower risk;

(c) encourage the improvement of vehicular access and egress for residents and fire fighting vehicles in bush fire prone areas;

(d) ensure that a bush fire attack level assessment is carried out on land that is subject, or likely to be subject, to bush fire hazard; and

(e) ensure that land use and development in areas where there is a significant risk to life and property from bush fires takes into account bush fire safety requirements and includes specified protection measures, while having regard for the amenity and environmental values of the locality.

Clause 6.5.5 requires that prior to the adoption of a structure plan introducing or proposing the intensification of development, a bush fire attack level assessment which satisfactorily addresses the level of bush fire hazard is to be submitted to the Shire.

A bushfire management plan has been prepared and contained at Appendix B and is further summarised and addressed within this report.

1.3.2 Relevant Legislation

1.3.2.1 Swan and Canning Rivers Management Act 2006

The *Swan and Canning Rivers Management Act 2006* establishes protection and management functions in respect of the Swan and Canning Rivers and associated land.

Clause 10 of the Act establishes the Swan River Trust Development Control Area (SRT DCA). The SRT DCA as it relates to the Structure Plan area is defined in Figure 5 below.

Refer to Figure 5 – Swan River Trust Development Control Area

It is noted that the SRT DCA only applies to the portion of the Structure Plan area that is reserved for Parks and Recreation. However development of future lots directly abutting the SRT DCA will trigger the requirement for the local authority to refer the application to the SRT for advice and recommendations.

1.3.3 Planning Strategies

1.3.3.1 Directions 2031

Directions 2031 is the highest level spatial strategic plan that establishes a vision for the future growth of the Perth and Peel metropolitan region. At its core, the Directions 2031 framework seeks to coordinate the provision of housing, infrastructure and services.

The strategic document establishes a number of principles for development, including:

- Identification of a network and hierarchy of activity centres which will create an equitable distribution of jobs and amenity throughout the City, while also encouraging intensification of residential density in and around these activity centres.
- It seeks to establish an integrated system of public and private transport networks.
- A green network of parks, reserves and conservation areas to support biodiversity, preserve natural amenity and protect valuable natural resources.

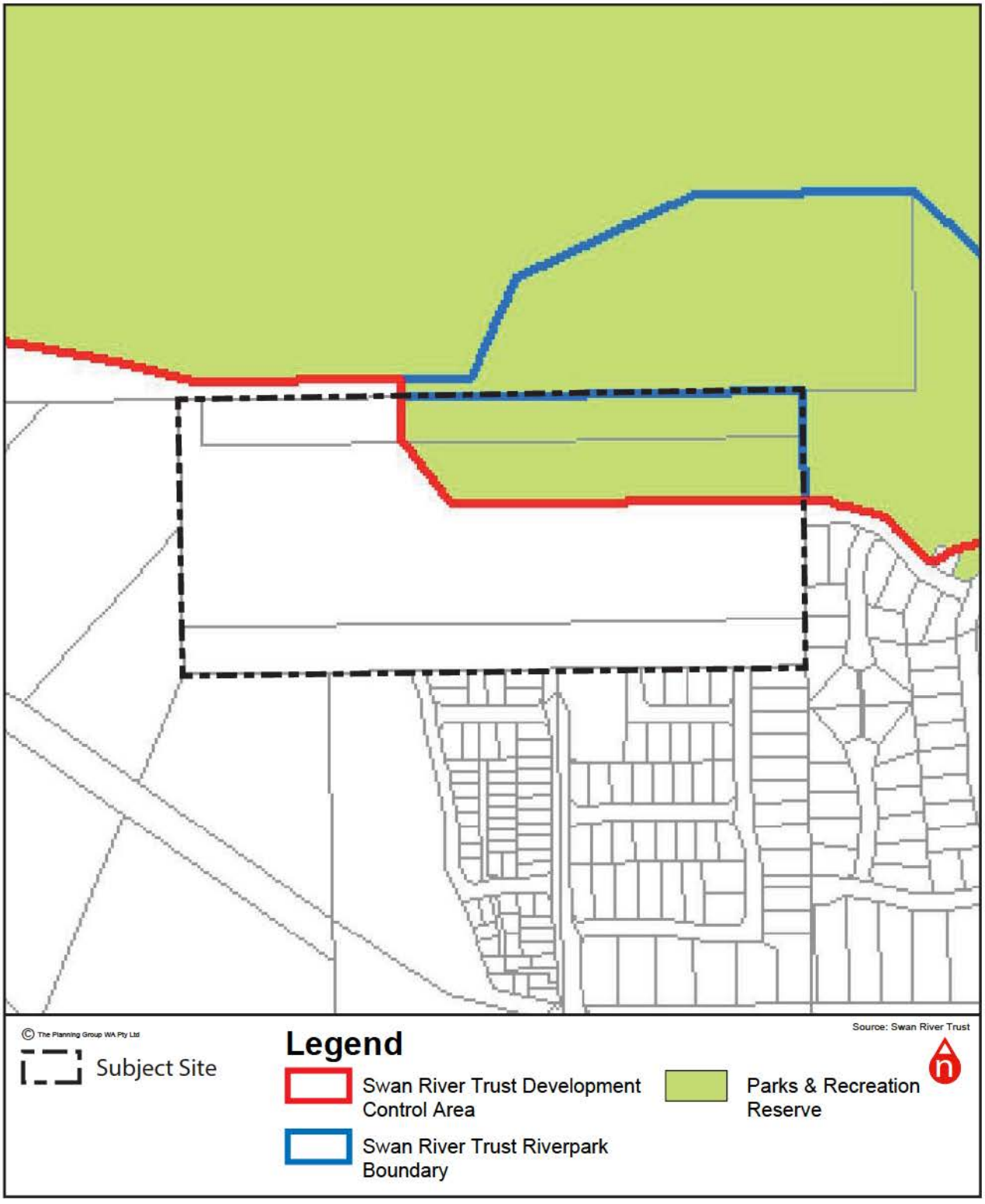
In relation to the above, it is important to note that the subject site is not identified as part of the green network of parks and natural bushland identified by Directions 2031.

Directions 2031 also establishes infill residential targets within each local government area in order to minimise the extent of new greenfield land required to be developed and in order to provide new housing in established areas with existing services and amenity.

The Shire of Mundaring is located within the north-east sub-region. Within this sub region, Direction 2031 sets a target of an increase in population of 69,000 people and an additional 40,000 dwellings to accommodate this additional population.

This structure plan proposes the creation of 67 new residential lots to contribute toward meeting these targets.

Figure 5 – Swan River Trust Development Control Area



1.3.3.2 Outer Metropolitan Perth and Peel Sub-Regional Strategy

A number of sub-regional strategies, including the Outer Metropolitan Perth and Peel Sub-Regional Strategy (the Strategy), have been prepared to support Directions 2031 and deliver strategic planning at a local level. The sub regional strategies address issues that extend beyond local government boundaries to provide a regional response to common issues, such as the provision of housing.

Within the North-East sub region, Midland is identified as continuing to provide a regional activity centre function and Mundaring is identified as a District Centre.

The Strategy identifies an estimated dwelling supply of between 3,950 to 4,970 dwellings within the Shire of Mundaring. With respect to this, the Strategy identifies the subject site as falling within an undeveloped urban zoned area that has potential to generate in excess of 300 residential lots.

The Strategy also acknowledges the intersection upgrade of Roe Highway and the Great Eastern Highway.

1.3.3.3 Perth and Peel @ 3.5m

The *Draft Perth and Peel at 3.5 Million* document is the Western Australian Planning Commission's (WAPC) most recent strategic planning framework for the Perth and Peel Region. *Perth and Peel at 3.5 million builds* on the vision and objectives of *Directions 2031 and beyond* and provides a link across the four sub-regional planning frameworks that define the spatial plan for the Perth and Peel regions for the next 35 to 40 years.

The structure plan area is located within the North-East sub Regional Planning Framework (the Framework), which is expected to more than double its population to 450,500 by 2050.

The Structure Plan area is identified as 'Urban' under the Framework.

1.3.3.4 Shire of Mundaring Local Planning Strategy

The Local Planning Strategy (LPS) sets the strategic direction for land use planning and development for the Shire over the next 10 to 15 years and makes a number of recommendations in relation to zoning and development requirements which have informed LPS4.

Key strategic objectives of the LPS include:

- To set out the long-term planning directions for the Shire;
- To outline, interpret and, as appropriate, apply State and regional planning policies and strategies; and
- To provide the rationale for zones and reserves, Special Control Areas and other provisions of the Shire's accompanying Local Planning Scheme No. 4.

The following strategies contained within the LPS are relevant to this proposal:

1. Include land in Helena Valley already zoned Urban in the MRS but zoned Rural Landscape Living in TPS3 in a Development zone in LPS4, to allow for determination of residential densities and disposition of land uses through structure planning.
2. In structure planning for residential development within the Development zone in Helena Valley, seek to achieve a net residential density of around 15 dwellings per hectare.

In addition to the above, the other relevant recommendations of the LPS relevant to this proposal are summarised below.

Local Natural Areas

Local Natural Areas identified within the Shire's Local Biodiversity Strategy are mapped in the LPS and are subject to a range of recommendations to encourage retention and protection.

The maps contained within the Strategy identify portions of the subject site as being identified for 'Protection'.

The Strategy notes that where land contains 'Protection' category Local Natural Areas and has subdivision potential, structure planning and subdivision should minimise (and if possible avoid) clearing and fragmentation of Local Natural Areas and that these should be retained within a single landholding with a conservation covenant or within public open space.

In regards to this, the Strategy further requires where a structure plan may adversely impact on a Local Natural Area, the structure plan is to *"provide vegetation, flora and fauna reports or management plans. Such reports should be provided at the earliest possible stage in 51 and 56 and matters of national environmental significance, and may include the involvement of environmental agencies where appropriate."*

The landowner has subsequently commissioned more detailed investigations into the quality of vegetation and habitat within the areas identified for protection and the outcomes of this investigation are discussed later on in this report.

Bushfire Hazard

The Strategy recommends that bushfire planning occurs in accordance with the *Planning for Bush Fire Protection Guidelines* and recommends a Special Control Area to be applied to those areas with an 'Extreme' or 'Moderate' bushfire hazard.

A Bushfire Hazard Assessment has been prepared to address this requirement and is summarised later in this report and contained within the Bushfire Management Plan located at Appendix B.

Residential Hills (Existing towns/villages)

The relevant strategies applicable to this structure plan in relation to residential hills development are listed below:

- Where land containing Retention Category Local Natural Areas has subdivision potential, structure planning and subdivision should minimise clearing and fragmentation of Local Natural Areas where possible.
- Special environmental features are to be identified at the rezoning or structure planning stages, and wherever possible, included within POSL.
- Encourage medium density housing development where reticulated sewerage is available, to provide greater housing choice and better meet the housing requirements of the Shire's residents over time.

Helena Valley Locality

The relevant strategies applicable to the Helena Valley locality include:

- In structure planning for the balance of future residential land in Helena Valley, south of the Helena River, investigate the possibility of securing a site for an oval and/ or other recreational facilities to provide for the population of Helena Valley south of the river.
- In structure planning for residential development within the Development zone in Helena Valley, seek to achieve a net residential density of around 15 dwelling per hectare.

1.3.3.5 Mundaring Local Biodiversity Strategy

The Shire of Mundaring is the first local government to incorporate its endorsed local biodiversity strategy within its local planning strategy and local planning scheme. Within the Local Biodiversity Strategy, the Shire has defined Local Natural Areas (LNA's) based on their conservation significance, land zoning, and other planning considerations such as structure plans and lot size. LNA's are categorised into three categories being:

- **Conservation:** LNA's generally have high ecological values and are either on Crown land vested for a conservation purpose, included within a Local Reserve for Conservation in the Shire's new Local Planning Scheme No. 4, or protected by a Conservation Covenant.
- **Protection:** LNA's have high ecological value but are located on private lands.
- **Retention:** LNA's have a relatively lower ecological value and also generally located on private lands.

LNA's are natural areas that exist outside of Bush Forever Sites, the CALM Managed Estate and Regional Parks.

LNA'S were identified through remnant vegetation mapping undertaken in 2007 and by interpretation of 2005 aerial photography. The Mundaring Local Biodiversity Strategy states *"any decision relating to the retention, protection or management of a Local Natural Area should be supported by site-specific assessments using standardised formats."*

1.3.4 Relevant Policy Framework

1.3.4.1 State Planning Policy No. 3 – Urban Growth and Settlement (SPP 3)

State Planning Policy No. 3 – Urban Growth and Settlement (SPP 3) sets out the key considerations with apply to planning for urban growth and settlement in Western Australia.

Of particular relevance to this Structure Plan, SPP 3 identifies the need to give priority to infill development in established urban areas and areas well serviced by employment and public transport in order to effectively manage the urban growth of the Perth metropolitan area.

1.3.4.2 State Planning Policy 3.4 – Natural Hazards and Disasters (SPP 3.4)

State Planning Policy 3.4 (SPP 3.4) identified the need for the planning of urban areas to consider natural hazards including flooding, bush fire, landslides, earthquakes, cyclonic activity, coastal erosion, severe storms, storm surge and tsunamis. Of particular relevance to this Structure Plan is flooding and the risk of bushfire.

The Structure Plan area is located in proximity to the Helena River and the Kadina Brook, which would both be subject to flooding from time to time. Flood mapping associated with these water systems and the associated impact on the Structure Plan area has been examined.

Flood mapping for the Helena River shows that the 1 in 100 year flooding level extends approximately 400 metres up Kadina Brook, but terminates 100 metres north of the site. Therefore the site is not subject to flooding from the Helena River. Flood levels for the Kadina Brook are likely to be contained within the reserve and buffer associated with this wetland.

The risk of bushfire is discussed in further detail in relation to the Draft Planning for Bushfire Management policy.

1.3.4.3 Draft Planning for Bushfire Management (Draft SPP 3.7)

Draft SPP 3.7 establishes a risk minimisation approach to assist in decision making with respect to planning and development in proximity to bushfire-prone areas. The policy is to be read in conjunction with the document *Planning for Bushfire Risk Management Guidelines* (the Guidelines) and relevant legislation.

Bushfire prone areas may be identified by a number of ways, one of which being via a local government bushfire map. In this instance, the Shire of Mundaring has adopted its bushfire prone mapping pursuant to LPS4 via a Special Control Area (Clause 6.5 of TPS4). The mapping identifies areas of 'Extreme' and 'Moderate' bush fire hazard which has been determined in accordance with the Type 1 and Type 2 Bush Fire Hazard Assessment Procedures in *Planning for Bush Fire Protection (2001)*.

In this instance portions of the Structure Plan area and land adjacent to the Structure Plan area in the north and west have been mapped as being of a 'Moderate' bushfire hazard.

In accordance with Draft SPP 3.7, identification of an area as being bushfire-prone is not in itself an indication of bushfire risk, but it does trigger the requirement for a proponent to assess the level of risk through either a bushfire hazard assessment and/or a Bushfire Attack Level (BAL) assessment.

The BAL rating descriptions are contained in the Guidelines and are described in the table below:

Table 2 – BAL Ratings

BAL	Description
BAL-LOW	There is insufficient risk to warrant any specific construction requirements but there is still some risk.
BAL-12.5	There is risk of ember attack.
BAL-19	There is risk of ember attack and burning debris ignited by wind-borne embers and a likelihood of exposure to radiant heat.
BAL-29	There is an increased risk of ember attack and burning debris ignited by wind-borne embers and a likelihood of exposure to an increased level of radiant heat.
BAL-40	There is much increased risk of ember attack and burning debris ignited by wind-borne embers, a likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front. Not supported by planning.
BAL-Flame Zone	There is an extremely high risk of ember attack and burning debris ignited by wind-borne embers, and a likelihood of exposure to an extreme level of radiant heat and direct exposure to flames from the fire front. Not supported by planning.

Draft SPP 3.7 requires that the Bushfire Hazard Assessment identify the applicable BAL rating and any development of an area rated at BAL 40 or above is not to be supported unless it can be demonstrated that the risk can be reduced to comply with the policy requirements or the proposal is considered to be unavoidable development.

A Bushfire Management Plan (BMP), including a bushfire hazard assessment, has been undertaken and is contained in Appendix B.

This BMP provides acceptable solutions and responses to the performance criteria that fulfill the intent of the bushfire hazard management issues outlined in the Planning for Bush Fire Protection Guidelines (WAPC et al., 2010) and the draft Planning for Bushfire Risk Management Guidelines (WAPC 2014). However, community bushfire safety is a shared responsibility between governments, fire agencies, communities and individuals.

Dwellings located in bushfire prone areas (i.e. within 100m of classified vegetation) will have the risk mitigated via compliance with AS 3959 standards. BAL-29 is not exceeded and an internal Bushfire Protection Zone (BPZ) is incorporated into the Structure Plan where classified vegetation is immediately adjacent to proposed development. Road reserves and landscaped POS areas with fuel management programs can also be effective BPZs. A minimum of two access options and internal loop roads, reticulated water supply, and hydrants are provided. The proposed development will fall within the acceptable level of risk.

1.3.4.4 State Planning Policy 2.4 – Basic Raw Materials

State Planning Policy 2.4 – Basic Raw Materials (SPP 2.4) provides for the protection of basic raw materials, with the intention of this policy to ensure these resources can be fully utilised, through appropriate land uses and timeframes for development that may otherwise conflict with this intention.

The structure plan area is not located within a designated extraction area or resource location according to the mapping contained within SPP 2.4 and therefore there are no associated constraints on the timing of the proposed future urban development in accordance with the policy requirements. There have, however, been historical clay extraction activities across a large portion of the site, particularly the east.

1.3.4.5 State Planning Policy 5.1 – Land Use Planning in the Vicinity of Perth Airport (SPP 5.1)

The objectives of SPP 5.1 include:

- Protect Perth Airport from unreasonable encroachment by incompatible (noise sensitive) development, to provide for its ongoing development and operation; and
- Minimise the impact of airport operations on existing and future communities with reference to aircraft noise.

The policy establishes requirements for development in relation to different ANEF contours. With respect to areas between 20 ANEF and 25 ANEF of which portions of the subject site fall within, the following requirements are applicable.

(a) Zoning and associated development control provisions (including structure plans) should take into consideration the level of noise exposure forecast and the Building Site Acceptability for the particular noise exposure zone.

(b) Where land is zoned for residential purposes, the maximum dwelling density should generally be limited to R20, except where –

  a. There is a strategic need for more consolidated development;

  b. A higher density coding is desirable to facilitate redevelopment or infill development of an existing residential area; and

  c. There is some other public interest reason which justified the need for higher density coding.

The Structure Plan has given due regard to this policy and has designated all residential land within the 20-25 ANEF Contour with a maximum R-Code of R20.

1.3.4.6 Development Control Policy 1.5 – Bicycle Parking

Development Control Policy 1.5 – Bicycle Parking (DC 1.5) seeks to ensure that planning for new residential subdivisions caters for cyclists. Relevant requirements include:

- Ensuring that the local road network is safe for cyclists;
- Within new residential areas, the emphasis should be on on-road facilities linked by segregated paths to ensure continuity of the cycle route system; and
- Subdivision design should provide for bicycle access along river and coastal foreshores.

The proposed local road network will receive low volumes of vehicular traffic and are adequately designed to accommodate cyclists. Additionally, all proposed local roads will accommodate a shared path within the verge to accommodate pedestrians and young cyclists.

A shared path is also proposed adjacent to the Kadina Brook within the wetland buffer, which ideally would link in with cycle path connections to the north and south of the Structure Plan area.

1.3.4.7 Development Control Policy 2.2 – Residential Subdivision

Development Control Policy 2.2 – Residential Subdivision (DC 2.2) establishes requirements for residential subdivision. Residential subdivision contemplated by this Structure Plan is compliant with the requirements of this policy.

1.3.4.8 Development Control Policy 2.3 – Public Open Space in Residential Areas

Development Control Policy 2.3 – Public Open Space in Residential Areas (DC 2.3) seeks to ensure that residential development is supported by adequate public open space which contributes to the amenity of a place.

Amongst other matters, DC 2.3 typically requires the provision of 10 percent POS corresponding to the requirements of Liveable Neighbourhoods.

The policy also requires that where a subdivision includes land which is designated as 'Parks and Recreation' under the MRS, that portion of land will be created as a separate lot at subdivision stage pending acquisition by the WAPC pursuant to the MRS.

The proposed Structure Plan provides POS and Regional Open Space in accordance with the requirements of this policy.

2. Site Conditions and Constraints

2.1 Surrounding Context

The Structure Plan area is located at the northern front of a Development zone that has substantially been subdivided previously. Residential subdivision borders the Structure Plan area to the south and east and these areas are serviced by a local road network that can be extended into the Structure Plan area.

Not all the adjacent road connections are required to extend into the Structure Plan area to service the future subdivision. In this regard, it is proposed to extend Melita Drive, Carabeen Avenue, Tuckeroo Parade and Parkview Garden into the Structure Plan area to provide local connectivity back into the existing adjacent residential areas. This in turn will improve connectivity between the existing residential subdivision to the south and east.

A drainage reserve and public open space exists immediately to the south of the Structure Plan area. This drainage reserve receives stormwater from the immediate surrounding residential catchment. It is not proposed to utilise this drainage sump in relation to drainage of the future subdivision but rather to direct stormwater through an open swale system into the Kadina Brook with a view to improving the ecological function of Kadina Brook.

The Structure Plan proposes to extend the adjacent Carabeen Avenue into the future subdivision so that there is a direct vehicular and pedestrian link between this POS area and the future residential subdivision.

The residential lots created between Melita Drive and Allamanda Gate immediately to the south of the Structure Plan area sit substantially higher than the Structure Plan area and consequently a high retaining wall runs along this boundary interface.

Regional Open Space exists immediately to the north of the subject site and this is associated with the Helena River. Portion of the Structure Plan area has been reserved for 'Parks and Recreation' under the MRS and is ultimately proposed to be ceded as Regional Open Space to form part of the wider Helena River Parks and Recreation reserve.

Kadina Brook also runs through the western portion of the site and this wetland along with a buffer will be provided as public open space for the purpose of conservation.

2.2 Biodiversity and Natural Area Assets

2.2.1 Flora and vegetation values

Regional vegetation mapping undertaken by Heddle et al (1978) indicates that the site was originally composed primarily of the 'Forrestfield Complex', which is described as: Open Forest of *Corymbia calophylla, Eucalyptus wandoo* and *E. marginata* to Open Forest of *E. marginata, C. calophylla, Allocasuarina fraseriana* and *Banksia spp.* with fringing woodlands of *E. rudis* in gullies.

The site contains two main areas of remnant native vegetation in the north and west of the site, and an area of planted trees in the south-east. These natural areas range in condition from "Good – Degraded" to "Completely Degraded". Overall the western vegetation is more intact, with condition ranging from "Degraded" to "Degraded – Completely Degraded". The northern vegetation is generally "Degraded – Completely Degraded" with a very small area of "Good – Degraded". Overall, this suggests that the vegetation remaining in these areas is unlikely to be representative of the Forrestfield complex, given the absence of vegetation structure including understorey species.

Based on a preliminary flora and vegetation site assessment undertaken by Emerge Associates, vegetation within the site is made up of the following communities:

- **CcOF:** Open Forest of *Corymbia calophylla, Eucalyptus rudis* and *E.wandoo* subsp. wandoo over scattered *Acacia pulchella* and *Juncus kraussii* (or native species absent in understorey) and Closed Grassland including **Lolium rigidum, *Ehrharta longifolia* and **Avena barbata.*
- **EcOW:** Open Woodland of planted mature **Eucalyptus camaldulensis subsp. obtusa* over dense saplings (self-seeded) and Closed Herbland/Grassland of broadleaf weeds and pasture grasses.
- **ErMrLOF:** Low Open Forest of *Eucalyptus rudis* over Isolated Trees to Low Open Woodland of *Melaleuca rhaphiophylla* over occasional dense patches of **Gomphocarpus fruticosus* over Sparse Sedgeland of *Juncus kraussii* fringing the creek lines, and **Cynodon dactylon, *Paspalum dilatatum* and **Lolium rigidum Closed Grassland.*
- **ErOF:** Open Forest of *Eucalyptus rudis* over Closed Grassland/Herbland of broadleaf weeds and pasture grasses.
- **JkOS:** Open Sedgeland of *Juncus kraussii* fringing open water over Closed Herbland/Grassland of broadleaf weeds and pasture grasses.
- **Parkland Cleared:** Scattered remnant and planted *Eucalyptus spp.* over *Watsonia sp.* and Herbland/Grassland of broadleaf weeds and paddock grasses.

2.2.2 Local Natural Areas

Two Local Natural Areas (LNAs) are located over the western portion of the site, the western most associated with Kadina Brook and an area of remnant vegetation to the east of Kadina Brook.

Within the Shire's Local Biodiversity Strategy, these areas are identified as Priority 1. The LNA's were originally defined through interpretation of 2005 aerial photography. The Shire's policy framework recognises the ability for LNAs to be further defined and refined through on site ground truthing.

Emerge Associates have undertaken this ground-truthing of the values provided by the LNA for the site and this is documented in Appendix C.

The detailed site assessments undertaken by Emerge revealed that vegetation within the site and LNA's is generally in 'Completely Degraded' to 'Degraded' condition. In accordance with the Shire's Local Biodiversity Strategy and the *Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region* the term 'bushland' only applies to native vegetation in 'good or better' condition, therefore the LNAs within the subject site do not represent 'bushland' in accordance with this definition.

The implementation of the proposed Structure Plan will involve the clearing of vegetation within the eastern LNA. The western LNA will, however be permanently retained within the REW reserve and buffer that is accommodated in the Structure Plan. The proponent proposes to undertake revegetation/ planting works within the REW and buffer area in order to increase the ecological values of the wetland, provide improved fauna habitat and to provide a consolidated environmental linkage.

In accordance with the Shire of Mundaring LPS No. 4, *"an owner of a lot wholly or partly affected by a Local Natural Area may request in writing that the Shire reconsider the designation of boundary of that Local Natural Area as it affects that lot".* The assessment of the Structure Plan by the Shire of Mundaring will consider the removal of the eastern LNA (and improvements to the western LNA) and on this basis it is requested that the extent of LNAs as mapped for the subject site be reviewed as part of the process of considering this structure plan.

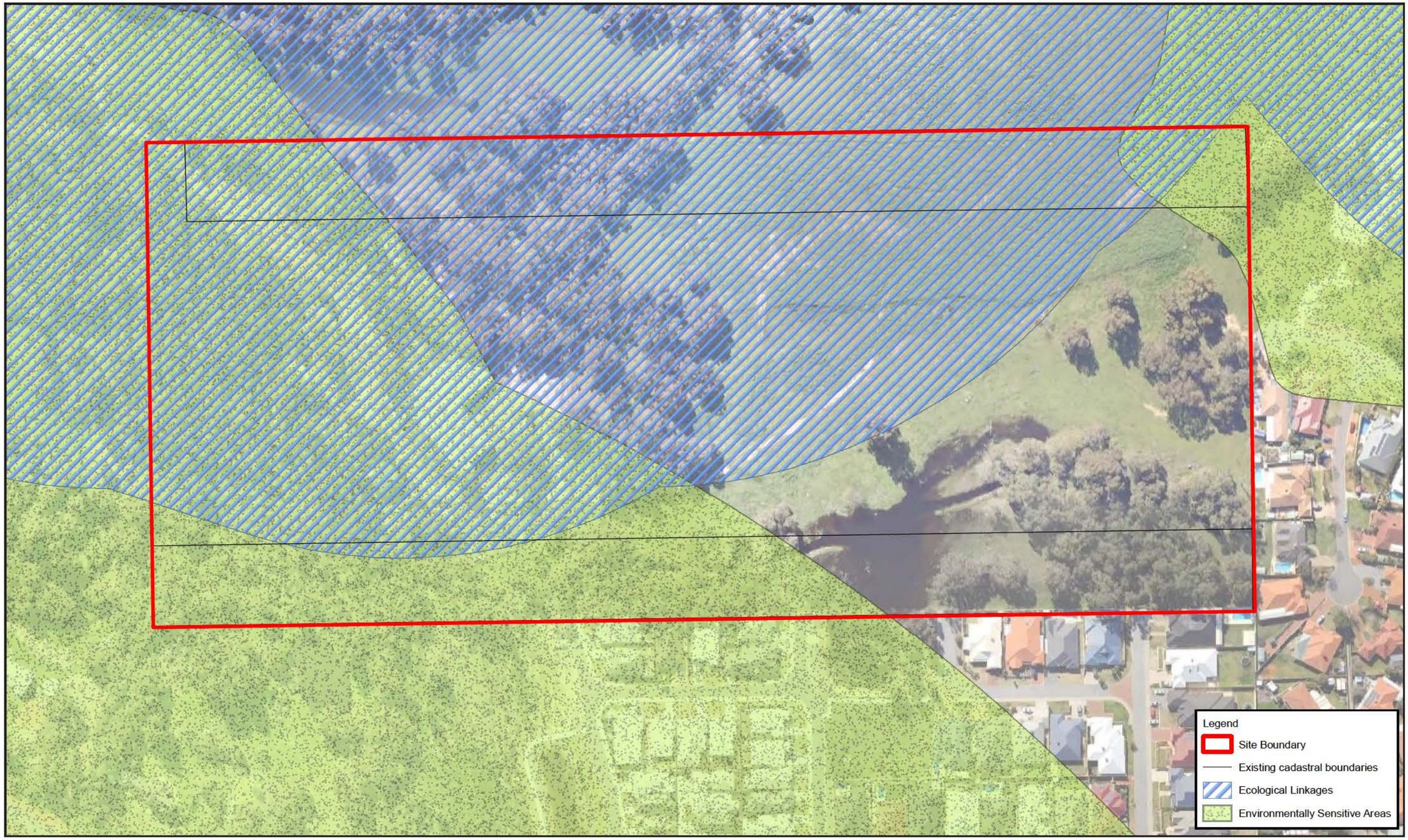
2.2.3 Ecological Linkages

The Perth Biodiversity Project's (PBP) *Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region* (2004) Regional Ecological Linkage 134 covers the majority of the structure plan area, connecting the Conservation Category Wetlands to the north-west, and Resource Enhancement Wetland within the site, to further wetland areas south and east of the site.

Refer to Figure 6 – Local Natural Areas

The connectivity of this linkage will be maintained through the long term retention of vegetation within the wetland area in the west of the structure plan area, and areas of remnant vegetation west and east of the site. Any areas of vegetation retained in POS within the structure plan area will contribute to this linkage, however the integrity of the connection is not dependent on the vegetation within the site. No further consideration is required within this Structure Plan as further consideration will be given at the subdivision stage.

Figure 6 – Local Natural Areas



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2.2.4 Environmentally Sensitive Areas (ESA)

The entire western portion of the structure plan area, as well as the north-eastern tip is covered by ESA's, likely associated with wetland areas surrounding the site. The extent of declared ESAs within and surrounding the structure plan area is documented in the Environmental Assessment and Management Strategy prepared by Emerge Associates contained at Appendix C.

2.2.5 Wetlands

Based on the Department of Parks and Wildlife's (DPaW) Geomorphic Wetland series mapping, there is a floodplain Resource Enhancement Wetland (REW) and a floodplain Multiple Use Wetland (MUW) covering the south-west of the site (DPaW, 2013), associated with the Kadina Brook.

REW areas are recognised as wetlands with moderate natural and human use attributes that can be restored and enhanced. The management objective for these wetlands is to restore value through the maintenance and enhancement of wetland functions and attributes. Spatial considerations required for the REW associated with the Kadina Brook within the site have been provided for through the placement of a 30 metre buffer between the mapped REW and the proposed development, with a road interface along the majority of the buffer to provide additional setback from potential damage.

MUW areas are recognised as having few wetland attributes, but still provide some hydrological functions. The management objective for these wetlands is to *"use, develop and manage in the context of water, town and environment planning through land care"*. These MU wetlands do not form any significant constraint to the proposed future urban development, but will need to be considered in the context of groundwater levels and fill requirements as part of stormwater management and engineering design, which is addressed in the supporting Local Water Management Strategy (LWMS).

2.3 Landform, Topography and Soils

2.3.1 Landform and Soils

The site occurs on the Swan Coastal Plain, the geomorphic element that characterises the Perth area and surrounds. On the Swan Coastal Plain, the site occurs on the Ridge hill shelf, which forms the laterised foothills of the Darling Scarp. Soil deposits of the Kadina Brook (located in the western portion of the site) consist of alluvium (clay, sand and loam) and the remainder of the site consists of colluvium (valley fill deposits, variably laterised).

2.3.2 Topography

Available contours for the site indicate that elevations within the site range from approximately 17.6m Australian Height Datum (AHD) at its highest point in the east of the site to 6m AHD at its lowest point in the north-west. Land contours within the site have, however, been significantly altered from their natural elevations, likely through historic quarrying activities and associated rural land uses across the majority of the site.

2.3.2.1 Public Drinking Water Source Areas (PDWSAs)

There are no Public Drinking Water Source Areas located within, or adjacent to the site (DoW, 2013).

2.4 Groundwater and Surface Water

2.4.1 Groundwater

Detailed groundwater monitoring has been carried out within the site by Emerge Associates on a monthly basis from October 2011 to December 2013. Peak levels were observed to occur during September or October. Depth to groundwater ranges between 4.99 and 0.07 metres below ground level (mBGL).

2.4.2 Surface Water and Existing Drainage

Kadina Brook, a tributary of the Helena River, runs through the south-west corner of the site and is also a mapped REW. Flood mapping for the Helena River shows that 1 in 100 year flooding level extends approximately 400m up Kadina Brook, but terminates 100m north of the site. Therefore the site is not subject to flooding from the Helena River. Flood levels for the Kadina Brook are likely to extend to the edge of the wetland mapping boundary, except for the eastern side where the wetland has been filled and landform raised.

Surface water ponding occurs in the south of the site in a depression formed through historic quarrying activities. Historic aerials show that while that area may have been a natural low-point within the site, quarrying operations created a drainage channel through the south of the site connecting to the Kadina Brook in the west of the site. Ponding in the area increased with the blockage of this drainage channel, resulting in the permanent wet area currently in the south of the site. This is not a natural feature, and will not require significant consideration within the Local Structure Plan other than the consideration of drainage and groundwater management.

2.5 Bushfire Hazard

There are a number of vegetated areas which require consideration in terms of future bushfire hazards. Vegetation within and surrounding the site has been classified according to AS3959 Construction of Buildings in Bushfire-Prone Areas (Standards Australia, 2009). Hazard ratings have been based on the vegetation classifications which in turn define necessary responses within the Local Structure Plan and for future development.

Vegetation that is to be permanently retained within and surrounding the site will pose permanent bushfire hazard considerations. In the same way, vegetation that is to be cleared for future urban purposes in the short to medium term will pose only temporary bushfire management considerations. Remnant vegetation within the site is limited in extent, and is intended to be largely cleared for urban development, and therefore does not require consideration in terms of posing future bushfire hazards. Vegetation to be retained permanently within the site is limited to the wetland area in the west of the site, which will require long term consideration and management of bushfire hazards. This has been addressed in the detailed Bushfire Management Plan (Emerge Associates and Bushfire Safety Pty Ltd 2014) attached in Appendix B.

2.6 Heritage

2.6.1 Indigenous heritage

Based on a review of the Department of Aboriginal Affairs 'Aboriginal Heritage Inquiry System' online database (DAA 2014), there are two registered Indigenous heritage sites within the site, and one in close proximity to the north-west corner of the site. The details for these registered sites are as follows:

Table 3: Registered Indigenous heritage sites within close proximity of the site

Site ID	Description	Location
3758	HELENA RIVER – Ceremonial, Mythological, Repository/Cache	Entire site and surrounding area
3971	HOLDING PADDOCK 5-8 – Artefacts / Scatter	South-west corner of the site
3967	HELENA RIVER A-C – Artefacts/Scatter, Historical	North-west of the site

The presence of registered heritage sites within the site will require further consideration, particularly in regards to obligations under the *Aboriginal Heritage Act 1972* prior to ground disturbance within the site. Consultation will be undertaken with relevant parties to understand the extent of the heritage values within the site.

2.6.2 Non-indigenous heritage

A desktop search of the State Heritage Office database (Heritage Council 2012) and the Australian Heritage Database (Department of Environment 2013) indicated there are no registered heritage sites within or in close proximity to the site.

2.7 Landfill and Contamination

The site has previously been used as a landfill and in response the landowners have engaged Worley Parsons to complete a Geotechnical and Environmental Site Assessment and Emerge Associates to undertake a Preliminary Site Investigation.

Given the historic land uses over the site, the site has been classified by the Department of Environment Regulation (DER) as "Possibly contaminated - investigation required" pursuant to the *Contaminated Sites Act 2003*. A Preliminary Site Investigation (PSI) was conducted by Emerge Associates (2015) to determine the extent of potential contamination within the site and to support the LSP. The PSI found that while the site will require further investigation (and potential remediation), in line with the *Contaminated Sites Act 2003*, based on the information at hand, there appear to be no significant contamination related impediments to the proposed land uses that could not be addressed during earthworks associated with a standard residential development.

The Preliminary Site Investigation (PSI) is contained at Appendix H and provides further detail regarding the form and extent of contamination and landfill recorded in relation to the structure plan area.

2.7.1 Earthworks

The geotechnical assessment indicates that the soil profile consists of pebbly silt and it is expected that filling will be required to achieve a site classification suitable for residential development and to manage the fall across the site between lots.

There is some uncontrolled fill on site from past land fill uses. The proposed structure plan has responded to the geotechnical conditions of the site relating to the uncontrolled fill by avoiding placing the residential lots and associated road system over the majority of the uncontrolled fill area. The proposed lots or roads only intersect with the uncontrolled fill in areas that have been mapped as having typically shallow levels of uncontrolled fill and so can be dealt with by either removing it or compacting the material to a suitable standard to allow development of the site. This will be the subject of further more detailed investigation prior to subdivision and development.

It is expected that additional filling will be required to achieve levels to service the site with sewer and to provide sufficient clearance to the groundwater table.

Retaining walls will be required to address the approximate 5 metre fall across the site. The final levels will be a balance between minimising retaining walls and reducing importing fill to produce lots suitable for building, which is achievable across the extent of the structure plan area.

2.7.2 Future contamination management requirements

Extensive contamination investigations, and potentially remediation, will be required through the future subdivision process and prior to any works being undertaken within the site, in line with the WAPC's model subdivision condition EN9 (WAPC 2012).

a) Prior to commencement of subdivision works, investigation for soil and groundwater contamination is to be carried out to determine if remediation is required. As a minimum, the investigation will need to confirm:

   i. The presence/absence of contaminants, including asbestos as ACM, in soil associated with the historic landfill.

   ii. The presence/absence of contaminants, including asbestos as ACM, in soil associated with the imported fill in the central raised area.

   iii. The presence/absence of contaminants in soils associated with the material storage areas including the storage of hydrocarbons, drilling fluids and painting / coating products.

   iv. The presence/absence and extent of landfill gas from the acceptance of putrescible and household waste during the operation of the former landfill. It is noted that the previous landfill was licensed to operate as an inert landfill site.

   v. A groundwater investigation to confirm local groundwater flow direction beneath the site and the presence/absence of contaminants in groundwater associated with the historic land uses which may have migrated through the soil into the groundwater or directly from the uncontrolled fill in which groundwater is currently located.

b) If required, remediation, including validation of remediation, of any contamination identified shall be completed prior to the issuing of titles to the satisfaction of the Western Australian Planning Commission on advice from the Department of Environment and Conservation, to ensure that the lots created are suitable for the proposed use.

Investigations and remediation are to be carried out in compliance with the *Contaminated Sites Act 2003* and current Department of Environment and Conservation Contaminated Sites Guidelines.

A subdivision approval (and associated conditions) provides the trigger for the site to enter the formal Contaminated Sites assessment process (pursuant to the Contaminated Sites Act 2003) and ties the remediation of the site to the subdivision approval and clearance process. The proponent will be required to demonstrate that the site has been suitably remediated to accommodate the proposed land uses prior to subdivision being granted (and titles issued) and all documentation will be required to be approved by an independent accredited auditor.

2.8 Acid Sulfate Soils

Acid Sulfate Soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state ASS are generally present in waterlogged anoxic conditions and do not present any risk to the environment. When oxidised, ASS produce sulphuric acid, which can pose risks to the surrounding environment, infrastructure and human health.

Available information from the Department of Environment and Conservation (2010), now Department of Environment Regulation, indicated that the area east of the site has a 'High to Moderate' risk of ASS occurring within three metres of the natural soil surface. The remainder of the site has 'no known risk' of ASS occurring within three metres of the natural soil surface (DER 2010).

Detailed ASS investigations will not be required to support the LSP, however may be required as part of future subdivision and associated development depending on the extent of excavations or if dewatering is required (e.g. for services, including sewer).

Refer to Figure 7 – Acid Sulfate Soils Risk Mapping

2.9 ANEF Contours

As discussed previously in this report, portions of the Structure Plan area fall within the 20-25 ANEF contours associated with the Perth Airport.

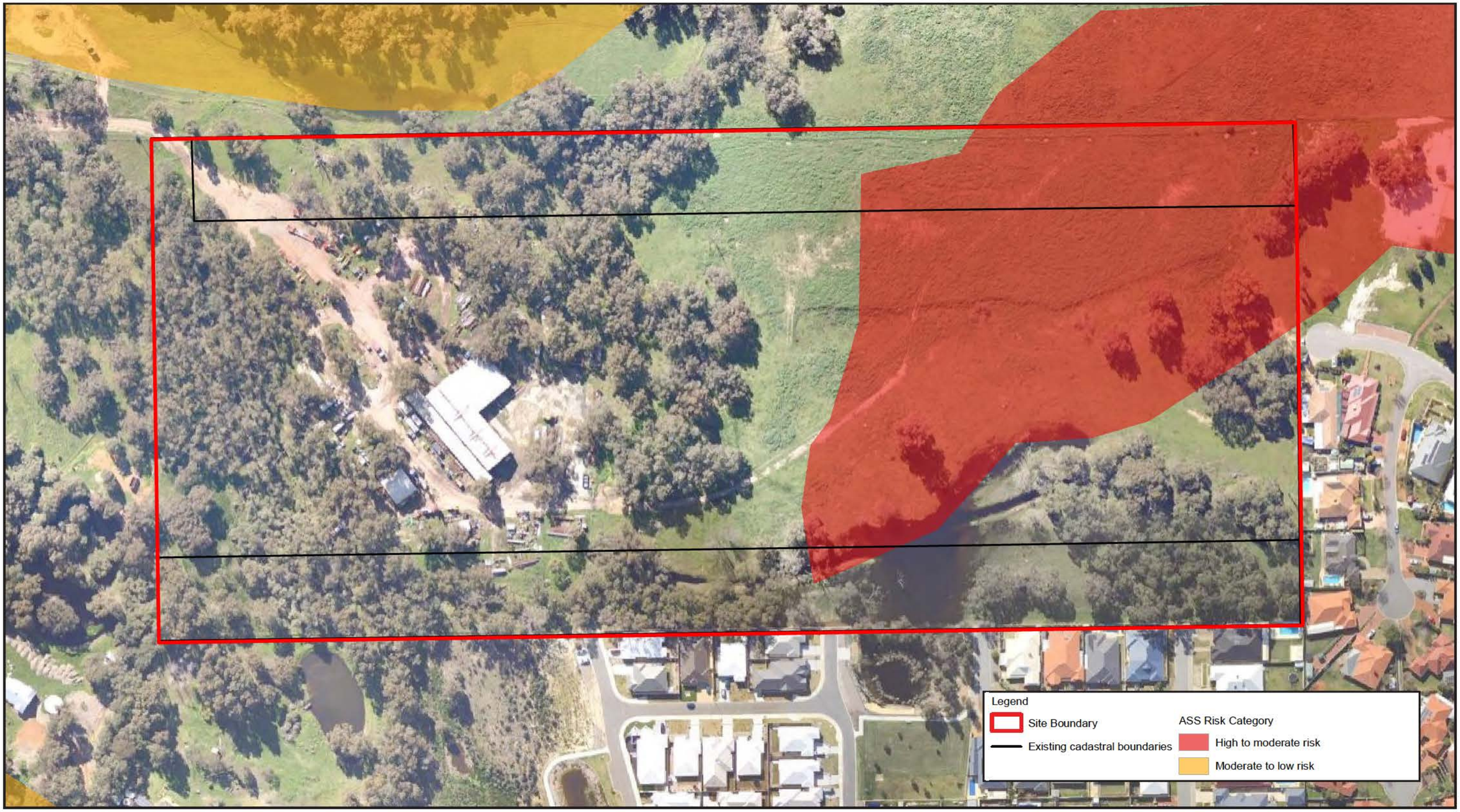
Portions of land contained within the 20-25 ANEF noise contour band is proposed to be developed for residential purposes in accordance with the R20 and R30 density code. Justification for this approach is already provided elsewhere in this report.

2.10 Environmental Response

The subject site is a significantly constrained piece of land from an environmental point of view and considerable investigation work has been undertaken to understand these environmental issues in order to inform the preparation of this local structure plan. The fundamental site considerations which have also informed the placement of roads and developable land within this LSP are summarised below:

1. **Past landfill and geotechnical considerations.** A Geotechnical and Environmental Site Assessment was undertaken by Worley Parsons to map the extent of landfill on the subject site and this assessment identified areas of the past landfill that were potentially geotechnically unsuitable to accommodate residential development. This area is generally defined as zone 1 as identified on the plan contained at Appendix D. Zone 1 includes a sizeable portion of land centrally located within the structure plan area. This area has informed the positioning of roads to define the outer extent of this geotechnically unsuitable landfill area.
2. **Resource Enhancement Wetland and Buffer.** Creation of a 30 metre buffer from the mapped REW to provide an appropriate buffer between the ecological values of the wetland and proposed development. The Kadina Brook and associated wetland buffer will be the focus of extensive revegetation works to improve the ecological linkage to the Helena River reserve and the overall environmental functionality of this watercourse feature. The inclusion of the REW and its 30m buffer within a reserve has meant that development is excluded from occurring in the western extent of the structure plan area.

Figure 7 – Acid Sulfate Soils Risk Mapping



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3. **Parks and Recreation Reserve.** A portion of the northern section of the structure plan area is reserved for 'Parks and Recreation' pursuant to the MRS and therefore is required to be set aside as parks and recreation for future inclusion in the reserve associated with the Helena River floodplain.
4. **Historical 25 ANEF Airport Buffer.** The Historical 25 ANEF airport noise control area has previously defined the extent of 'Urban' zone pursuant to the MRS. While it is noted that the 25 ANEF Contour has retracted following the 2014 Airport Masterplan review and no longer impact the subject site, the MRS Zoning of Rural eliminates the north-western portion of the subject site being subdivided for residential purposes.
5. **Site Remediation.** The structure plan also identifies requirements relating to the future subdivision of the site, including the requirement to undertake remediation works in accordance with the process and requirements of the Contaminated Sites Act 2003.
6. **Local Water Management.** Preparation of a Local Water Management Strategy (Emerge Associates 2014) in accordance with Better Urban Water Management (BUWM) (WAPC 2010). The LWMS focuses the effort for improving ecological function of the Kadina Brook, which in its current condition, is significantly degraded. It is proposed to direct treated stormwater towards the brook to improve water flow as well as improving the ecological function of the Brook through revegetation of the watercourse and associated buffer. This is considered an appropriate environmental outcome for the site given that the Kadina Brook is recognised as a Resource Enhancement Wetland.
7. **Bushfire Management.** Preparation of a Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2014) and placement of a road reserve to interface with the REW buffer to accommodate a 20m BPZ required to manage bushfire threats resulting from retained vegetation within the REW area and Parks and Recreation reserve.

Overall, the implementation of the Structure Plan through the planning and development process will involve a number of environmental benefits including:

- Removal of existing potentially contaminating land uses from the site.
- Remediation of the site in accordance with the proposed land uses identified in the Structure Plan.
- Extensive revegetation works associated with Kadina Brook and the creation of a vegetated wetland buffer and improved ecological linkage to Helena River.
- Transfer of the "Parks and Recreation" reserve into State management for integration with the wider Helena River catchment reserve.
- Improved stormwater management for the site in accordance with a Local Water Management Strategy.

Despite these significant constraints, the LSP will facilitate remediation works to clean-up the site in accordance with the process outlined within the *Contaminated Sites Act 2003.* Additionally the LSP will provide important road connections between existing residential subdivision to the south and east to better integrate existing developed areas. The LSP will also facilitate the ceding of additional land to contribute to the Helena River catchment area.

It is considered that the local structure plan provides a viable and workable solution to the development of the site despite having significant constraints to development and in consideration of this it is deemed to deliver substantial net positive gains to the subject site and local area.

3. Land Use and Subdivision Requirements

3.1 Land Use

The predominant land use identified within this Structure Plan is residential, with a portion of the Structure Plan area proposed for the Rural-Residential purposes. The portion of land set aside for Rural-Residential zone on Lot 2 is in response to geotechnical constraints with this portion of the site and is proposed to accommodate a range of rural-residential uses, such as horse agistment, which are suitable to the geotechnical conditions of this portion of the site. Such rural-residential uses will be controlled through land use provisions proposed within this structure plan to ensure that the uses do not have a detrimental impact on the amenity of adjacent residential uses.

The structure plan proposes a total of 56 residential lots, 7 of which are designated R30 and 59 lots designated as R20. The proposed residential use of the subject site is consistent with surrounding residential land to the east and south and the proposed road network is integrated with the existing road network in this regard.

The Structure Plan also comprises the following designations:

- Public Open Space (0.6276 ha)
- Restricted Public Open Space (0.1568 ha)
- Resource Enhancement Wetland (1.3784 ha)
- Resource Enhancement Wetland Buffer (0.8305 ha)
- Regional Open Space (1.8859 ha)

The Structure Plan is provided at Figure 8 below.

Refer to Figure 8 – Structure Plan

3.2 Open Space

3.2.1 Public Open Space Provision

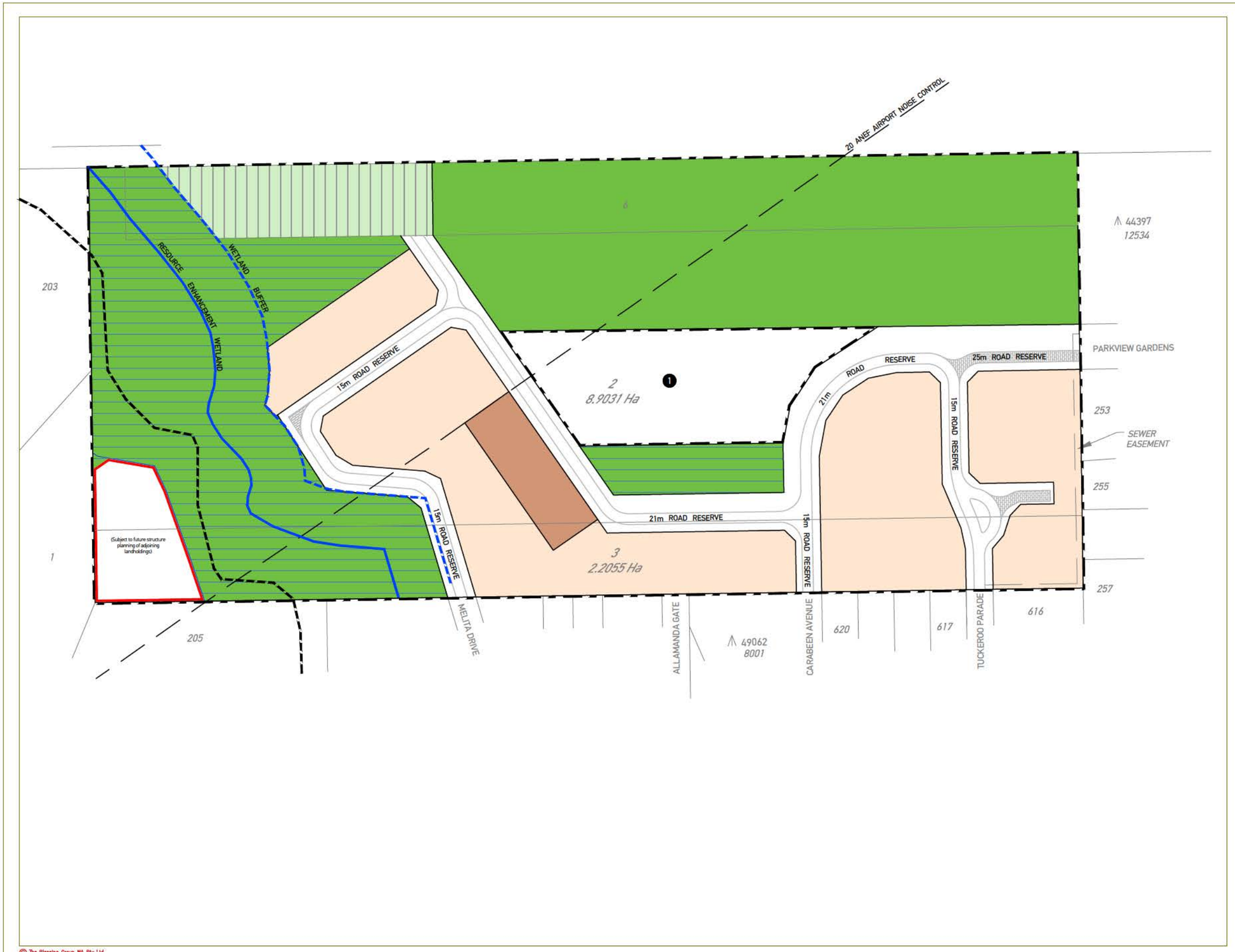
Public Open Space (POS) will be provided in accordance with the requirements of Liveable Neighbourhoods, which requires that a minimum of 10% of the Net Subdividable Area be provided as POS. Two percent of the 10% POS provision may comprise restricted use POS, such as drainage reserves and natural wetlands. In this case, it is proposed to utilise portion of the buffer associated with the Resource Enhancement Wetland as restricted use POS, as portion of the buffer area will be useable as passive recreation with a shared use path proposed within this buffer area.

The provision of public open space is identified at Figure 9.

Refer to Figure 9 – Public Open Space Provision

The POS Schedule is detailed in **Table 4.**

Figure 8 – Structure Plan



PLAN 1
STRUCTURE PLAN
Lots 2, 3 & 6 Midland Road, Helena Valley

Date: 22 September 2016
Scale: 1:2000 @ A3
Project Manager: TP
Checked: TP
Drawn: LC
Drawing No. 714-128 ST1G Plan 1 2016-09-22.dwg

0 50 100m

LEGEND

- Structure Plan boundary
- Residential R20
- Residential R30
- Rural Residential
- Development (Subject to future structure planning of adjoining landholdings)
- Public Open Space / Drainage
- Regional Open Space
- Creekline
- Resource Enhancement Wetland
- 30m wetland buffer

NOTES

1. Land use and development subject to further detailed geotechnical investigation (excluded from Structure Plan Area)

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Figure 9 – Public Open Space Provision



PLAN 2
OPEN SPACE PLAN
Lots 2, 3 & 6 Midland Road, Helena Valley

Date: 22 September 2016
Scale: 1:2000 @ A3
Project Manager: TP
Checked: TP
Drawn: LC
Drawing No. 714-128 ST2G Plan 2 2016-09-22.dwg

0 50 100m

LEGEND

- Structure Plan boundary
- Public Open Space / Drainage
- Regional Open Space
- Creekline
- Resource Enhancement Wetland
- 30m wetland buffer

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Table 4: POS Schedule

Public Open Space Schedule	Sub Total	Total
Site Area		12.2586 ha
Less Deductions		
Regional Open Space	3.3259 ha	
Resource Enhancement Wetland	1.3907 ha	
Rural Residential Land	0.5472 ha	
Sub Total	**5.2638 ha**	
Net Residential Subdividable Area		6.9733 ha
Residential Public Open Space @ 10 percent		**0.6973 ha**
Net Rural Residential Land Area	0.5472 ha	
Rural Residential Public Open Space @ 5 percent		**0.0274 ha**
Total Public Open Space Requirement		**0.7247 ha**
Public Open Space Contribution		
Unrestricted Public Open Space		
POS (Area B)	0.2850 ha	
POS (Area C)	0.3394 ha	
Sub Total		0.6244 ha
Restricted Public Open Space		
Portion of Resource Enhancement Wetland Buffer (Area D)		0.1597 ha
Sub Total		0.1597 ha
Total POS Provision		**0.7841 ha**

3.2.2 Form and Function of Public Open Space

Open Space Area A as identified on Figure 9 is Regional Open Space and is described in further detail in Section 3.2.2.

Public Open Space Area B is 2,850 m² in area and located in a position adjacent to the Regional Open Space to provide a contiguous area with the regional open space that can provide passive local scale recreational facilities. This may include the provision of playground facilities, subject to the approval of the local government.

Public Open Space Area C totals 3,394 m² in area and is located in areas adjacent to the Resource Enhancement Wetland buffer to provide a contiguous open space area adjacent to the wetland that will accommodate remnant vegetation, where appropriate, as well as providing a passive open space function and accommodating drainage requirements.

Open Space Areas D and E are associated with the Kadina Brook. Open Space Area E corresponds to the Resource Enhancement Wetland area associated with Kadina Brook and Open Space Area D is a 30 metre wide buffer to this wetland area. This wetland buffer area is proposed to be extensively revegetated to restore the ecological function of this section of the Kadina Brook.

3.2.3 Regional Open Space

A total of 3.3259ha of Regional Open Space (ROS) is proposed to be ceded in accordance with the Regional Open Space reservation of this land under the Metropolitan Region Scheme. This ROS is associated with the Helena River ROS and will ultimately form part of the Helena River catchment reserve. The ROS will be ceded upon subdivision of the parent lots.

3.2.4 Proposed Management Responsibilities

The local Public Open Space, being Area B, Area C, Area D (wetland buffer) and Area E (resource enhancement wetland) will ultimately be handed over to the local government free of cost and therefore the management of this POS will ultimately be the responsibility of the local government.

The Regional Open Space (Area A) will be ceded to the Western Australian Planning Commission free of cost. It is likely that the Regional Open Space will ultimately be transferred to the local government to take on the management responsibilities of this open space.

3.3 Residential Land Use

3.3.1 Residential Density

Residential density applicable to land within this Structure Plan area is to be determined by reference to the designated R-Code number superimposed on the Structure Plan (Figure 10).

Refer to Figure 10 – Residential Density Plan

The development of land for residential purposes is to be in accordance with the requirements of the Residential Design Codes with reference to the applicable R-Code number, except as otherwise as required by a Detailed Area Plan.

3.3.2 Dwelling / Lot Mix

The structure plan contemplates the creation of a total of 65 vacant residential lots plus one rural-residential lot, as follows:

- A total of 7 lots are coded R30 with a minimum and average lot size of 360 m^2.
- A total of 59 lots are coded R20 with a minimum lot size of 360 m^2, average lot size of 576 m^2 and maximum lot size of 857 m^2.
- 1 lot is designated as 'Rural-Residential' and is 1.2468 ha in area.

A building envelope is required to be identified on the Rural-Residential lot which designates the location of where a single dwelling can be placed on this lot. It is expected that this building envelope will be placed over the portion of the future lot to be included within the residential zone. Additional outbuildings may be approved outside of this building envelope at the discretion of Council.

3.3.3 Density Targets

The Shire's Local Planning Strategy establishes a density target of 15 dwelling units/ha for new structure plan areas within Helena Valley.

The proposed structure plan achieves an average of 19.64 dwellings per hectare over the residential zoned portion of structure plan area. This is considered acceptable given the need to accommodate various environmental constraints within open space areas.

3.3.4 Lot Orientation and Views

Lot orientation has largely been dictated by site constraints, including the need to contain past landfill activities within open space and the provision of a buffer to the resource enhancement wetland in the western portion of the site.

A total of 34 lots have been orientated east-west in order to achieve optimal or close to optimal solar orientation.

Future lots will be afforded views over the Kadina Brook and across into the Helena Valley reserve.

3.4 Rural-Residential Land Use

Rural Residential land has been designated in the north west corner of the structure plan area to reflect the Rural Zoning under the MRS.

Land use permissibility for land designated as Rural-Residential will be in accordance with Table 1 of TPS4, however this structure plan prescribes additional land use restrictions to ensure that the amenity of nearby residential lots is maintained. In this regard, the following additional provisions relating to land use and development rural residential land is proposed:

1. Rural Residential land is required to be fenced to a high standard, such as post and rail or other suitable fencing type to the satisfaction of the local authority, to maintain a high level amenity outlook for the surrounding residential lots;

Figure 10 – Residential Density Plan



PLAN 3
INDICATIVE SUBDIVISION LAYOUT

Lots 2 & 6 Midland Road, Helena Valley

Date: 22 September 2016
Scale: 1:2000 @ A3
Project Manager: TP
Checked: TP
Drawn: LC
Drawing No. 714-128 ST3G Plan 3 2016-09-22.dwg

0 50 100m

LEGEND

- Structure Plan boundary
- Residential R20
- Residential R30
- Rural Residential
- Development (Subject to future structure planning of adjoining landholdings)
- Public Open Space / Drainage
- Regional Open Space
- Creekline
- Resource Enhancement Wetland
- 30m wetland buffer

tpg
TOWN PLANNING URBAN DESIGN AND HERITAGE

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Figure 11 – Proposed path network



PLAN 4
INDICATIVE PATH NETWORK
Lots 2, 3 & 6 Midland Road, Helena Valley

Date: 22 September 2016
Scale: 1:2000 @ A3
Project Manager: TP
Checked: TP
Drawn: LC
Drawing No. 714-128 ST4E Plan 4 2016-09-22.dwg

0 50 100m

LEGEND

- Structure Plan boundary
- Residential R20
- Residential R30
- Rural Residential
- Development (Subject to future structure planning of adjoining landholdings)
- Public Open Space / Drainage
- Regional Open Space
- Creekline
- Resource Enhancement Wetland
- 30m wetland buffer
- Shared Path (2.3m)
- Footpath (1.8m)

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2. Requirement for a Dust Management Plan in relation to any future grazing activities;
3. Consideration of the siting and location of any horse stables and other rural outbuildings in relation to residential dwellings and lots; and
4. Preparation of a management plan in relation to any application for a 'Rural Pursuit' to address issues such as nutrient loading, pasture management, dust control, manure control including fly management and other issues.

3.5 Development Zone Parcel

The south-west portion of the Structure Plan area has been zoned 'Development' and is proposed to be set aside and subject to future structure planning due to current limitations in terms of access and servicing to this portion of the site due to its location in relation to the Resource Enhancement Wetland. The land to the south-west of the subject site is also zoned 'Development' and therefore it is proposed that the 'Development' zoned portion of the Structure Plan area will be subject to future structure planning at this same time as this adjacent land. This future structure plan will seek to resolve access and servicing arrangements, after which the land can be subdivided and developed in accordance with the endorsed structure plan.

3.6 Movement Network

3.6.1 Local Road Network

The road network represents an extension of the existing local road network to the subdivision to the south. All roads proposed are local roads and will be constructed to the Shire of Mundaring standards, including 6 metre wide pavement within 15m wide road reserve, except for a portion of the local road network located adjacent to the Rural-Residential lot, which is planned to be up to a 21m wide road reserve to accommodate the adjacent swale infrastructure.

Where practical, the local road network provides a hard interface with open space areas to ensure an appropriate transition between the public open space and residential lots.

The local road network also provides connection into the lot to the north to allow any future development of this site to utilise the local road connections proposed in this structure plan.

3.6.2 Paths and Cycleways

A 1.8 metre wide footpath will be provided on one side of all internal roads within the proposed subdivision to facilitate an active lifestyle by encouraging walking and cycling.

In addition, a 2.3 metre wide shared path will be provided within the buffer associated with the resource enhancement wetland.

The proposed path network is identified in Figure 11.

Refer to Figure 11 – Proposed path network

3.7 Water Management

The Local Water Management Strategy (LWMS) for the Local Structure Plan (LSP) area has been developed in accordance with *Better Urban Water Management* (WAPC 2008), *State Planning Policy 2.9 Water Resources* (WAPC 2006) and *Planning Bulletin 92 Urban Water Management* (WAPC 2008a). Water will be managed using an integrated water cycle management approach, which has been developed using the philosophies and design approaches described in the *Stormwater Management Manual for Western Australia* (DoW 2007).

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving waters and their ecosystems. Characteristics of both the existing and past environment within the site have been investigated. In summary, the environmental investigations conducted to date indicate that:

- The site receives 773 mm on average annually with the majority of rainfall received in June and July.
- The site topography ranges from 11.0m Australian Height Datum (AHD) to 17.0m AHD.
- The soil profile generally consists of silt over clayey sand over sandy clay. Uncontrolled fill occurs throughout the north east of the site.
- The majority of the site presents no known risk of acid sulfate soils (ASS). The eastern half of the site contains a region that presents a 'high to moderate risk' of ASS being present within 3.0m of the natural surface.
- No Threatened or Priority Flora occur within the site. The wetland vegetation is in a "Degraded" condition. Areas subject to uncontrolled fill are in a "Completely Degraded" condition.

- Kadina Brook is located in the west of the site (Unique Feature Identifier (UFI) 15885) and is classed as a resource enhancement wetland (REW). The surrounding floodplain (UFI 15440) is classed as a multiple use wetland (MUW). The Helena River floodplain REW is located immediately to the north of the site (UFI 14230).
- The majority of runoff flows off site towards the north-west as dictated by the natural topography.
- Total pre-development peak flows leaving the site are 0.36 m^3/s and 0.76 m^3/s for the 5 year ARI and 100 year ARI events respectively.
- A small anthropogenic drainage depression occurs in the south eastern quadrant of the site.
- Kadina Brook experiences elevated Total Phosphorous (TP) concentrations.
- Maximum groundwater levels (MGL) range between 15.17m AHD and 12.08m AHD across the site with groundwater flowing to the north west.
- Groundwater TP is elevated across the site.
- The site has experienced clearing and filling activities associated with the historic operation of a brick factory and is currently used for general industrial purposes.

The LSP includes a total land area of 13.2332ha and will incorporate areas of Public Open Space (POS) designed to achieve a balance between useable passive and active open space, as well as recognising drainage requirements within POS reserves.

The development will incorporate 67 lots comprised of 25 R30 lots, 41 R20 lots and one rural residential lot. Stormwater management infrastructure will be incorporated within POS and Regional Open Space (ROS) and will consider the adjacent REW. Where applicable, stormwater management infrastructure will be appropriately integrated with the associated wetland buffer.

The overall objective for integrated water cycle management for residential developments is to minimise pollution and maintain an appropriate water balance. The LWMS design objectives seek to deliver best practice outcomes using a Water Sensitive Urban Design (WSUD) approach, including detailed management approaches for:

- Potable water consumption;
- Flood mitigation;
- Stormwater quality management;
- Groundwater quality management.

The criteria proposed within this LWMS are based on the characteristics of the existing environment and a contemporary best-practice approach to integrated water cycle management.

The overall approach to water conservation is to reduce the amount of scheme water required within the development at both a lot and an estate scale. Water conservation measures proposed include fit-for- purpose water sources, including scheme water for potable uses within lots and harvested rainwater for irrigation of private lot gardens and to supplement potable water use within dwellings. Within the lot, scheme water will also be reduced by use of water efficient fittings and appliances and implementation of waterwise gardens. On an estate scale water will be reduced by use of waterwise landscaping practices including use of native vegetation within POS areas where possible.

Stormwater management focuses on stormwater runoff quantity and quality. The principle behind the stormwater management strategy for the LSP is to mimic the existing hydrology. The 1 year 1 hour ARI event runoff from the site will be retained as close to source as possible using a combination of soakwells, roadside swales and bio-retention areas. Stormwater runoff greater than the 1 year 1 hour ARI event will be conveyed to Kadina Brook, as currently occurs in the pre-development environment. The design of stormwater management infrastructure ensures overall peak discharge from the development does not exceed the pre-development peak discharge rates for up to the 100 year ARI event. Stormwater quality will be addressed using a treatment train approach, utilising the storage provisions discussed above.

Groundwater is within close proximity of the surface across the majority of the site. Groundwater level management includes the importation of fill to provide clearance of lots and inverts of drainage infrastructure from the MGL. Groundwater quality will be managed by managing nutrient inputs within surface runoff (consistent with those proposed for stormwater quality).

The Local Water Management Strategy is contained at Appendix F.

3.8 Education Facilities

No education sites are contemplated within this local structure plan. The nearest school facilities to service future residents of the estate include:

- Clayton View Primary School
- Helena Valley Primary School
- Swan View Senior High School
- Guildford Grammar

3.9 Infrastructure Coordination, Servicing and Staging

A Servicing Report has been undertaken by McDowall Affleck in relation to the proposed Structure Plan and this report is contained at Appendix G. The recommendations of this report are summarised in the following sub sections.

3.9.1 Wastewater (Effluent) Disposal

Liaison with the Water Corporation has determined that the lots can be serviced via the Helena Valley Temporary Pump station. Based on minimum grades to comply with the Water Corporation Design Manual, the final lot levels are RL 17.7 – 18.0m AHD with an expected fill depth of up to 3.3 to 3.5m in some areas. The sewer main heading west out of the Parkview Gardens pump station is at a steep grade and could be lowered. Approximately 130m of sewer main reconstructed at a lower level and flatter grades can lower the level of connection by approximately 1m. This will lower the fill required over some of the proposed lots by 1m, which will have significant cost savings with fill. The site can ultimately be serviced with sewer reticulation.

3.9.2 Water Supply

Liaison with the Water Corporation has determined that the lots can be serviced via connection to the 150 diameter main in Allamanda Gate, the 100 diameter mains in Carabeen Avenue, Tuckeroo Parade and Parkview Gardens. Parkview Gardens will require an upgrade to the 63 MDPE to a 100P-12.

The site can ultimately be serviced with water reticulation.

3.9.3 Power Supply

The Underground Power Development Pty Ltd (UPD) has advised the following:

- The power network is 22kV supplied from Hazelmere substation.
- Power supply around the area is via overhead lines along Helena Valley Road that may have capacity for supply. It would appear that there is 5MVA spare capacity from the zone substation.
- Existing ground mounted transformer in Allamanda Gate may have some capacity to supply a portion of the proposed subdivision. This transformer is 500kVA so could possibly be upgraded to 630kVA to provide some additional power.

The site can ultimately be serviced with underground power.

3.9.4 Telstra

Design for telecommunications to the new National Broadband Network (NBN) specifications will be required. Independent consultants can design the telecommunications to NBN specifications.

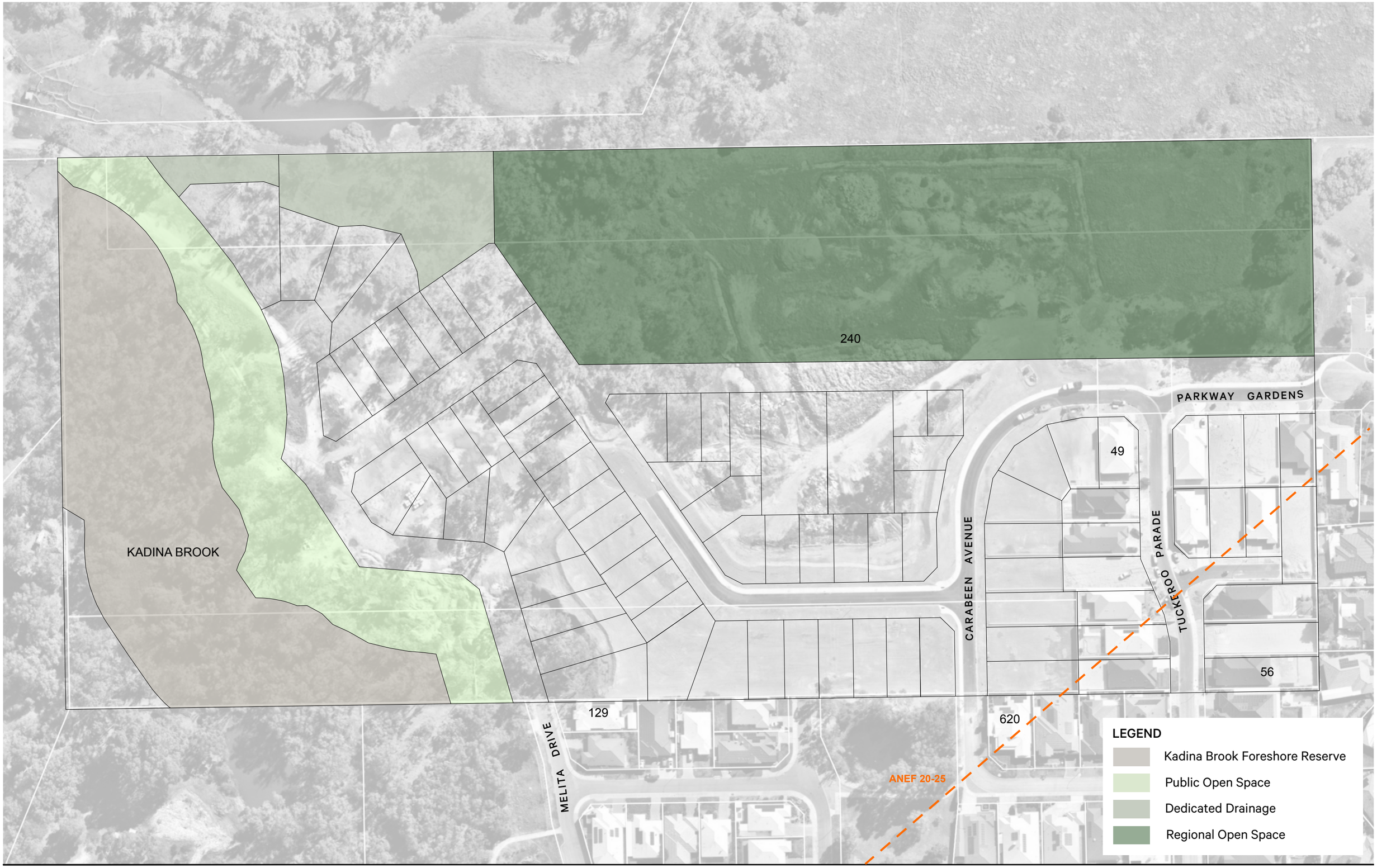
3.9.5 Natural Gas

WA Gas Network has been contacted regarding the provision of reticulated gas to the proposed development and have advised the following:

- There is currently a 100 PVC medium pressure main that runs along Allamanda Gate which could have the required capacity to service the development.
- The site can ultimately be serviced with natural gas reticulation.

APPENDIX 2

Indicative Subdivision Concept Plan



Subdivision Concept

Lots 2, 3 and 6 Midland Road, Helena Valley

0 30m

Date: 07 Mar 2025 Scale: 1:1500 @ A3 1:750 @ A1 File: **20-088 CP02** Staff: JK GW TS Checked: JP

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APPENDIX 3

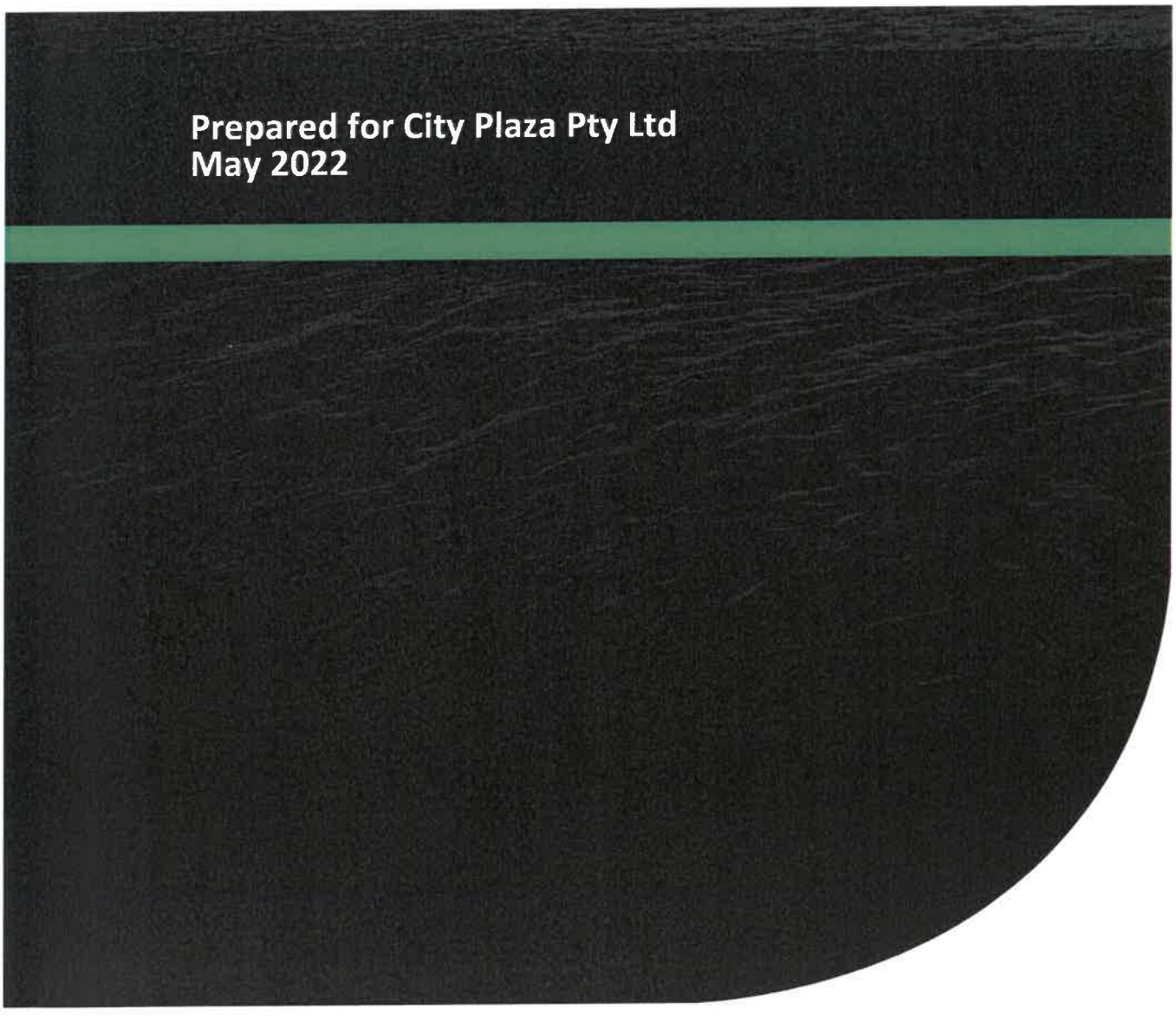
Foreshore Management Plan

emerge ASSOCIATES
Integrated Science & Design

Foreshore Management Plan

Kadina Brook within Lots 2, 3 and 6 Midland Road Helena Valley

Project No: EP21-019(03)



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Executive Summary

City Plaza Pty Ltd is progressing the subdivision of Lots 2, 3 and 6 Midland Road in Helena Valley (the 'site') for residential purposes. The site is located in the Shire of Mundaring.

This *Foreshore Management Plan* (FMP) has been prepared to address a condition of subdivision approval to ensure the protection and management of Kadina Brook which flows through the site (Western Australian Planning Commission (WAPC) application no. 156909).

The purpose of this FMP is to define a foreshore reserve and outline the management actions that are proposed within the foreshore.

Two primary goals are identified for the FMP:

1. Revegetate native vegetation within the Kadina Brook foreshore reserve and adjacent POS.
2. Provide public use facilities within the adjacent POS without negatively affecting the Kadina Brook.

Specific objectives are then provided for each goal, along with management actions relating to revegetation, construction and a monitoring and evaluation framework covering a three-year implementation period.

The site is divided into the following five management areas that reflect approaches to achieving the goals for management:

- landscape planting
- turf
- stormwater treatment swales
- revegetation 1
- revegetation 2
- revegetation 3.

The actions within the FMP are the responsibility of City Plaza Pty Ltd until handover to the Shire of Mundaring and thereafter will be at the discretion of the Shire of Mundaring and to the Shire's standards. All contractors engaged to undertake works within the site by these parties will be required to adhere to this plan.

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Appendices

Appendix A

Subdivision Concept

Appendix B

Concept Landscape Plan

Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
DBCA	Department of Biodiversity, Conservation and Attractions
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environment Regulation
UFI	Unique feature identifier
WAPC	Western Australian Planning Commission

Table A2: Abbreviations – General terms

General terms	
CBD	Central business district
DUP	Dual use path
MUW	Multiple use wetland
POS	Public open space
REW	Resource enhancement wetland

Table A3: Planning

Planning terms	
FMP	Foreshore management plan
LPS	Local Planning Scheme
LWMS	Local water management strategy
MRS	Metropolitan region scheme

Table A4: Abbreviations – units of measurement

Units of measurement	
g/L	Grams per litre
ha	Hectare
MGL	Maximum groundwater level
m	Metre
mAHD	Metres Australia Height Datum
mm	Millimetre
m2	Square metre
Km	Kilometre

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1 Introduction

City Plaza Pty Ltd is progressing residential subdivision of Lots 2, 3 and 6 Midland Road, Helena Valley in the Shire of Mundaring for residential purposes (herein referred to as 'the site'), as shown on **Figure 1**.

This *Foreshore Management Plan* (FMP) has been prepared to address condition 9 of the Western Australian Planning Commission (WAPC) subdivision approval for the site (application no. 156909), which requires that:

> *Prior to the commencement of subdivision works a foreshore management plan for Kadina Brook is to be prepared and approved in consultation with Department of Biodiversity, Conservation and Attractions (Estuaries Division) and Department of Water and Environmental Regulation to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan.*

The Kadina Brook is a minor non-perennial watercourse that runs through the south-western portion of the site, connecting with the Helena River approximately 500 m to the north-west of the site.

1.1 Scope and purpose

This FMP relates to the Kadina Brook foreshore reserve and adjacent areas of public open space as outlined in the subdivision concept provided as **Appendix A**.

The purpose of this FMP is to communicate the arrangements made for the site to ensure the protection and management of environmental values as per Condition 9 (WAPC no. 156909).

2 Existing Environment

2.1 Topography

The topography across is relatively flat with much of the eastern half of the site at an elevation of 14 to 17 m in relation to the Australian height datum (m AHD). Local low points are present in the northern and western portions of the site and ranges from 9 m AHD to the north of the site, backing onto the Helena River to 12 m AHD in Kadina Brook to the west.

The Kadina Brook waterway itself is a very well-defined but narrow channel as shown below in **Plate 1.** East of the Kadina Brook some landform has been modified, particularly adjacent to an area of hardstand.

The topography of the site and surrounding area is shown in **Figure 2.**

2.2 Hydrology

The Kadina Brook runs through the south-western portion of the site, connecting with the Helena River approximately 500 m to the north-west of the site (**Figure 2**). The Department of Water and Environmental Regulation (DWER's) flood mapping for the Helena River shows that the boundary of the 1 in 100-year floodway lies on the northern boundary of the site, and that a small area of flood fringe extends into the central northern portion of the site (**Figure 2**).

A foreshore area for Kadina Brook was agreed with DWER as best defined by a 30 m setback from the Kadina Brook channel.

Two 'resource enhancement' wetlands (REWs) occur on the western half of the site (DBCA 2020). 'Unique feature identifier' (UFI) 15885 is 'floodplain' associated with Kadina Brook. UFI 14230 is mapped over a small area at the northern most edge of the site which is associated with the Helena River that occurs to the north of the site. The UFI 15884 is mapped to the east of Kadina Brook. The features mapped within the site are shown on **Figure 2.**

2.3 Vegetation

A number of flora and vegetation investigations within the site were undertaken between 2011-2014 (RPS 2011; Emerge Associates 2014).

Generally, the vegetation in the site shows evidence of significant historical and contains:

- six plant communities (consisting of four native plant communities and two non-native plant communities)
- vegetation in 'good – degraded' to 'completely degraded' condition according to the Keighery (1994) scale.
- no threatened or priority flora species or communities.
- two 'declared pest' species under Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act); **Gomphocarpus fruticosus* (cotton bush) and **Zantedeschia aethiopica* (arum lily).

Plant community **ErMrLOF** was identified as occurring over the majority of Kadina Brook. This vegetation is described as comprising a low open forest of *Eucalyptus rudis* over isolated trees to low open woodland of *Melaleuca rhaphiophylla* over occasional dense patches of **Gomphocarpus fruticosus* over sparse sedgeland of *Juncus kraussii* fringing the creek lines, and **Cynodon dactylon, *Paspalum dilatatum* and **Lolium rigidum* closed grassland (Emerge Associates 2014). Plant community **CcOF** occurs over the south-eastern most portion of Kadina Brook is mapped. This vegetation is described as comprising of an open forest of *Corymbia calophylla, Eucalyptus rudis* and *E. wandoo* subsp. *wandoo* over scattered *Acacia pulchella* and *Juncus kraussii* (or native species absent in understorey) and closed grassland including **Lolium rigidum, *Ehrharta longifolia* and **Avena barbata* (Emerge Associates 2014) (shown on **Figure 3**).

Vegetation within Kadina Brook was mapped as being in 'degraded' or 'degraded – completely degraded' condition (Emerge Associates 2014), as shown in **Figure 4**.



Plate 1: The Kadina Brook channel and riparian vegetation (plant community ErMrLOF) in 'degraded – completely degraded' condition.



*Plate 2: The Kadina Brook channel showing 'degraded' plant community **ErMrLOF**, high weed cover and historic landform modification.*



Plate 3: Altered landform adjacent to the Kadina Brook in south-eastern extent of the foreshore reserve

2.4 Fauna habitat

Fauna habitat in the site has limited values for terrestrial fauna, albeit small or medium sized native mammals and reptiles may utilise grass and weedy understorey for cover (RPS 2011). The Shire of Mundaring have advised that *Chelodina oblonga* (south-western oblong turtle), *Isoodon fusciventer* (quenda) and *Macropus fuliginosus* (western grey kangaroo) populations occur in/near the waterbody along the southern boundary of the site. Tree canopy provides habitat for birds and arboreal fauna and wetland and watercourse provide movement corridor for fauna generally (RPS 2011).

3 Subdivision Design

The subdivision concept is provided as **Appendix A**. The subdivision concept proposes a 'foreshore reserve' 30 m either side of Kadina Brook and an adjacent area of public open space (POS) to the east.

The foreshore reserve encompasses the full extent of REW 15885 and the majority of the riparian vegetation, as shown in **Figure 5**.

The POS area will encompass additional riparian vegetation, as well as landscaped areas and public access infrastructure (**Figure 6**). Augmenting foreshore reserves with additional public open space is consistent with the Shire of Mundaring *Foothills Growth Strategy* (Shire of Mundaring 2017) and the approach taken for the Kadina Brook in recent adjoining residential subdivisions.

Stormwater management is outlined in the *Urban Water Management Plan* (UWMP) (DEC 2021).

4 Goals and objectives

Given the pre-existing degraded to completely degraded condition of the Kadina Brook foreshore, significant effort will be required to achieve even modest restoration outcomes within the site.

Two primary goals are identified for the FMP:

1. Revegetate native vegetation within the Kadina Brook foreshore reserve and adjacent POS.
2. Provide public use facilities within the adjacent POS without negatively affecting the Kadina Brook.

To guide implementation specific objectives are identified that relate to each goal as shown in **Table 1**. The objectives provide a basis for monitoring and evaluating the performance of works undertaken under the FMP.

Table 1: Goals, objectives and the timeframes for the site

Goal		Objectives	Timeframe
1.	Revegetate native vegetation within the Kadina Brook foreshore reserve and adjacent POS.	1.1 Weed cover is less than 10% across revegetation areas.	3 years from commencement of works
		1.2 No new weeds are introduced as a direct result of construction activities	
		1.3 Native plant density is on average greater than 0.1 per m^2 for tree and shrubs and 2 per m^2 for sedges/rushes across revegetation areas.	
		1.4 No formal public access	
2.	Provide public use facilities within the adjacent POS without negatively affecting the adjacent Kadina Brook.	2.1 Rubbish not present or minimal	From practical completion until handed over to the Shire of Mundaring
		2.2 All pedestrian paths in good useable condition	
		2.3 Signage intact and in good condition	
		2.4 No existing native trees damaged or impacted by path construction	
		2.5 No (or minimal) existing native understorey vegetation damaged or impacted by path construction	
		2.6 All facilities in good working order	
		2.7 Formal public access (paths and boardwalks)	
		2.8 Informal public access (turf and other areas)	
		2.9 Minimal irrigation overspray to hardstand and other non-turfed areas	
		2.10 Stormwater treatment before discharge into the foreshore reserve and Kadina Brook	

5 Implementation

5.1 Management areas

The site is divided into the following five management areas that reflect approaches to achieving the goals for management:

- landscape planting
- turf
- stormwater treatment swales
- revegetation 1
- revegetation 2
- revegetation 3.

Management areas are shown on **Figure 6**.

5.2 Management actions

Management actions will broadly include:

- weed and pathogen prevention (refer to **Section 5.2.1**)
- installation of public infrastructure (refer to **Section 5.3.1**)
- landscape planting and turf establishment (refer **Section 5.3.2** and **Section 5.3.3**)
- revegetation with native species (refer to **Section 0**)
- monitoring and evaluation (refer to **Section 5.3.7**).

5.2.1 Weed and pathogen prevention

Actions to minimise the spread and/or introduction of weeds and plant pathogens such as *Phytophthora cinnamomi* (dieback) and *Quambalaria coyrecup* (marri canker) will be undertaken in all management areas through unauthorised access control.

During construction, landscape planting or revegetation, all vehicles, personnel, machinery, tools, equipment and clothing will be clean and free of all mud, soil and plant material (especially weed seed) on arrival at the site. If present, all visible soil and plant material will be removed. If large amounts of material is present, a full wash-down off-site or within clean-down area will be undertaken.

5.2.2 Fauna management

Prior to clearing or earthworks in the POS, fauna management will be conducted to mitigate potential impacts as agreed with the Shire of Mundaring. Fauna management will be undertaken by an experienced fauna specialist under valid Biodiversity and Conservation Act 2016 license obtained from the Department of Biodiversity, Conservation and Attractions (DBCA). If possible, clearing will be undertaken outside of the main breeding season (spring). Clearing should also be undertaken in a single direction to allow fauna to disperse safely.

Southwestern oblong turtles will be relocated from the waterbody prior to disturbance. Relocation methods may include the use of aquatic traps and/or draining of the lake to retrieve any turtles present. South-western oblong turtles will be relocated to suitable habitat at a location agreed upon with DBCA.

5.3 Erosion control

Erosion control will be implemented during construction to prevent silt, sand and/or gravel from being lifted by wind or suspension by stormwater runoff in line with the approved *Erosion and Sedimentation Management Plan*[1](Emerge Associates 2022)as follows:

- All vegetation identified for retention within the POS will be adequately protected from damage during works by temporary fencing to prevent access.
- Stockpiles will be located away from existing POS infrastructure and completed landscape planting and revegetation planting areas. Stockpiles will be stabilised or covered, if possible.
- Vehicles and equipment movement will be limited to a single approved and stabilised construction entrance and prepared parking areas.
- All access tracks, stockpiles and other disturbed areas shall be regularly watered to prevent wind erosion.
- Sediment movement from access tracks, stockpiles and other disturbed areas will be regularly monitored and sediment recovered before it is exported into landscape planting, stormwater treatment swales or revegetated areas.

5.3.1 Public infrastructure

5.3.1.1 Fencing

If required by the Shire of Mundaring, conservation style fencing to Shire of Mundaring standard specification will be installed within revegetation area 3 as shown on **Figure 6**. The conservation fencing will form a barrier to pedestrian and vehicle access to the majority of revegetation areas and the foreshore reserve. The fencing will be permeable to small or medium sized ground based native fauna movement. Gates or access points will be included in fencing if required, as agreed with the Shire of Mundaring.

5.3.1.2 Dual Use Path

A dual use path (DUP) which will cater for pedestrians, bicycles, prams and wheelchair users will be constructed within the POS as shown on **Figure 6**.

5.3.1.3 Lighting

Solar powered lighting will be installed within the POS to increase safety for pedestrians. The International Commission of Illumination's *Guide on the Limitation of Effects of Obtrusive Light from Outdoor Lighting Installations* (ICI 2017) will be implemented for all lighting within the site.

[1] In preparation

Lighting infrastructure within the site will include structures and/or methods to direct light within the site and illuminate only the necessary infrastructure or immediate area. Due to the type of lighting to be installed, there will be minimal to no light spill to the Kadina Brook, nearby vegetation or the sky. As per DBCAs recommendations, light spill to the Kadina Brook and to vegetation within the foreshore reserve will be no more than 0.01-0.03 lux (moonlight) to ensure no adverse ecological consequences. Yellow globes will be installed in lighting in place of white lights, to reduce the extent to which mosquitoes and midges are attracted to the light.

5.3.2 Landscape planting and maintenance

Landscape planting areas will be established as mulched garden beds and planted with native low fire threat species as determined by specialist bushfire assessor[2].

Landscape planting areas will be maintained as non-irrigated long-term. Temporary irrigation will be applied to assist plant establishment. The irrigation design will take into account the water requirements of native plant species and aim to irrigate 'little and often'. Irrigation will be ceased once plants are established.

Minimal slow-release fertiliser will be applied as appropriate for native species which have low fertilizer requirements.

Weed control[3] and maintenance will be completed as required.

5.3.3 Turf installation and maintenance

The landscape concept for the POS has minimised areas of turf.

Turf areas will be prepared by importing free draining clean sand fill to a minimum depth of 800mm from existing ground levels to ensure adequate separation to groundwater (controlled) and ensure compliance with Shire of Mundaring requirements to ensure good turf health.

Turf will be irrigated at the minimum required to maintain healthy turf consistent with Shire of Mundaring standard practice.

Fertiliser will be applied to turf at low rates during warmer months when turf is actively growing to ensure absorption and reduce the risk of runoff. All fertilizer will be applied in accordance with DWER guidance *Fertiliser application on pasture or turf near sensitive water resources* (DoW 2010).

Weed control[4], mowing and maintenance will be completed as required. Turf clippings and waste will be removed offsite to an appropriate waste facility.

[2] Refer detailed landscaping plans.
[3] Herbicides will only be applied by a licenced pest management technician and in accordance with manufacturer's instructions as provided on product label.
[4] Herbicides will only be applied by a Department of Health licenced pest management technician and in accordance with manufacturer's instructions as provided on product label.

5.3.4 Stormwater treatment swales

Stormwater treatment swales will be constructed in the POS as indicated in **Appendix B** and on **Figure 6.** The location and extent of stormwater treatment swales will be confirmed as part of detailed landscape design[5].

5.3.5 Firebreaks

Firebreaks will be re-established around the western and southern perimeter of the foreshore reserve or as agreed with the Shire of Mundaring.

5.3.6 Revegetation

Revegetation areas will be planted with tubestock of local native species. Revegetation works will adhere to any requirement of the *Remediation Action Pan* (Emerge Associates 2022).

Revegetation area 1 is associated with Kadina Brook as defined by the presence of channel/s and occupying the lowest topographical position (11 – 12.4 m AHD). Revegetation area 2 is associated with the banks of the Kadina Brook occupying a slightly higher topographical position (12.5-15 m AHD). Revegetation area 3 interfaces with landscape planting areas in the POS.

Landforms within revegetation areas 1 and 2 will not be modified. The landform within vegetation area 3 will be reshaped as required to ensure soils are stably integrated with levels in the rest of the POS suitable for use as a public reserve.

Weed control and identification of weed species will be completed in revegetation areas by a contractor experienced in management of natural areas in south-west Western Australia prior to planting. Following tubestock planting ongoing weed control measures will include at least two treatments (winter and summer). Initial weed control may include blanket or spot spraying using a broad-spectrum herbicide formulation such as Roundup© (glyphosate 360 g/L). Follow up weed control will include both manual (hand weeding) and chemical (herbicide) based approaches.

Herbicide use near Kadina Brook will be in accordance with the recommendations contained in *'Water Note No. 22 Herbicide Use in Wetlands'* (WARC 2001). The application of these methods will be dependent on-site conditions and are likely to change over the course of this plan. The dominant weeds in the site and their potential control methods are listed in **Table 2**.

[5] Refer detailed landscaping plans.

Table 2: Dominant weeds in the site and recommended control methods (DBCA 2021).

Species	Method	Techniques	Timing
*Echium plantagineum	Chemical	Spot spray in late autumn/winter when most seed has germinated for the year with 0.5 g/10 L chlorsulfuron + wetting agent. Glyphosate at 75 ml -100 ml/15 L or metsulfuron methyl 5 g/ 100 L applied at early flowering will control existing plants.	May - August
*Lathyrus tingitanus		Spot spray using 0.2 g metsulfuron(600 g/kg) plus 25 mL Pulse® in 10 L water	July - October
* Tropaeolum majus		Spot spraying during active growth with 20 mL glyphosate(450g/L) plus 25 mL wetting agent in 10 L water.	June - August
*Zantedeschia aethiopica		Wipe individual leaves with with metsulfuron methyl or chlorsulfuron at 0.4g/15L of water + Pulse®	June - November. Repeat spray 2 months later.
*Watsonia meriana		Wipe individual leaves with glyphosate 10% or spray dense infestations 2,2-DPA 10 g/L + Pulse®	September. Follow up as necessary.
*Ficus spp.	Chemical/ manual	Hand remove seedlings. Stem inject with 50% glyphosate and foliar spray regrowth with 10% glyphosate. For stems less than 30 cm diametre apply 250 ml Access® in 15 L of diesel to basal 50 cm of trunk (basal bark).	December - February
*Lupin spp.		Hand remove scattered plants. Spray dense infestations with metsulfuron methyl 0.1 g/15 L (2-3 g/ha) + wetting agent or spot spray Lontrel® 6 ml/10 L (300 ml/ha) + wetting agent to late flowering, this will prevent seed set.	July - October
*Raphanus raphanistrum		Hand remove isolated plants several times throughout the year. Spot spray 1% glyphosate before flowering. A combination of approaches is usually most successful.	June - December
*Arundo donax		For small infestations mowing, tillage and removal of material from site ensuring all rhizomes are removed may be sufficient. Larger infestations may require a single glyphosate foliar application at 3% to 5% late in the season to kill stems and stop production of new stems the following spring	February - March (chemical)
*Cynodon dactylon		Blanket spray with 1% glyphosate or Fusilade® Forte at 16 ml/L + wetting agent THEN Mechanical slashing/ripping	November – January (chemical)
*Paspalum dilatatum			
*Gomphocarpus fruticosus		Hand pull small plants before seed set. Foliar spray with glyphosate at 1.5% or cut and paint with glyphosate at 50%	September – December (manual and chemical)

Tubestock will be sourced from a Nursery Industry Accreditation Scheme Australia (NIASA) accredited nursery supplier and grown from local[6] seed or cuttings with genetic diversity. Native species planted in revegetation area 1 and 2 will include those listed in **Table 3**. Species planted in revegetation area 3 will be determined as part of detailed landscape design[7].

Table 3: Species recommended to be planted in each revegetation area within the foreshore reserve

Lifeform	Species	Revegetation Area	
		1	2
Tree	Banksia grandis		X
	Corymbia calophylla		X
	Eucalyptus rudis		X
	Melaleuca preissiana		X
	Melaleuca rhaphiophylla	X	X
Shrub	Acacia pulchella		X
	Astartea scoparia	X	X
	Hakea trifurcata		X
	Hakea varia		X
	Hypocalymma angustifolium	X	X
	Jacksonia sternbergiana		X
	Kunzea recurva		X
	Melaleuca incana		X
	Melaleuca lateritia		X
	Melaleuca seriata		X
	Melaleuca viminea		X
	Regelia ciliata		X
	Regelia inops		X
	Viminaria juncea		X
Herbs and groundcovers	Anigozanthos humilis		X
	Centella asiatica	X	
	Conostylis aculeata		X
	Dianella revoluta		X
	Lobelia anceps	X	X
	Patersonia occidentalis		X

[6] Within 50 km
[7] Refer detailed landscaping plans.

Table 3: Species recommended to be planted in each revegetation area within the foreshore reserve (continued)

Lifeform	Species	Revegetation Area	
		1	2
Sedge – spreading	Baumea juncea	X	
	Ficinia nodosa	X	X
	Lepidosperma longitudinale	X	
Rush – clumping	Juncus pallidus	X	X
	Juncus subsecundus	X	X
	Leptocarpus canus	X	X
	Leptocarpus scariosus	X	X

5.3.7 Timing

Landscape planting will commence following completion of landform construction and public facilities.

Tubestock will be installed as soon as possible once winter rains have begun to allow plants time for establishment before the summer dry period.

Once works commence the revegetation will be managed for a period of two and a half years from planting up until handover to the Shire of Mundaring.

5.3.8 Contingency

The management actions outlined in **Sections 5.1** aim to meet the goals and objectives for the foreshore reserve and POS. If it is identified that the goals and objectives are not met, contingency actions will be implemented that include, but not limited to, the management actions outlined in **Section 5.2**. A range of contingency response for unmet objectives are outlined in **Table 4**.

Table 4: Contingency examples

Goal		Objectives	Unplanned outcome	Contingency
1.	Revegetate native vegetation within the Kadina Brook foreshore reserve and adjacent POS.	1.1 Weed cover is less than 10% across revegetation areas.	Weed cover is or is expected to be greater than 10 % across revegetation areas.	Weed control will be completed as per Section 0.
		1.2 No new weeds are introduced as a direct result of construction activities	New weeds are introduced as direct result of construction activities	Weed control will be completed as per Section 0.
		1.3 Native plant density is on average greater than 0.1 per m^2 for tree species, 0.5 per m^2 for shrubs and 2 per m^2 for sedges/rushes across revegetation areas.	Native plant density is not on average greater than 0.1 per m^2 for tree species, 0.5 per m^2 for shrubs and 2 per m^2 for sedges/rushes across revegetation areas.	Tubestock planting will be completed as per Section 0.
		1.4 No formal public access	N/A	N/A

Table4: Contingency examples (continued)

Goal		Objectives	Unplanned outcome	Contingency
2	Provide public use facilities within the adjacent POS without negatively affecting the adjacent Kadina Brook.	2.1 Rubbish not present or minimal	Rubbish is present	Rubbish will be collected and disposed of in appropriate waste disposal receptacle
		2.2 All pedestrian paths in good useable condition	Pedestrian paths not in good useable condition	Repairs will be undertaken
		2.3 Signage intact and in good condition	Signage is not intact or in good condition	Repairs or replacement will be undertaken
		2.4 No existing native trees damaged or impacted by path construction	Existing native trees damaged or impacted by path construction	Discussion will be had with Shire of Mundaring and repair and repairs or replacement will be undertaken
		2.5 No (or minimal) existing native understorey vegetation damaged or impacted by path construction	Existing native understorey vegetation is damaged or impacted by path construction	Discussion will be had with Shire of Mundaring and repair and repairs or replacement will be undertaken
		2.6 All facilities in good working order	All facilities not in good working order	Repairs or replacement will be undertaken
		2.7 Formal public access (paths and boardwalks)	Formal public access (paths and boardwalks) not present	Construction will be undertaken
		2.8 Informal public access (turf and other areas)	Informal public access (turf and other areas) not present	Construction will be undertaken
		2.9 Minimal irrigation overspray to hardstand and other non-turfed areas	Irrigation overspray to hardstand and other non-turfed areas not minimal	Repairs or replacement will be undertaken

5.4 Monitoring and evaluation

Monitoring will be performed to assess the outcomes of management actions against the goals and objectives (**Table 1**) and to trigger contingency actions, if necessary.

As primary monitoring method, a routine inspection (walkover) will be carried out every three months to assess the site for the following:

- infrastructure condition (e.g. paths, fences)
- weed cover
- plant survival
- threats or impacts (e.g. herbivory, vandalism, plant disease).

At least three photographic monitoring locations ('photopoints') will be established within the foreshore reserve and POS during the first walkover. These photopoints will comprise a specific location at which a digital photograph will be taken at the same height and orientation during each walkover, to enable visual progress tracking.

Additional monitoring will be undertaken within revegetation areas to provide a formal measure of weed cover and tubestock survival. Revegetation results will be reported to the Shire of Mundaring.

5.5 Roles and responsibilities

The implementation of this FMP will be the responsibility of the developer (City Plaza Pty Ltd) through their various parties.

All contractors engaged to undertake works within the site by these parties will be required to adhere to this plan.

5.6 Timeframes

Implementation of this FMP will be undertaken over multiple years. Construction of the POS and revegetation is expected to commence in 2022 (year 1).

Handover to the Shire of Mundaring will be two years following practical completion for the POS including landscaped planting, turf areas and part revegetation area 3[8] and associated public infrastructure.

Revegetation areas within the foreshore reserve will be managed for a period of two and half years from planting (summer 2024) up until handover to the Shire of Mundaring.

[8] Inside fence

6 Conclusion and Summary

This FMP has been prepared to address a condition of subdivision approval to ensure the protection and management of Kadina Brook which flows through the site (WAPC application no. 156909).

Once approved, this FMP, in conjunction with detailed landscape designs, will guide all works in the site.

A summary of management actions and responsibilities is outlined in **Table 5**.

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Table 5: Management actions and responsibilities

No.	Timing	Management action	Area	Responsibility
Site infrastructure and management				
1.	Before construction personnel begin	Induct all staff and on-site personnel regarding required actions within this plan.	Foreshore reserve and POS	Civil engineer
2.	Prior to earthworks and at all times	Inspect temporary fencing and markers to delineate the boundary of the foreshore reserve	Foreshore reserve and POS	Civil engineer
3.	Prior to earthworks and at all times	Fauna management.	POS	Fauna specialist
4.	As required	Maintain firebreaks.	Foreshore reserve	Civil contractor/landscape contractor
5.	During construction	Ensure all vehicles, tools, equipment, machinery and staff and all on-site personnel are free of mud, soil and plant material before entering the site, as well as before entering retained vegetation.	Foreshore reserve and POS	Civil engineer
6.	During construction	Ensure any soil brought into the site for landscape construction is free from pathogens and heavy metals and produced in accordance with *Australian Standard AS 4454-2003 Composts, Soil Conditioners and Mulches*.	POS	Civil contractor/landscape contractor
7.	During construction	Flag and fence areas of native vegetation to be retained to ensure they are not disturbed during construction	POS	Civil contractor/landscape contractor
8.	At the completion of earthworks	Install conservation fencing in revegetation area 3	POS	Civil engineer
Revegetation				
9.	Prior to planting	Place tubestock order	Foreshore reserve and POS	Environmental consultant/landscape architect
10.	Prior to planting	Weed control – spot spray and manual removal	Foreshore reserve	Revegetation contractor
11.	Prior to planting	Weed control – broad spectrum blanket spray and/or spot spray	Foreshore reserve	Revegetation contractor

Table 5: Management actions and responsibilities (cont.)

No.	Timing	Management action	Area	Responsibility
12.	Following construction of adjacent road.	Plant native species in accordance with specifications outlined in this plan	Foreshore reserve	Revegetation contractor
13.	Following construction of adjacent road, or winter of 2022	Weed control – spot spray and manual removal	Foreshore reserve	Revegetation contractor
14.	Summer prior to planting in 2023 or following the construction of the adjacent road, whichever comes later.	Weed control – broad spectrum blanket spray and/or spot spray	Foreshore reserve	Revegetation contractor
15.	Once first rains have begun in winter of 2023 or following the construction of the adjacent road, whichever comes later.	Plant native species in accordance with specifications outlined in this plan	Foreshore reserve	Revegetation contractor
16.	Spring 2023 or following the construction of the adjacent road, whichever comes later.	Weed control - spot spray and manual removal	Foreshore reserve	Revegetation contractor
17.	Spring-summer 2023 or following the construction of the adjacent road, whichever comes later.	Weed control - spot spray and manual removal	Foreshore reserve	Revegetation contractor

Table 5: Management actions and responsibilities (cont.)

No.	Timing	Management action	Area	Responsibility
Monitoring and evaluation				
18.	After practical completion	Undertake monitoring of infrastructure and undertake contingency actions as required	POS	Landscape architect
19.	From after practical completion for 3 years	Undertake routine walkover monitoring and undertake contingency actions as required	POS and foreshore reserve	Botanist/revegetation contractor
20.	In spring after initial tubestock planting for 3 years	Undertake monitoring	Foreshore reserve	Botanist/revegetation contractor
21.	Three years after initial tubestock planting	Evaluate results of monitoring against objectives provide monitoring report to Shire of Mundaring	Foreshore reserve	Botanist/revegetation contractor/landscape architect

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7 References

7.1 General references

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Figures

Figure 1: Site Location

Figure 2: Environmental Features

Figure 3: Plant Communities

Figure 4: Vegetation Condition

Figure 5: Foreshore Reserve

Figure 6: Management Areas and Public Infrastructure



Figure 1: Site Location

Project:	Foreshore Management Plan Kadina Brook within Lots 2, 3 and 6 Midland Road Helena Valley
Client:	City Plaza Pty Ltd

Plan Number: EP21-019(03)_F07
Drawn: GAR
Date: 16/06/2021
Checked: SKP
Approved: TAA
Date: 05/07/2021

N

0 50 100 150
Metres
Scale: 1:4,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
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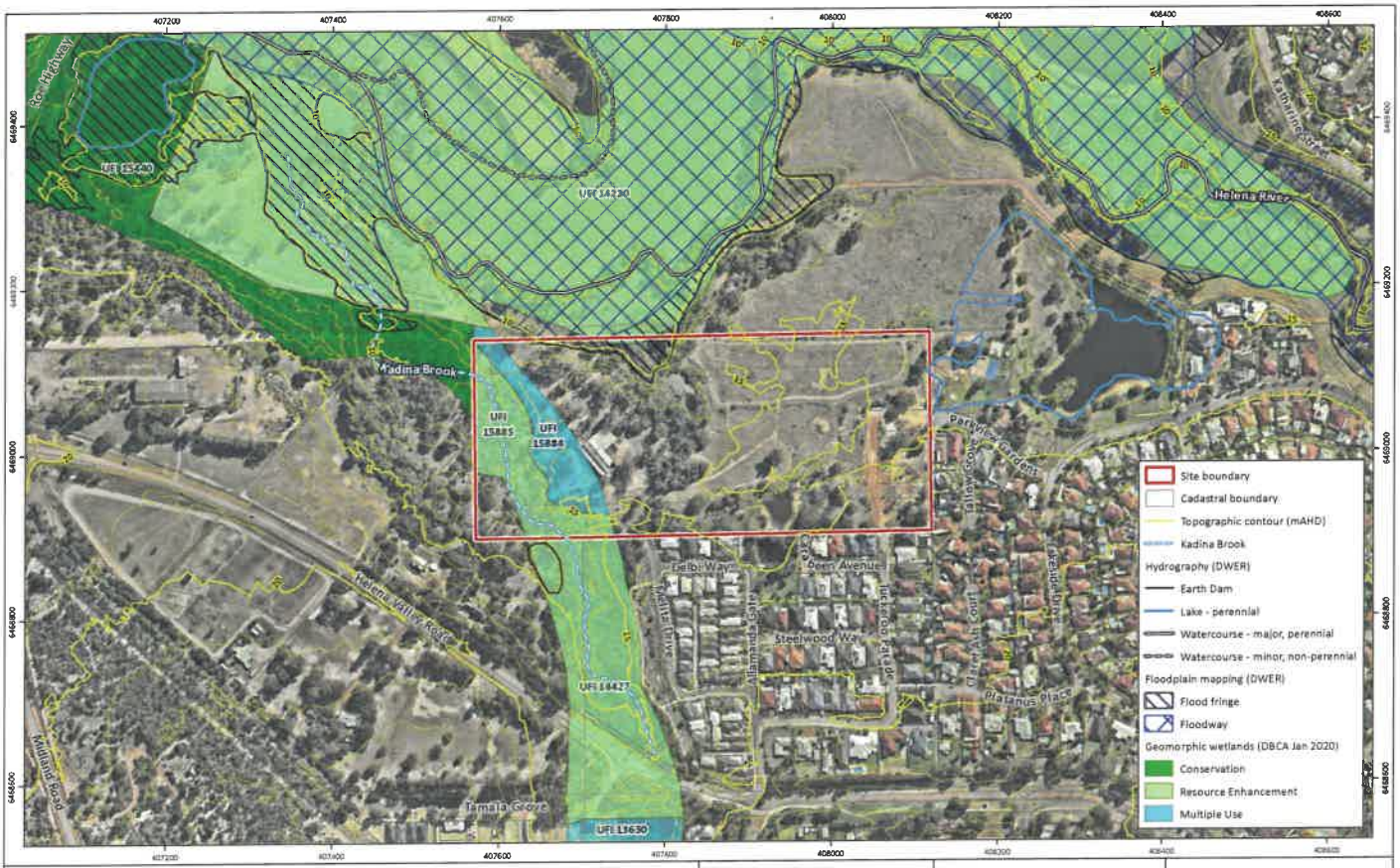


Figure 2: Environmental Features

Project:	Foreshore Management Plan Kadina Brook within Lots 2, 3 and 6 Midland Road Helena Valley
Client:	City Plaza Pty Ltd

Plan Number: EP21-019[03]--F08
Drawn: GAR
Date: 16/06/2021
Checked: SKP
Approved: TAA
Date: 05/07/2021

Scale: 1:6,000@A4
GDA 1994 MGA Zone 50

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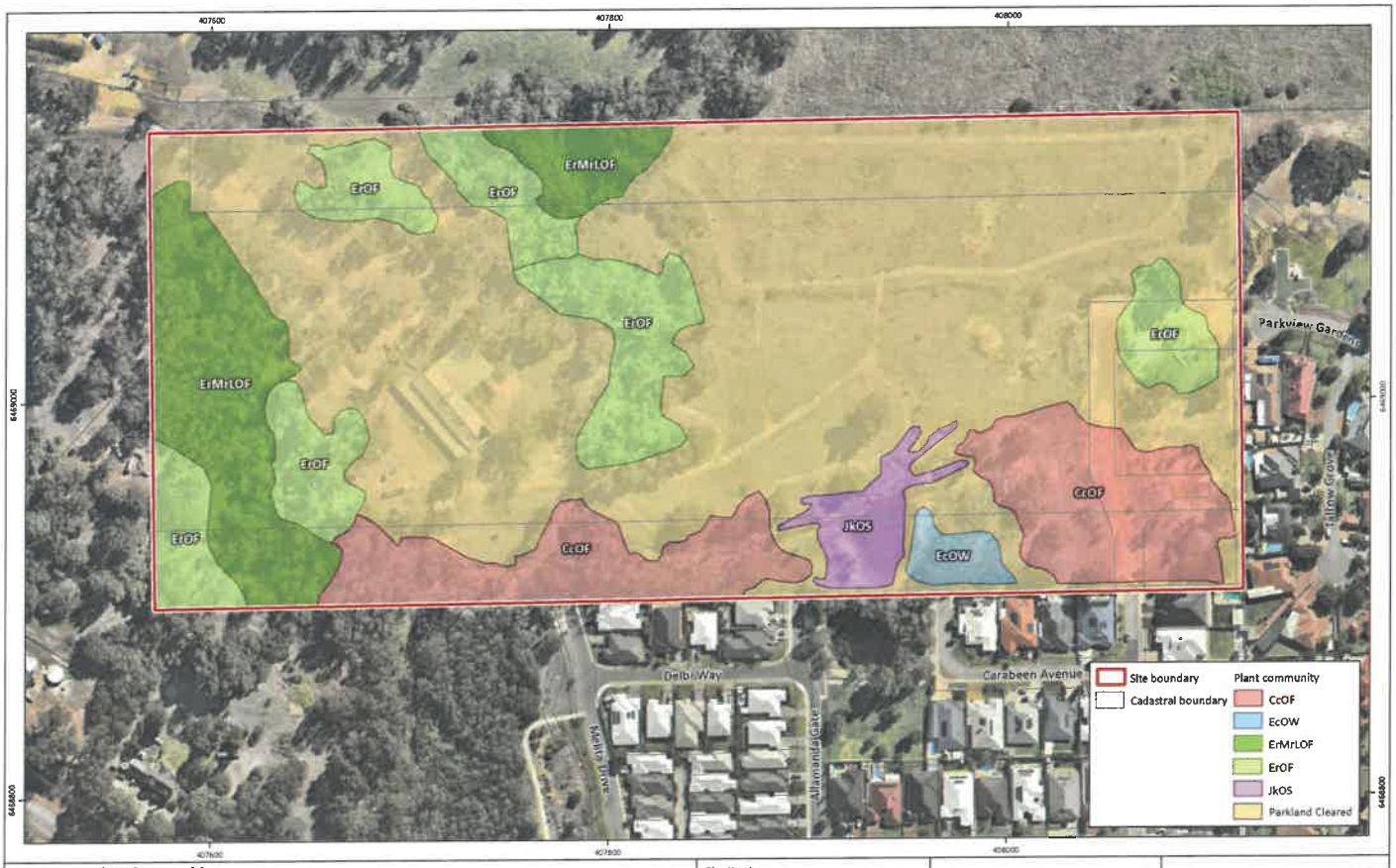


Figure 3: Plant Communities

Project:	Foreshore Management Plan Kadina Brook within Lots 2, 3 and 6 Midland Road Helena Valley
Client:	City Plaza Pty Ltd

Plan Number:	EP21-019(03)--F09
Drawn:	GAR
Date:	16/06/2021
Checked:	SKP
Approved:	TAA
Date:	05/07/2021

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Metres

Scale: 1:2,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

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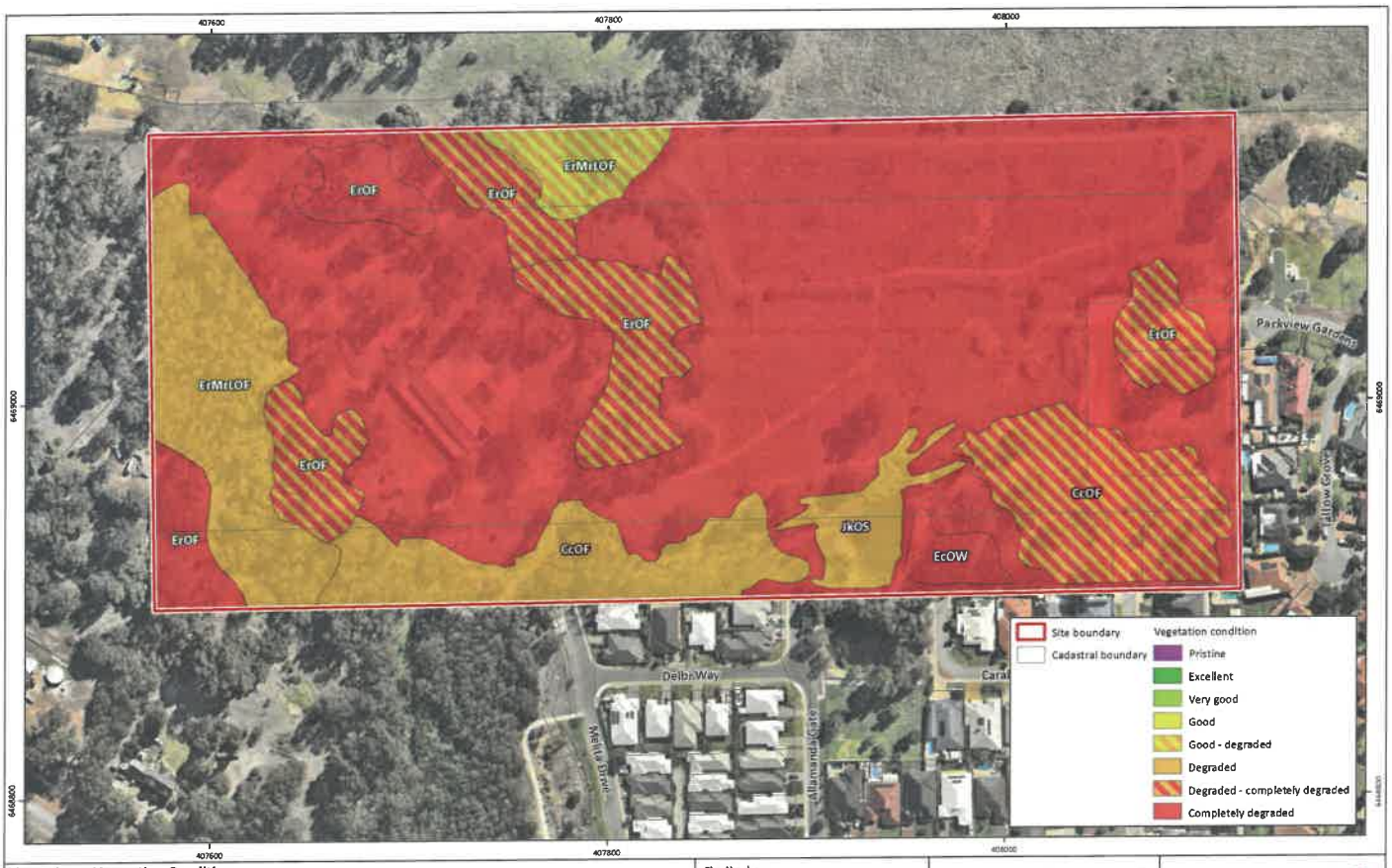


Figure 4: **Vegetation Condition**

Project:	Foreshore Management Plan Kadina Brook within Lots 2, 3 and 6 Midland Road Helena Valley
Client:	City Plaza Pty Ltd

Plan Number: EP21-019[03]-F10
Drawn: GAR
Date: 16/06/2021
Checked: SKP
Approved: TAA
Date: 05/07/2021

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Scale: 1:2,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

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Figure 5: Foreshore Reserve

Project:	Foreshore Management Plan Kadina Brook within Lots 2, 3 and 6 Midland Road Helena Valley
Client:	City Plaza Pty Ltd

Plan Number:	EP21-019(03)–F11b
Drawn:	GAR
Date:	27/05/2022
Checked:	MS
Approved:	TAA
Date:	27/05/2022

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Metres
Scale: 1:1,750@A4
GDA 1994 MGA Zone 50

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Figure 6: **Management Areas and Public Infrastructure**

Project:	Foreshore Management Plan Kadina Brook within Lots 2, 3 and 6 Midland Road Helena Valley
Client:	City Plaza Pty Ltd

Plan Number:	EP21-019(03)–F12c
Drawn:	GAR
Date:	27/05/2022
Checked:	MS
Approved:	TAA
Date:	27/05/2022

N

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Metres
Scale: 1:1,750@A4
GDA 1994 MGA Zone 50

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Appendix A

Subdivision Concept



Subdivision Concept

Lots 2, 3 & 6 Midland Road, Helena Valley

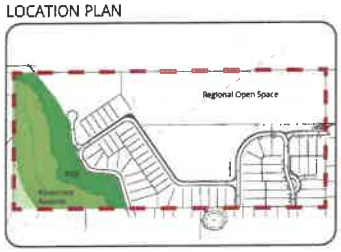
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Appendix B

Concept Landscape Plan

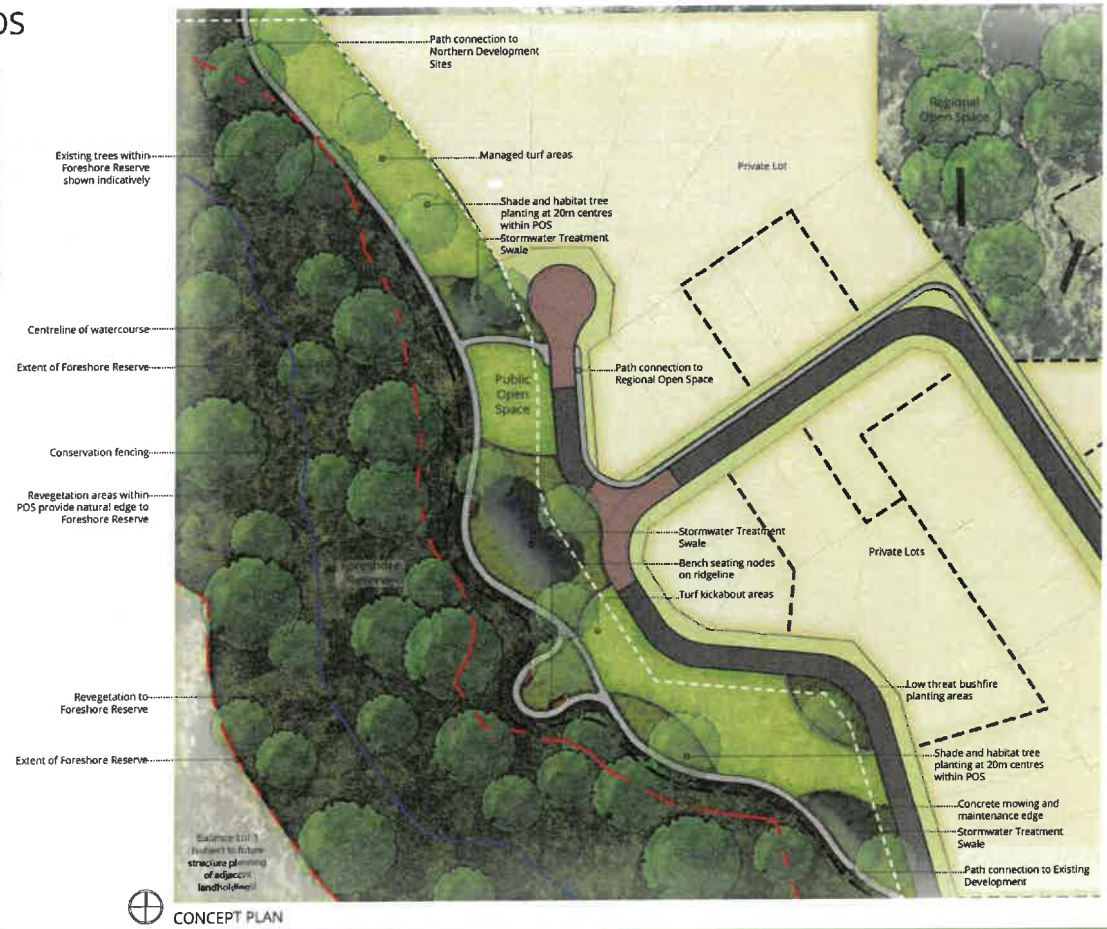
Foreshore Reserve & POS

LOCATION PLAN



LEGEND

- Foreshore Reserve Boundary
- Centreline of Watercourse
- POS Lot Boundary
- Conservation Fencing
- Existing Native Tree Planting
- Shade and Habitat Tree at 20m spacings
- Native Low fire Threat Shrub Planting Areas
- Revegetation Planting
- 2.1m Wide Concrete Path
- Informal / Bench Seating
- Turf areas
- Concrete Mowing/ Maintenance edge
- Road Treatments
- Stormwater Treatment Swale



CONCEPT PLAN

LOTS 2, 3 & 6 MIDLAND ROAD, HELENA VALLEY

FORESHORE & PUBLIC OPEN SPACE PLAN

emerge

element.

APPENDIX 4

Urban Water Management Plan

REPORT

CITY PLAZA PTY LTD
LOTS 2, 3 AND 6 MIDLAND ROAD, HELENA VALLEY

URBAN WATER MANAGEMENT PLAN

JULY 2024

DEVELOPMENT
ENGINEERING
CONSULTANTS

Revision History:

Revision	Description	Checked	Approved	Date
0	Original Issue for DoW and Council approval	SRA	SRA	28th May 2021
1	UWMP Updated to reflect the agreed location of the Basin and accommodate comments from DBCA	SRA	SRA	4th April 2022
2	UWMP Updated to Reflect further comments from DBCA and Shire of Mundaring	SRA	SRA	26th May 2022
3	UWMP Updated to Reflect further comments from DBCA	SRA	SRA	11th July 2022
4	UWMP updated to reflect the ultimate proposed development as per amended plan	SRA	SRA	19th July 2024

DEVELOPMENT
ENGINEERING
CONSULTANTS

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Summary

- The general fall of the land is in a north and westerly direction towards the Kadina Brook and Helena River on the north and west of the site.
- The site is traversed by the existing Kadina Brook, which will be left in its current form. Drainage will be detained to predevelopment rates prior to outflow into the brook and Helena River.
- All piped drainage systems will be designed to accommodate the 20% AEP rainfall event.
- All roads within the subdivision will be kerbed & drained to Council standards.
- All detention basins will be designed to manage all storm events up to and including the following:
  - 1% AEP event with outflow controlled using weirs and orifice to limit various ARI storms to pre development rates.
  - The biological uptake areas for the drainage basins will be sized based on 2% of the connected impervious area of the catchment of the basin.
- Lot Drainage Systems shall allow for disposal of stormwater by soakage on site using the equivalent of 2 by 1.5m diameter and 1.2m deep soakwells to hold the 1 EY 1 Hour AEP storms on the site and provide a detention volume to limit outflows for the various AEP storms.
- Information Packages will be provided as part of sales documentation to all lot purchasers to: (a) Fully inform lot owners of the requirement to provide soakage facilities to assist in the disposal of site drainage; (b) To encourage the use of rainwater tanks (plumbed into their homes for household); (c) To utilise water efficient devices & appliances throughout their homes; and (d) To maximise the use Water & Nutrient-wise plants, and to minimise the use of lawns.

1 Planning Approval

The subdivision has been approved for subdivision under WAPC subdivision approval (No. 156909) dated 26th July 2019.

The site includes a portion of Kadina Brook on the western side and abuts the Helena River flood plain to the north. The Kadina Brook connects with the Helena River some 500m north of the site.

The approved subdivision layout plan in Appendix A of this report illustrates how the site will be developed and integrated into the existing residential area to the south of the site. The development consists of approximately 65 residential allotments averaging from 360 to 750 square metres in area. In addition to the approval, the developers are proposing to further subdivide the 1.2595ha Balance Lot 3 into 24 residential allotments plus a further group housing parcel, plus a further 4 lots plus POS on the 1.004ha Balance Lot 2. The proposed plan for this is shown in Appendix A in the Land Surveys Plan 2400025-PR002-D. Although these have not been approved provision within the drainage system to cater for this proposed extension of the development has been made within this report as it is a more conservative approach.

This plan is being prepared in compliance with Condition 4 of the approval requires the following:

Prior to the commencement of subdivisional works, an Urban Water Management plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation and Department of Biodiversity, Conservation and Attractions (Estuary Division), consistent with any approved Foreshore management Plan and Local Water Management Strategy. (Local Government).

The Location of the Site, together with the approved subdivision area, approved plan and proposed plan are shown in Appendix A.

2 Design Objectives

2.1 Development Objectives

A Local Water Management Strategy (LWMS) was prepared for the site by Emerge dated September 2015.

This plan included several design objectives to manage potential impacts on the hydrology and environment which are outlined in the tables below.

Protection of environmental assets from the potential impacts of development

Objective:	*Compliance:*
» Minimise changes to hydrology to prevent impacts on watercourses & wetlands	Lot stormwater run-off will be directed in to soakwells to maximise infiltration as close as possible to where it is generated. Road Drainage Systems to also incorporate soakage at source.
» Manage & restore watercourses &/or wetlands	The existing alignment of Kadina Brook will be retained and enhanced as part of the landscape strategy..

Surface water management to protect infrastructure, assets & receiving environments

Objective:	*Compliance:*

» Minimise changes to hydrology to prevent impacts on receiving environments » Manage surface water flows from major events to protect infrastructure & assets	Peak flows leaving the site should be comparable to pre-development flows up to the 1% AEP event. The road drainage network will be designed to convey the 20% AEP event. Maintain a minimum average grade of 1 in 500 across the length of roadside swales. All finished floor levels of allotments to be a minimum of 0.5m above the 1% AEP flood level for the back flooding of the Helena River or the Local Detention basins whichever is higher.
» Manage groundwater levels to protect assets, infrastructure & groundwater dependent ecosystems	Lots should have a clearance to the measured maximum groundwater level (MGL) of at least 1.2m. Inverts of bio-retention areas will be set at least 0.3m above the measured MGL. Downstream groundwater quality should be at least the same as or better than, upstream water quality.

Water Quality management Measures for Urban Development

Objective:	*Compliance:*
» Achieve pollutant load reduction from stormwater runoff generated from the development.	Retain the 1EY event as close to source as practical. The surface area of bio-retention areas is to be a minimum of 2% if the connected impervious area. Bio Retention areas should maintain 1 in 3 side slopes and a maximum depth of 0.5m. Non Structural measures including Education of residents in regards to management measures to minimise nutrient loading.

Water Conservation and Improvement in Water use Efficiency

Objective:	*Compliance:*
» Improve potable water consumption targets	Lot purchasers will be encouraged to install rain water tanks (plumbed into their home); to use water efficient devices & appliances and to plant "Water-wise" & "Nutrient-wise" gardens. This will be by reference to publications and provision of data as part of sales documentation.

2.2 *Water Quantity Objectives*

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

Item	Description	Requirement	Source / Comment
1	Water Quality	1EY storm to be Retained on site	DoW requirements
2	ARI for pipe design	20% AEP	Standard Council requirement
3	ARI for compensating basin design	1% AEP outflow limited to predevelopment flow rates.	Standard DoW/Council requirement
4	Flow rates	1% AEP outflow limited to predevelopment flow rates.	Standard DoW/Council requirement

Item	Description	Requirement	Source / Comment
5	Min. lot freeboard	0.5m above basin or Helena River flood level. 0.3m above 100 Yr HGL in Road System	Standard Council/DoW requirement developments
6	Basin Criteria		
	Side slopes – In POS	Max. 1 in 6	Standard Council requirement
7	Run-off coefficients C_{100}	0.70 – for road reserves	Council Requirements
		$C_{1\%}$ = 0.51, $C_{10\%}$ = 0.39, $C_{20\%}$ = 0.33, C_{1EY} = 0.18 – For Urban Residential Allotments	As Calculated by first principles as per "at Lot' calculations in Appendix C
		$C_{1\%}$ = 0.14 for POS	Per Pre Development Allowances

3 Site Characteristics

3.1 Soil Conditions

The Perth Environmental Geology Mapping[1] (Gozzard, 1986) defines the materials beneath the site as follows.

Soil profile M_{gs1} – This comprises the eastern portion of the site and is described as pebbly silt with common to fine to occasionally coarse grained sub-rounded laterite quartz heavily weather granite pebble and some fine to medium grained quartz sand of alluvial origin.

A clay quarry was shown on the northern side of the site.

Topographical contours across the site are shown on the catchment plan contained in The Pre Development Catchment Plan U-03 in Appendix B.

3.2 Geotechnical

A geotechnical report was undertaken over the site by JDSI in June 2017. Further investigations were also undertaken by Douglas Partners in early 2017 to facilitate the construction of a Water Corporation sewer across the subject land. In addition to this, Emerge undertook excavations as part of the UWMP and environmental investigations.

The report generally supports the regional mapping insofar as the predominant soil type of the area is sandy clay and medium plasticity clay.

A large portion of the site is covered with uncontrolled fill ranging to in excess of 4.3m. The uncontrolled fill material consisted of a mixture of construction rubble (Such as bricks, steel, concrete and gravels), sands and clay.

The report indicated that soil improvement by impact rolling and "rafting" over the deeper uncontrolled fill would be the preferred approach to limit differential settlement and enable house construction over the affected areas. It also recommended a minimum depth of 1.2m of sand be placed over the area to ensure a minimum site Classification "S" under AS2870 – 2011 'Residential Slabs and Footings". The "rafting" consists of a geotextile membrane in conjunction with 300mm of limestone/lime sand which will form a barrier between the untreated uncontrolled fill below and the treated and clean material above.

A copy of the geotechnical investigation report is included in Appendix E of this document together with a plan detailing the various areas described above.

3.3 Environmental

3.3.1 Natural Environment on the Site

Emerge Associates inspected the site as part of the LWMS and undertook a wetland assessment. The survey found that no Threatened or Priority Flora were on the site. The wetland vegetation was found to be in a "Degraded" condition with the areas subject to filling being "Completely Degraded". The remainder of the site consisted of cleared paddocks.

Acid Sulphate soils Mapping across most of the site indicates that all soils within 3.0m of surface levels were either a moderate to low risk or Low to no risk of Acid Sulphate Soils occurring. The eastern portion of the site indicates a High to moderate risk of ASS being on the eastern portion of the site.

3.3.2 Natural Environment abutting or Close to the Site

The only site of environmental significance within or adjacent to the site is the Kadina Brook, which in turn drains to the Helena River, some 0.5km downstream of the site. The Kadina Brook is recognised as a Resource Enhancement Wetland (REW) with the surrounding floodplain being classed as a Multiple Use Wetland (MUW). The Helena River Floodplain also abuts the site to the north and this has the same classifications with the River being a REW and the floodplain being a MUW.

3.3.3 Uncontrolled Fill on the Site and Proposed Remediation

As outlined in Section 3.2 a large portion of the site is underlain by uncontrolled fill to a significant depth in parts. The uncontrolled fill is subject to an environmental remediation action plan (Emerge Associates, 2021)[6] which requires uncontrolled fill material within 2.6m of the finished surface level to be screened, contaminants removed, tested for compliance, then replaced. The raft as discussed in section 3.2 is required for structural proposes, together with a warning barrier will be placed at the base of the excavation to ensure that if any future excavations occur in the area, there will be a sufficient barrier between the treated and untreaded soils. The top 1.2m of the site area will be clean imported sand.

The action plan[6] indicated that despite some exceedances of guideline levels of hydrocarbon and polyfluoroalkyl compounds (PFAS) which have likely resulted from the landfill, the PFAS represented only a theoretical risk to human and environmental health. The hydrocarbons were only found at discrete locations and hence were deemed to be low risk. The report further indicated that risk to human health could only occur if the groundwater was used for non-potable purposes, but the geological conditions of the area means that groundwater extraction is not feasible hence it was deemed that there was no feasible completed source-pathway-receptor linkage that would result in exposure. Qualitative risk assessment assessed the risk to the environment as "very low" and no action was required.

To safeguard against further mobilization of contaminants, subsoils are proposed to be above groundwater levels where possible and all groundwater is treated prior to outflow to

Helena River. All soakwells and subsoils will be located within the top 2.6m of remediated and clean fill.

An existing deep sewer has been installed through the site and the remaining services required for the development are generally shallow and dewatering is unlikely to be required other than for surface water if works are undertaken in periods of wet weather. If any dewatering is required, effluent will be measured and if samples indicate trigger levels are exceed, lime treatment will be introduced to ensure that the discharge levels meet required criteria. Testing to date indicates that the groundwater is relatively free of pollutants and ASS.

3.4 Surface Water

The existing area mainly consists of open paddocks with stockpiles in the south eastern corner from the earthworks completed by the Water Corporation sewer works through the site. There is an existing dammed water body which overflows to the north east of the site. The western area of the site is the Kadina Brook and foreshore area. The north western portion of the site is more of less foreshore reserve with a steep embankment falling from around RL 14.00mAHD to around RL9.5mAHD. There are significant trees along the embankment area.

The Kadina Brook flows along the western side of the site and the Helena River is to the north. According to DWER flood mapping, the 1% AEP flood level of the Helena River abutting the site is at around RL10.50m AHD which is some 5.0m lower than the general levels of the site.

The site falls into three main catchments; Helena River to the north, Broz Park to the east and Kadina Brook to the west. There is a dam in the southern portion of the site which receives overflow from an existing drainage basin to the south and in turn overflows to Broz Park.

As outlined above, the existing drainage basin referred to above (EB) has been constructed on the southern side of the site which discharges into the subject land. Based on original design work undertaken by Development Engineering Consultants (DEC) in 2006, the peak outflow from the basin for the 1% AEP of some 283l/s. Based on the total area of the site of some 6.5ha, this equated to around 43l/s/ha. EB will treat stormwater prior to outflow, hence this overflow will need to be incorporated within the stormwater system for the development, but will not need to be routed through further treatment mechanisms.

In the LWMS, Emerge undertook predevelopment surface water modelling and calculated that from the subject land the 5 year (20% AEP) flows and 100 Year (1% AEP) flows were some $0.36m^3/s$ and $1.07m^3/s$ respectively. Based on the site area of some 13.2ha, the total average outflow was around 81l/s/ha for the 1% AEP storm which appears to be relatively high compared to the previous development outflows.

Based on previous work by DEC in upstream areas of Kadina Brook with similar soil conditions, and the work done by Belleng VDM Pty Ltd for Lots 229 and 230 Helena Valley Road, Helena Valley[2], the 1% AEP storm equated to some 43l/s/ha, which is similar to that used by DEC in the adjoining development and is significantly lower outflow than proposed by Emerge.

3.5 Groundwater

3.5.1 Calculation of Predevelopment Groundwater Levels:

Groundwater level monitoring was undertaken by Emerge between October 2011 to November 2012 and 5 months of 2013. The peak contours as measured by Emerge are shown in Drawing U-03 in Appendix B, together with the bore locations.

Groundwater flow directions are generally grading from RL15.20m AHD on the eastern boundary of the site in a northerly and westerly direction towards Kadina Brook and Helena River. The level on the eastern boundary of the site is around 2.5m below surface level. According to the records the remainder is around 1-2.0m below existing surface levels.

According to the 2003 Groundwater Atlas, which generally designates AAMGL levels, the groundwater falls in a similar direction, being around 10.00mAHD at the south eastern boundary of the site flowing north east to Helena River at around 7.00mAHD.

The groundwater contours shown on the LWMS are based on only three bore locations and are not representative of the unconfined groundwater levels for the area. The groundwater levels shown are a blend of a deeper confined aquifer combining with upper layers being perched on clay.

For example, the groundwater level on the Emerge drawing near the intersection of Carabeen Ave and Parkview Gardens is shown as RL14.80mAHD which in some cases is already 0.3m above existing surface levels, which based on anecdotal information and site review is clearly not the case. The Geotechnical Report and the remediation action plan[6] indicates the groundwater some 4.0m below surface levels. In contrast to this, the Emerge LWMS shows groundwater levels abutting the Helena River are shown some 2.0m above existing levels, which given the proximity to the Helena River is clearly erroneous.

Clearly this is a significant discrepancy and the unconfined groundwater levels are significantly lower than shown in the Emerge LWMS.

The regional mapping is significantly lower than the levels measured by Emerge, and looking at the geotechnical report, the water levels appear to be coincidental with the upper level of clayey layers, meaning that the measured water is the perched water fed from winter rainfall.

3.5.2 Predevelopment Groundwater Monitoring

Monitoring bores were placed over the site in a number of locations process over the site locations as shown in U-03 in Appendix B. B ores as outlined below have been installed to monitor groundwater levels over the area.

The bore locations have been plotted on Drawings U-03 and U-04 in Appendix B.

3.5.2.1 Measured Groundwater Levels

The measured levels from the Emerge reporting are replicated below, which indicated a 2.0m variation between summer and winter, which is a significant variation and indicates the impact of surface water perching.

As outlined above, the measured levels appear inconsistent with the regional data and geotechnical excavations on the site, giving rise to the view that the measurement is likely to be the effect of a deeper confined aquifer and superficial surface water perching over the winter months. The bores were generally 7.0m deep and the measured water levels on their installation was significantly deeper than the measured levels on the graph below, which indicates that effect of the confined aquifer.

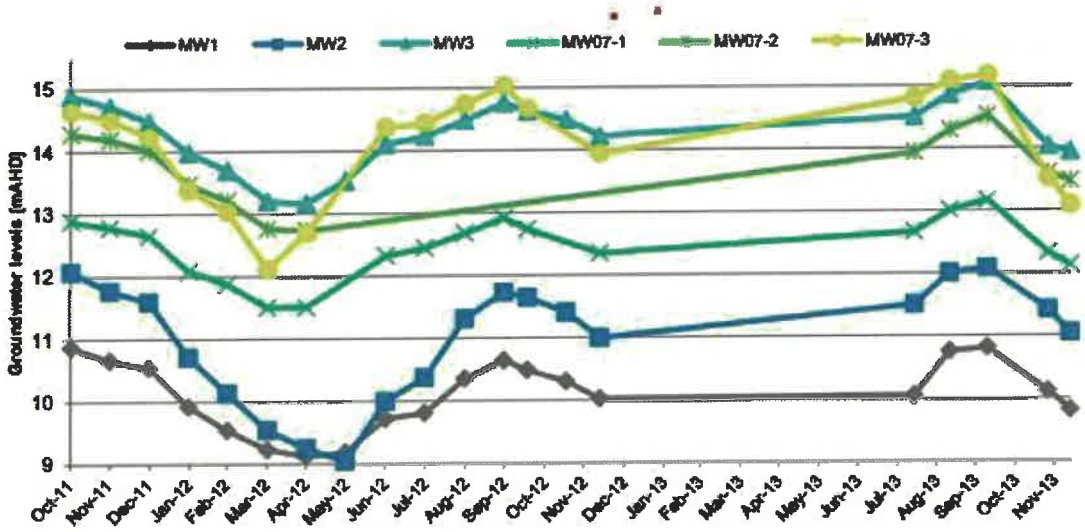


Chart 1 Measured groundwater levels (2011-2013)

3.5.2.2 Measured Groundwater Quality

Groundwater Quality was sampled by Emerge as part of the LWMS investigations on four occasions during 2011 and 2012. The summary of results specifically in regard to nutrient levels is outlined below in Table 3.1.

Table 3.1 – Groundwater Quality Monitoring Results – Emerge Associates – Lot 2,3 and 6 Midland Road, Helena Valley – Local Water Management Strategy

Sample ID	Date	Trigger	Total P	Total N	TKN	NOx-N
		PQL[a]	0.05	0.1	0.1	0.051
		FWG[b]	0.2	2	NG	NG
		LIWG[c]	0.05	5	NG	NG
MW1	2011/2012		0.13	0.46	0.46	0.03

Sample ID	Date	Trigger	Total P	Total N	TKN	NOx-N
		PQL[a]	0.05	0.1	0.1	0.051
		FWG[b]	0.2	2	NG	NG
		LIWG[c]	0.05	5	NG	NG
MW2	2011/2012		0.2	0.88	0.84	0.07
MW3	2011/2012		0.54	0.36	0.34	0.05

a. Practical Quantitation Limits (PQL).

b. Values for Wetland Environments – Table 3.3.6 ANZECC/ARMCANZ 2000 Freshwater and Marine WQ Guidelines Chapter 3. NG – No Guidelines.

c. Long term Irrigation Water Quality Guidelines (LIWG).

Although the level of phosphorous is slightly above the guideline levels all other parameters are within the guideline levels. This indicates that the uncontrolled fill on the site is generally inert and the groundwater in its current state is quite fresh.

Further environmental work on the uncontrolled fill indicated that despite some exceedances if guideline levels of hydrocarbon and polyfluoroalkyl compounds (PFAS) which have likely resulted from the landfill, the PFAS represented only a theoretical risk to human and environmental health. The report further expanded that risk to human health could only occur if the groundwater was used for non-potable purposes, but the geological conditions of the area means that groundwater extraction is not feasible, hence it was deemed that there was no feasible completed source-pathway-receptor linkage that would result in exposure. Qualitive risk assessment assessed the risk to the environment as "very low" and no action was required.

3.5.3 Post Development Groundwater levels:

To control the rise of the perched water, it is proposed that subsoil drainage will be installed within the development. All drainage will be laid with subsoil drains in parallel with the drainage pipes. All the drainage will be backfilled with sand resulting in the subsoils being hydraulically linked with the sand/clay interface, thereby controlling any potential groundwater rise.

All internal drainage will be installed with subsoil drainage to control perching of surface water on the superficial layers. All this perched water will be treated by routing this water through the end of line basin prior to outflow to the Helena River.

As part of the remediation of the upper 2.6m of the area of the uncontrolled fill the existing material will be excavated, screened to remove contaminants, tested for compliance, then replaced and recompacted. The subsoil drainage through the area will be laid within the remediated material meaning there will be little or no opportunity for the mobilization of contaminants. This in combination with the low concentrations of contaminants and the treatment of the water prior to outflow means there will be little or no opportunity of contamination.

The outlet drain from the existing basin needs to be laid lower than the drainage for the development to enable the existing drainage levels to grade to the river. The pipework levels of this line are as high as possible to accommodate the outlet level of the existing basin and it is proposed that these pipes will be installed without subsoil drainage to minimise the risk of mobilisation of any contaminants.

Assuming peak average annual 24 hour rainfall of 48mm and this will be drained over 5 days, the average subsoil flow is likely to be around 2.57l/s which will be easily treated in the proposed basin.

The proposed subsoil drainage details are shown in Drawing U-08 in Appendix C.

3.6 Landscape Areas

3.6.1 Proposed Public Open Space Development

The POS area is proposed to be located abutting the Kadina Brook and consists mainly of flood plain areas. A large portion of the site to the north is proposed to be acquired by DLPH as regional open space (ROS) which is shown on the plan.

Drainage Basin 1 is proposed to provide a bio filtration role and limit outflow to predevelopment rates is proposed to be located within an easement in allotments, hence will have no implication on POS areas. There is a relatively clear area abutting the floodplain that will facilitate the construction of the basin with linking pipes without significant damage to established trees.

Drainage Basin 2 is proposed for the small area at the connection point to Parkview Gardens and is located within the road reserve. This is proposed as a shallow swale with overflow to the existing drainage system on Parkview Gardens.

Both basins are proposed to be constructed as an artificial wetlands with subsurface drainage and improved soil beneath to ensure that the basins empty after each rain event.

Both basins are proposed to be planted with nutrient absorbing species such as the suggestions below:

- *Baumea articulata*
- *Ficinia nodosa*
- *Juncus krausii*
- *Eleocharis acuta*
- *Melaleuca rhaphiophylla*

Further planting details shall be in general accord with the Shire of Mundaring "Landscape and Revegetation Guidelines". Bio retention plant species have been selected on the basis of being tolerant of periodic inundation and extended dry periods, with deep and spreading root system. Planting should aim to provide 70-80% coverage at plant maturity.

Planting densities will be resolved at the time of detailed landscape design, but will be in accordance with the publication "Vegetated Guidelines for Stormwater Biofilters in the South West of Western Australis (Monash University, 2014".

The modeling in the calculations in Appendix D indicates that the basins will all facilitate dissipation within 72 hours after cessation of rainfall in accord with health Department recommendations, even for a 100 year storm.

As a result of the location of the drainage area within the lots, the whole of the POS is then unencumbered by drainage and the steep grades between the roadway and the brook can then be more easily reconciled with minimal retaining and a greater proportion of useable area.

3.6.2 POS Credits and Areas of Inundation:

POS credit calculations are typically based upon current "Liveable Neighbourhood" policy guidelines - where 100% of the area covered by the 1 in 1 year event of each compensating basin is typically not included as a "usable" or "unrestricted" POS area. The area between the 1 in 1 year and 1 in 5 year storms is typically rated as restricted although this cannot exceed 20% of the POS allocation.

There will be no impact on the POS due to the drainage, given that it will be located outside the POS area.

3.6.3 Irrigation Requirements for Landscape Areas

3.6.3.1 Water Source and Required Allocations

As part of this development, one parcel of POS will be created between the western roadway in the development and Kadina Brook totalling some 9,644 square metres.

Allowing the allowable irrigation volumes of 7,500kl per hectare per annum, an allocation will need to be sought for some 7,233kl per annum for this additional POS area. The POS area is abutting the previously developed portion of the foreshore reserve. There appears to be an existing bore close to Helena Valley Road which would make sense to connect into that irrigation system to utilise for the irrigation of this POS parcel. Alternatively a new bore will be installed to service the area.

An application for an allocation has been made to DWER which has been approved and a copy of the licence is within Appendix F.

3.6.3.2 Irrigation Schedules

In general, watering will be 10mm three times per day for initial establishment over a period of approximately 1 month, depending on the weather and the time of the year. This will be reduced to 10mm once per day for a period of approximately 2 months again dependent on the time of year. The watering is then reduced to 10mm every two days.

Establishment irrigation for street trees and POS planting is expected to be used for a period of 3 to a maximum of 5 years after planting.

As part of the landscape works, the top 300mm of soil in the landscaped areas will be improved to ensure free drainage and nutrient retention prior to planting.

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

Monitoring and Adjustment: The system will be checked regularly to detect faults and ensure water is being used effectively and efficiently.

In general the system will be checked at a frequency of

- November to April - Once per fortnight.
- May to October - Once a Month.

All sprinklers will be checked to fully pop-up and retract, bubblers and that nozzles are free of blockages and sprinklers are providing adequate coverage. Particular attention will be paid to irrigation of transplanted mature trees and street trees to ensure they are receiving adequate water.

The watering regime for planted areas shall reflect the plant's needs in accordance with the plant type and natural rainfall, in accordance with the Water Corporation of WA "Waterwise" guidelines. Watering will be monitored throughout the year and adjusted accordingly to ensure appropriate watering. Watering (Other than testing) will only take place within the hours stipulated by the DoW as a condition of the groundwater licence (Currently 6.00pm to 9.00am)

In general the Irrigation Schedule will be as outlined below, which are based on the landscape hydrozones

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

4 Water Sustainability Initiatives

4.1 General

In terms of water conservation, there is a growing acceptance of current water conservation initiatives being promoted by both the state and federal governments. Much of the water conservation effort needs to focus on encouraging the community to use water saving devices and appliances; promoting the use of plants appropriate to the local area and by providing information and community education programs about water conservation issues on a regular basis.

As part of sales documentation a flier will be provided to provide advice and encouragement for purchasers to utilize these initiatives as part of their housing construction works.

4.2 Water Supply and Efficiency Measures

It is widely accepted that current use of scheme water by Perth's households is unsustainable. The Water Corporation's "Domestic Water Study" (Water Corporation 2003) highlighted that in 2003 the average Perth household used 460 kilolitres (kL) of water per year. Of this total, almost 260kL was used in the watering of gardens.

The Western Australian 2003 State Water Strategy set a target of reducing the average per household potable water consumption (serviced by the Integrated Water Supply Scheme) to

155kL/year by 2012. The current consumption target for water of 100kL/person/yr, (State Water Plan target) includes no more than 40-60kL/person/yr of scheme water. This figure includes both in-house and ex-house demands.

The general approach to achieve these is to encourage the following water efficiency measures to be implemented by purchasers as part of development proposals:

- Limiting water through a minimum of 3 star efficiency household plumbing fixtures – encouraged by the government through financial incentives.
- Covering all new swimming pools as now required by legislation.
- Use of Domestic Bores for Irrigation
- Encouragement of waterwise garden measures including;
    - Flow regulators.
    - Rainwater Tanks
    - Use of garden Bores

This will be achieved through provision of fliers to purchasers to assist in the selection of waterwise products and to provide advice on various incentive schemes available. These approaches cannot be mandated, but will be encouraged.

4.3 Alternative Water Supply Scheme

No "alternative" water supply scheme is to be used in this development, the development will be connected to the Water Corporations reticulated water system.

4.4 Wastewater Management

Standard Water Corporation reticulated sewer is to be used in this development.

5 Stormwater and Groundwater Management

5.1 Pre-Development Hydrology

As outlined in Section 3.4 the site consists fill overlying clay which flows towards the Kadina Brook and Helena River.

The predevelopment modelling as part of the LWMS indicated that an average flow from the site was around 81l/s/ha. This is substantially greater than the work done by DEC in 2006 and by Belleng VDM[2] for upstream catchments at the same time. As a result, it is proposed to adopt the more conservative lower outflow for the drainage design criteria.

Applying AEP factors in general accord with the AR and R recommendations results in the following allowable outflows:

Table 5.1 – Predevelopment Flows from Catchments (per Unit Area)

AEP	1EY (l/s/ha)	20% AEP (l/s/ha)	10% AEP (l/s/ha)	1% AEP (l/s/ha)
Flow/ha	3.1	11.2	14.9	43.7

Although the total site area is some 13.7ha, a large portion of the site abutting the Helena River and Kadina Brook will remain in its natural state without the need for further

detention storage or nutrient treatment. Based on the total development catchment only which is some 5.65ha, the predevelopment flows from the area were calculated to be:

Table 5.2 – Predevelopment Flows from the Site (Development Area 5.65ha)

AEP	1EY (l/s/ha)	20% AEP (l/s/ha)	10% AEP (l/s/ha)	1% AEP (l/s/ha)
Flow	17.5	63.3	84.2	247

As outlined in Section 3.4 there is an existing drainage basin located between Allamanda gate and Carabeen Ave, this overflows into the subject land into a localized depression formed during the filling of the area. As part of the drainage for the development, this outlet is proposed to be piped as a separate line to the ultimate outlet to the Helena valley. Given the existing outlet level, this will be quite deep in comparison to the development drainage system and will be laid as a solid pipe to ensure it does not collect subsoil flows. The pipe has been sized to accommodate the 1% AEP outflow from the existing basin and is shown in Drawings U-05 and U-06 in Appendix C.

5.2 Flood Protection

5.2.1 Comparison to Emerge Local Water Management Strategy (LWMS)

The Emerge LWMS proposed to install swales along the roadways which at the time were proposed to be abutting POS areas, particularly the extension of Parkview Gardens. They also proposed two drainage basins, one to the north west of the site behind the proposed lots and another to the west abutting Kadina Brook. Both these locations are located in very steep terrain and both are impacted by existing trees. The earthworks and retaining to accommodate the basins as per the LWMS would be significant and would not result in an aesthetically pleasing outcome. As a result, it is still proposed to construct two basins, but in different locations as per Drawing U-04 in Appendix B.

Basin 1 is proposed in future lots 77-79 and will be located in an easement in favour of the Shire of Mundaring. The basin has been located at the base of the steep embankment between the development and the river foreshore but has been located high enough to be above the 1% AEP flood level of the Helena River. The basin has been located outside any of the area of uncontrolled historical filling. The basin has been located and checked on site with the Shire of Mundaring to minimise earthworks and has been located between trees to minimise any clearing and maximise the aesthetic outcome.

In terms of the proposed swales, there is a practical implementation problem with the swale on the extension of Parkview Gardens and Melita Drive (Northern side). The new proposal is to create allotments on the northern side of Melita Drive which would mean that swales will be difficult to accommodate with driveways. In addition to that, to ensure earthworks appropriately balance and allotments are constructed in sympathy with abutting areas, the entire length on Melita has been constructed with a saw tooth design to achieve minimum longitudinal grade for pavement drainage. Effectively, the land falls by 0.3m over the length of the road. Assuming that the swale is 0.3m deep at the eastern end assuming the 1 in 500 minimum grade as suggested by the LWMS, the swale will be around 0.8m deep at the western end, which is clearly too deep to accommodate within the road reserve. As a result it is proposed as part of this UWMP that apart from the small area served by Basin 2, all the bio-retention area be provided within Basin 1.

The LWMS was silent on the requirements for lot connection pits, but did outline the need for each allotment to hold the 1EY storm prior to outflow. Given that the site has a clay base and it is only proposed to fill some 1.2m over the clay base, it is proposed that lot connection pits be provided. These would allow overflow from soakwells, which will occur at least once per annum, to flow into the street drainage system.

5.2.2 General Drainage Approach

The main stormwater drainage strategy is proposed to dispose of water by a combination of soakage and outflow.

Subsoil drainage will be installed along each roadway to ensure that the groundwater is controlled over the site and ensure that soakwells installed within allotments will operate effectively.

The outlet to Drainage Basin 1 is proposed as a control weir to ensure that outflows will be limited to predevelopment rates. Subsoil outflows will be directed through the bio retention basins prior to outflow to the Helena River and the Parkview Gardens drainage system respectively.

Lots have been modelled with the equivalent of 2 by 1.5m diameter by 1.2m deep soakwells. For the lower ARI storms there will be no surcharge or run-off. For the larger storms, stormwater will surcharge and overflow into piped drainage connections provided to allotments. Modelling for a standard lot has been shown for the various AEP storms in Appendix D.

The additional approach is for all earthworks to be shaped to direct all roadways to the drainage basins to ensure conveyance of the 1% AEP storm. Piped drainage systems for the minor event will be sized for the 20% AEP storm.

5.2.3 1% AEP Storm

5.2.3.1 General Design Principles

The earthworks design has been prepared to ensure that the major storm events are directed to drainage basin locations. Lot levels will be set above road levels, meaning that even if water floods areas of roads, it will surcharge and flood to POS areas without flooding homes thereby providing the design flood routes as required by proper drainage management.

The post development catchment plan (Drawing U-04) which details the catchment boundaries, the areas and the basin details is shown in Appendix C. There are two basins proposed; Basin 1 located within an easement in future Lots 77-79 abutting the Helena Valley flood plan and Basin 2 in the verge of Parkview Gardens abutting Broz Park. The side slopes are proposed to be gentle (1 in 6) in the main with some localized steepening as required preserve significant trees.

The basin details are as outlined in the table below:

Table 5.1 – Drainage Basin Areas of Inundation and Storage Volumes

Total Area – Including the Extra Development Area to the North	Basin 1 Details	Basin 2 Details
Gross Catchment (Ha)	5.31	0.28

Total Area – Including the Extra Development Area to the North	Basin 1 Details	Basin 2 Details
Effective Impervious Area (1% AEP)	3.04	0.16
Storage Provided m^3 (1% AEP)	558	30
Retention Time(100Yr) Hours	10	9
TWL (1%AEP) mAHD	12.17	14.48
Allowable Outflow (1% AEP) (l/s)	232	12
LWL mAHD	11.50	13.9
Height above CGL (m)	0.30	0.30
Storage Provided m^3 (20% AEP)	405	18
Retention Time(20%AEP) Hours	17	6
Allowable Outflow (20% AEP) (l/s)	80	3.1
Storage Provided m^3 (1EY)	2405	13
Allowable Outflow (1 EY) (l/s)	17	0.9
Site Area Required/Area of Inundation (m^2) – 1% AEP	989	108
Site Area Required/Area of Inundation (m^2) – 20% AEP	810	78
Site Area Required/Area of Inundation (m^2) – 1 EY	810	66

As outlined the groundwater level in the area is generally perched due to the clay base. As a result subsoils are proposed to be located some 0.3m below the base of both basins to ensure that basin will drain effectively and minimise standing water times.

The 1% AEP event plan, which details the extent of flooding across the site for the 1% AEP, is detailed in Drawing U-05 in Appendix B. To ensure the earthworks design works from an economic perspective, the 1% AEP storms have been directed to both the existing basin and the new proposed basins. Effectively the existing basin is surrounded by development and as a result, the outflow pipeline proposed along Melita Drive to the Helena River has been sized to accommodate the 1% AEP storm. Calculations for the capacity of the pipeline have been included in Appendix D.

5.2.3.2 Impact of the Back Flooding of Helena River and Kadina Brook

The site is located within the flood fringe area of the Kadina Brook and Helena River. According to DWER flood mapping, the flood level of Helena River abutting the site is at RL10.5m AHD, which is well below the minimum site levels. The base of the drainage basin abutting the flood plain is at RL11.50mAHD which is also well above the flood level. The discharge from the basin is graded to the flood plain to minimize any erosion impact and discharges at around RL10.44 which is more or less at the 1% AEP back flooding level.

The flood levels have been plotted on Drawing U-04.

5.3 Stormwater Management System

5.3.1 1 EY Events

5.3.1.1 Allotments

The 1EY 1 hour drainage event will be detained on site with outflows limited to predevelopment outflow rates. Drainage basins will be designed with bio retention areas at the base to provide nutrient uptake prior to outflow.

All allotments will be required to contain at least the 1 EY 1 hour storm on site prior to any overflow.

Each lot has been modeled with the equivalent of 2 by 1.5m diameter by 1.2m deep soakwells. For the lower AEP storms there will be no surcharge or run-off and the soakwells will leach into the subsoil system aligned along the roadway. For the larger storms, stormwater will surcharge and overflow to the road drainage system through drainage connections provided for each lot.

Calculations for the "at lot" detention impact on the effective run-off from lots are shown in Appendix D.

As an alternative to this and in combination with the soakwells, all lot owners will be encouraged to install rainwater tanks plumbed into their homes for household use to help to conserve water and to retain all rainfall on-site.

The various catchments of all the lots and roadways are detailed in Drawing U-04 in Appendix B.

5.3.1.2 Roadways

The 1 EY storm for roadways, will be detained within in the end of line Basins 1 and 2 which are essentially soakage basins with outflow limited to pre development rates.

The outlet to the each basin will be constructed with a control weir. The 1EY 1 hour storm will be contained within the basin with no outflow other than leaching through the subsurface subsoil drainage system.

5.3.1.1 Detention Basin

Both detention basins will be required to limit the outflow from the site for all storms. As outlined in Section 5.2.1.1, water from allotments will flow direct from allotments after "at lot" detention of the 1EY 1 Hour storm. The capacity allocated to the outflow from the basin is the predevelopment flows proportioned to the catchment area as outlined in Section 5.1.

The outlet will be set at the 1EY 1 Hour storm level, meaning no outflow will occur prior to this storm other than infiltration through the subsoil system. Subsoil drainage will be installed beneath the basin to ensure water will drain from the basin within a reasonable time period. The water will be drained within the 72 hour period as required by the WA Health Guidelines. This will ensure that the 1EY 1 hour year run-off from contributing areas will be retained within the base area to be treated prior to any outflow.

The outflow from the basin will be controlled using a weir to limit outflows to predevelopment levels and maximise retention of stormwater to ensure sufficient treatment times. In essence, as the water level rises and the storage is reached, the outflow will increase. The outflow configurations are detailed in Drawing D-02 in Appendix C and calculations for outlet drainage structures are included in Appendix D.

5.3.2 20% AEP event

For the design nuisance storm event (20% AEP storm), storm water runoff from road pavements will be piped to the detention/bio-retention basin as shown in Drawing D-02 in Appendix C. The extent of flooding for this event is limited to basin areas.

Piped drainage systems detailing pipe sizes are included in Drawings U-05 and U-06 in Appendix C.

5.3.3 Non Structural Management Practices

It is well recognised that education of residents in terms of education and behaviour management of stakeholders will minimise the nutrient emanating from a catchment.

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.

5.4 Post- Development Groundwater Levels and Fill Requirements

5.4.1 Groundwater Level Management

At the existing sand clay interface in which the clay is relatively impervious, leads to perching of surface water.

As a result all drainage parallel with roadways will be constructed to the detail shown in Drawing U-08 in Appendix C to ensure that groundwater is controlled to the measured levels as plotted on Drawings U-03 and U-04.

5.4.2 Groundwater Quality Management Strategies

Surface water which will perch then be collected using subsoils which will in turn be routed through drainage basin areas to ensure biological treatment of the water prior to outflow.

5.4.3 Finished Lot Levels (Relative to the phreatic line)

Lot fill levels have been set a minimum of 1.2m above the measured groundwater levels.

This height in conjunction with the extensive subsoil drainage system will ensure that soakwells are effective and subsurface perching does not occur and will ensure that the required structural site classification will be achieved.

6 Managing Subdivision Works

6.1 Background:

The DWER 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.

A construction management plan and environmental management plan will be required to be prepared prior to commencement of works. The management plan will be dependent on construction methodology, the machinery proposed to be used and the time of year the works are done and will be prepared by the contractor undertaking the works with oversight from the developers appointed engineers.

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.

Common sources of pollutants from construction activities include those from:

- 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.

6.2 Actions to Address Acid Sulfate Soils &/or Contamination

Acid Sulphate soils investigations indicated that all soils within 3.0m of surface levels were a moderate to low risk of Acid Sulphate Soils occurring.

The existing deep sewer has been installed through the site and the remaining services required for the development are generally shallow and dewatering is unlikely to be required other than for surface water if works are undertaken in periods of wet weather. If any dewatering is required, effluent will be measured and if samples indicate trigger levels are exceed, lime treatment will be introduced to ensure that the discharge levels meet required criteria.

In the event that trigger levels within groundwater are reached, soils will be sampled for assessment to resolved required lime dosing levels.

6.3 Protection of Environmental Assets

Careful management of erosion during both construction and on completion will need to be undertaken to ensure that silt does not reach the Helena River or the Kadina Brook. The direction of all stormwater run-off to the basin prior to outflow and the construction of erosion protection measures at the outflow location will ensure that when the drainage system is implemented, any erosion will be adequately controlled. During construction it is envisaged that temporary siltation basins in conjunction with silt fences will be required to limit the potential risk of overflow to the river, particularly if work is undertaken in the wetter months.

The final measures will need to be incorporated within a environmental management plan which will be prepared by the contractor undertaking the work and will be dependent on; the time of year the works are done and the proposed construction methodology.

6.4 Management of Disease Vectors and Nuisance Insects

6.4.1 Insect and Disease Control

Where evident, steps will be taken to remove pests and or contain disease and keep all plant material in a healthy condition.

In general all water will soak away within 72 hours after rain ceases, which will assist with management of pests such as mosquitos and midge. The times for soakage are outlined in the drainage calculations included in Appendix C.

Insect numbers will be monitored and if numbers appear to be increasing to unacceptably high levels, resulting in regular resident complaints, the infested areas will be treated by an approved pesticide of low toxicity. Pesticides shall be used in strict accordance with the manufacturer's instructions at minimum rates. Biodegradable pesticides shall be used wherever possible.

Care will be taken in application of chemicals to minimize any toxic effect on plant, animal or person. Chemicals used in plant maintenance will be applied in accord with Health department Standards and Regulations.

6.4.2 Use of Herbicides and Pesticides

Application will only be made by Licensed Pesticide Operators. Chemical sprays will be used only in still conditions and during weekday early mornings or otherwise when public use of the site is likely to be at a minimum. Chemicals will only be applied strictly in accordance with Health Department regulations and the Manufacturer's recommendations.

Pesticides will not be applied within 10 metres of water bodies. Only "aquatic fauna safe" herbicide ("Round up Bi-Active") will be used within 20 metres of water bodies.

During application, the contractor will take all precautions necessary to avoid overspray, drift or contamination away from the target vegetation.

6.5 Proposed Management Strategies:

No contractor will be permitted to commence any construction activities on the site until an appropriate Environmental Management Plan (EMP) that fully addresses:

- litter and waste management practices (non-hazardous & hazardous materials);
- vehicle & equipment washing-down practices;
- water conservation practices;
- erosion and sediment control (based upon based on site conditions);
- product placement & storage practices;
- dewatering activities (if applicable); and
- Any other practices that may adversely impact upon receiving water bodies.

7 Monitoring Programme:

7.1 General

Post development monitoring is proposed to be undertaken over the site quarterly following the completion of the first stage. It is proposed to monitor surface water and groundwater as outlined within the LWMS. The surface water monitoring points will be at different locations to that shown in the LWMS given the different basin locations. The monitoring points are proposed to be upstream and downstream of basins as detailed in Drawing U-04 in Appendix B.

Groundwater monitoring will be undertaken in bores upstream and downstream of the main bioretention area.

Trigger levels as recommended in the LWMS have been included in Table 7.1 below. These have been established from the baseline levels measured on site prior to any development and have been agreed with DWER.

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

Table 7.1 – Proposed Post Development testing regime

Test	Abbreviation	Trigger level
Total Phosphorous (mg/l)	TP	0.22
Nitrate and Nitrite (mg/l)	NOx	0.03
Ammonia-Nitrogen (mg/l)	NH_3	0.10
Total Kjeldahl Nitrogen (mg/l)	TKN	1.0
Salinity (mS/cm)	EC or TDS	1.045
pH		5.45-8.0
Temperature		

Test	Abbreviation	Trigger level
Heavy metals		
Polyfluoroalkyl Compounds (PFAS)		
Hydrocarbons		

Note: Testing will include a full chemical analysis of water quality, inclusive of metals in the first instance, but metals will not be sampled beyond the first 12 months (As per DWER Policy), but if there are any aberrations in results which require further testing of metals, this will be implemented as required.

The water will be sampled quarterly January, March, June and October. The locations of the proposed surface water monitoring points are shown in Drawing U-04 in Appendix B.

The monitoring is proposed to be carried out for three years following completion of the last stage of civil construction and until hand over of the POS to the Shire of Mundaring, whichever is the latter.

Testing for Heavy Metals, PFAS and hydrocarbons will be compared to test data from the environmental investigations as part of the remediation action plan[6] to ensure thee contaminants are remaining on site and are not mobilized into the stormwater leaving the site.

An annual report will be submitted to the Shire of Mundaring and the DoW until 2 years after the completion of the last stage.

7.2 Contingency Measures:

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 DoW 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 density or alternative selection for planting of water and nutrient absorbing plants in drainage basin areas.

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

8 Implementation Plan

8.1 General

The developer is committed to

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

- Installing the physical measures as outlined within this report.

- Installing compensating basin designed and constructed to manage flows up to and including the 1% AEP storm event.

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 retain all rainfall on-site up to the 1 EY (1 hour) ARI event
- 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.

8.2 Maintenance Arrangements (Incl. Roles, Responsibilities & Funding)

8.2.1 Internal to Allotments

Each property owner will be encouraged to regularly inspect and clean their internal drainage systems including gutters, pipework – at least on an annual basis. This is well covered in current media releases and in Council notices.

8.2.2 Stormwater System

Over the summer period, particulate matter will build up in the storm water drainage system, within the trapped pit bases and soakwells. In the initial years of housing construction this will be from soil washed into the storm water system, although leaves, litter and grass clippings are more likely to reach the system in the longer term.

Although the system will operate with these small volumes of litter and leaves without their removal, if left for long periods of time they will break down and contribute to higher nutrient outflows from the site. As a result a regular maintenance programme is necessary with the following periodic maintenance required:

- Cleaning of drainage infrastructure. This is by sucking debris from drainage pits, and from the soakwells.
- Regular Street Sweeping to remove particulate build-up on the road surface and in gutters.
- Appropriate disposal or composting of grass clippings ensuring that they do not reach the storm water system. As an example, use of blowers and suchlike to blow clippings into stormwater systems is not supported.

Drainage infrastructure maintenance should at least occur on a biannual basis - just prior to winter & again in the middle of winter and obviously more regularly during periods of major housing construction. Maintenance of pits & street sweeping will need to occur at 3 month intervals further work may be required depending on the loading.

Subsoil lines should require minimal maintenance due to the design proposal, however in the initial years the developer will flush the lines at least annually.

The drainage basins are typically constructed to provide capability for some sediment build up. The trapped upstream pits, in conjunction with the flat surface gradients of the site will control silt loadings and reduce inlet scour.

It is anticipated that only standard Council checks and cleaning maintenance requirements will need to be applied to the drainage system developed for this subdivision – with suggested maintenance frequencies as outlined in Table 8.1.

Table 8.1 – Proposed Maintenance Responsibilities for Drainage Elements of the proposed development

#	Drainage Element:	Possible Maintenance and Inspection Frequency:	Responsibility:
1	Internal Allotment Drainage System	Annually inspection & clean-out (as necessary) – just prior to winter rains	Lot Owner
2	Subsoil Drainage Systems	During developer defects liability period and until the last stage of the development or the houses within the catchment are substantially completed, whichever is earlier. Inspect, clean-out & flush lines annually. After developer defects liability period: Inspect, clean-out & maintain structures as required.	Developer Council
3	Vegetated bio-retention basin and landscaped detention basins	During developer maintenance period: Inspect, clean-out & maintain plants ~2 - 3 month intervals (depending on loading) – as part of POS maintenance works. Inspect, clean-out & maintain structures 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 plants (as required) as part of standard Council POS maintenance program	Developer Council
4	Drainage culverts, standard table drains, pipes, pits.	During 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 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.	Developer Council
5	Base of compensating & bio-retention basins	Initial formal inspection & assessment of performance of bases at year 2 prior to hand over & then every 5 – 10 years.	Developer/Council.

8.3 Assessment and Review

It is not expected that this UWMP for this development will need to be reviewed after it is accepted / approved by the relevant authorities.

9 References:

1. Lots 2, 3 & 6 Midland Road, Helena Valley, Local Water Management Strategy (Project Number EP11-058), Emerge Associates, September 2015
2. Environmental Geology mapping Perth part sheets 2034 II and part 2034 III and 2134III , Gozzard JR., 1986
3. Lots 229 and 230 Helena Valley Road, Helena Valley WA Hydraulic Impact Assessment, Belleng VDM Pty Ltd, September 2006
4. Australian Rainfall and Run-off A Guide to Flood Estimation Volume 1, Institute of Engineers, 1987
5. Perth Groundwater Atlas (Edition 4), Department of Environment, 2004

6. Remediation Action Plan, Lots 2, 3 and 6 Midland Road – Stages 1A and 1B, Emerge Associates, June 2021

DEVELOPMENT
ENGINEERING
CONSULTANTS

APPENDIX A – OVERALL PLANS

- **Drawing U-01 – Locality Plan**
- **Drawing U-02 – Aerial Photograph with Development Plan Superimposed Thereon**
- **WAPC Approval 156 909 with Approved Plan**
- **Proposed Ultimate Development plan – Land Surveys 2400205-PR-002-D**



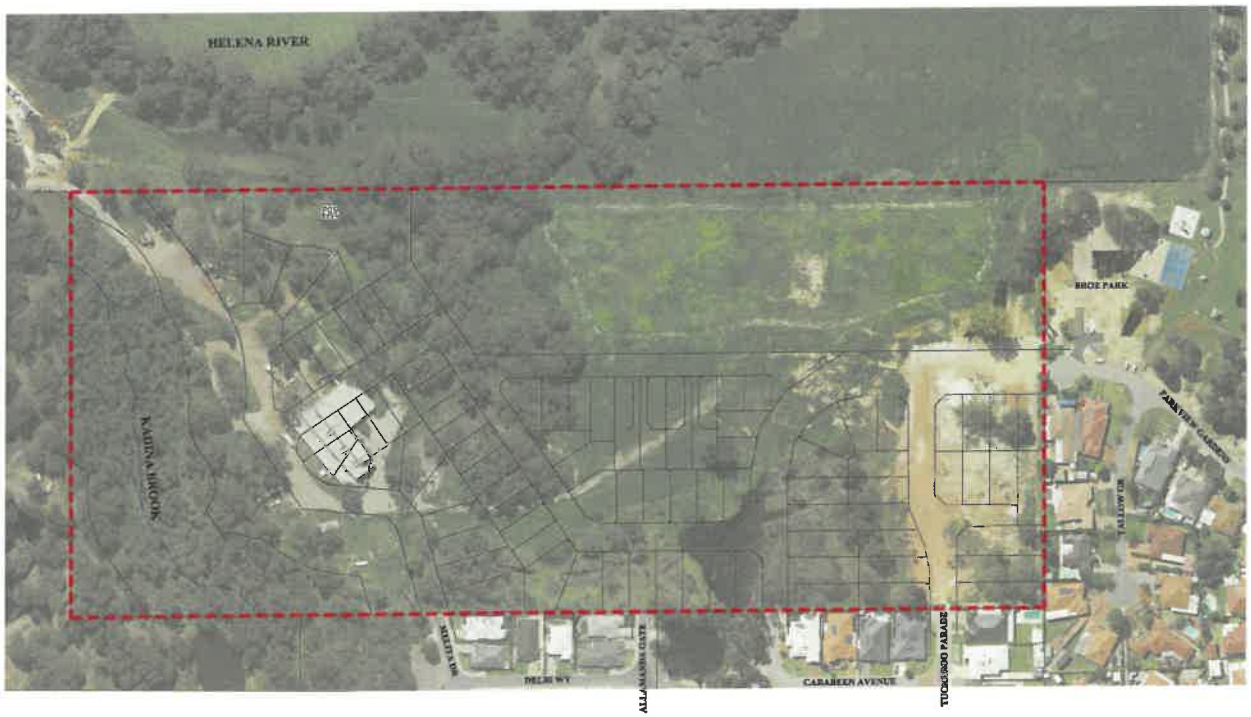
LEGEND

SUBJECT SITE

CLIENT: NOBLE HODGE PTY LTD	DEVELOPMENT ENGINEERING CONSULTANTS	PROJECT: LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY W.A.P.C. No. - 156969	DRAWING: URBAN WATER MANAGEMENT PLAN LOCALITY PLAN WM00A0	SCALE: 1:2000	DRAWN: W.B	CHECK: S.R.A	REV No: B
				DATE: MAY '21	NUMBER: W.B	APPROVED: S.R.A	
				PROJECT NUMBER: HVYBG001	DRAWING NUMBER: U01		

LEGEND

SUBJECT SITE



B	18/07/21	PRELIM AMENDED	SRA
A	27/05/21	INITIAL ISSUE	SRA

CLIENT: NOBLE HODGE PTY LTD

DEVELOPMENT ENGINEERING CONSULTANTS

SUITE 3, 123A COLIN ST. WEST PERTH 6005 WESTERN AUSTRALIA Ph. (08) 9481 1966 Fax (08) 9481 1968

PROJECT: LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY

W.A.P.C. No. - 156989

DRAWING: URBAN WATER MANAGEMENT PLAN AERIAL PHOTO

WMOAD

SCALE: 1:1000	DRAWN: MJS	CHECK: SRA	REV No: B
DATE: JULY '21	DESIGNED: MJS	APPROVED: SRA	

PROJECT NUMBER: HVYBG001

DRAWING NUMBER: U02

Western Australian Planning Commission

Your Ref : 17-809

Element Advisory Pty Ltd
Level 18, 191 St Georges Terrace

PERTH WA 6000

Approval Subject To Condition(s)
Freehold (Green Title) Subdivision

Application No : 156909

Planning and Development Act 2005

Applicant	:	Element Advisory Pty Ltd Level 18, 191 St Georges Terrace PERTH WA 6000
Owner	:	Nick Di Candilo P O Box 1109 MIDLAND DC WA 6936; Joseph Stefanelli, John Stefanelli, Shanklin Holdings Pty Ltd P O Box 266 MIDLAND DC WA 6936; Tattenhall Investments Pty Ltd 428 Great Northern Highway MIDDLE SWAN WA 6056
Application Receipt	:	29 June 2018

Lot Number	:	2, 3, 6
Diagram / Plan	:	Diagrams 3284, 3259, 3958
Location	:	-
C/T Volume/Folio	:	1409/591, 1409/592, 1409/593
Street Address	:	Lot 2, 3, 6 Midland Road, Helena Valley
Local Government	:	Shire of Mundaring

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a deposited plan in accordance with the plan date-stamped **29 June 2018** once the condition(s) set out have been fulfilled.

This decision is valid for **four years** from the date of this advice, which includes the lodgement of the deposited plan within this period.

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ABN 35 482 341 493

Western Australian Planning Commission

The deposited plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **29 July 2023** or this approval no longer will remain valid.

Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner may, within 28 days from the date of this decision, make a written request to the WAPC to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: http://www.sat.justice.wa.gov.au

Deposited plan

The deposited plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the deposited plan. A copy of the deposited plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: http://www.planning.wa.gov.au

Condition(s)

The WAPC is prepared to endorse a deposited plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the deposited plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s)

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identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When the written advice of each identified agency/authority or local government has been obtained, it should be submitted to the WAPC with a Form 1C and appropriate fees and a copy of the deposited plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the deposited plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITION(S):

1. The plan of subdivision is to be modified in accordance with the attached plan dated 11 March 2019 with balance lots 1 and 3 to be amalgamated. (Western Australian Planning Commission)

2. Other than buildings, outbuildings and/or structures shown on the approved plan for retention, all buildings, outbuildings and/or structures present on lot(s) 2,3 & 6 at the time of subdivision approval being demolished and materials removed from the lot(s). (Local Government)

3. Engineering drawings and specifications are to be submitted, approved, and works undertaken in accordance with the approved engineering drawings, specifications and approved plan of subdivision, for grading and/or stabilisation of the site to ensure that:

    a) lots can accommodate their intended use; and

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b) finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting. (Local Government)

4. Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation and Department of Biodiversity, Conservation and Attractions (Estuaries Division), consistent with any approved Foreshore Management Plan and Local Water Management Strategy. (Local Government)

5. Engineering drawings and specifications are to be submitted and approved in consultation with the Department of Biodiversity, Conservation and Attractions (Estuaries Division) and works undertaken in accordance with the approved engineering drawings and specifications and approved plan of subdivision, for the filling and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately treated and connected to the local drainage system. Engineering drawings and specifications are to be in accordance with an approved Urban Water Management Plan (UWMP) for the site, or where no UWMP exists, to the satisfaction of the Western Australian Planning Commission. (Local Government)

6. Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and

In the event that remediation works are required, the landowner/applicant is to provide a post geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government).

7. Drainage easements and reserves as may be required by the local government for drainage infrastructure being shown on the diagram or plan of survey (deposited plan) as such, granted free of cost, and vested in that local government under Sections 152 and 167 of the *Planning and Development Act 2005.* (Local Government)

8. A management plan detailing how risk of erosion and sedimentation impacts into nearby water bodies will be minimised during subdivision is to be:

a) prepared by the landowner/applicant and approved prior to the commencement of subdivisional works; and

b) implemented during subdivisional works. (Department of Biodiversity, Conservation and Attractions Rivers (Estuaries Division))

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9. Prior to the commencement of subdivision works a foreshore management plan for Kadina Brook is to be prepared and approved in consultation with Department of Biodiversity, Conservation and Attractions (Estuaries Division) and Department of Water and Environmental Regulation to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Local Government)

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

11. A notification, pursuant to Section 165 of the *Planning and Development Act 2005* is to be placed on the certificates of title of the proposed lot(s) between the 20 ANEF and 25 ANEF airport noise contour. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

'This lot is situated in the vicinity of Perth Airport, and is currently affected, or may in the future, be affected by aircraft noise. Noise exposure levels are likely to increase in the future as a result of increases in numbers of aircraft using the airport, changes in aircraft type or other operational changes. Further information about aircraft noise, including development restrictions and noise insulation requirements for noise-affected properties, are available on request from the relevant local government offices.' (Western Australian Planning Commission)

12. 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 of 12.5 or above, advising of the existence of a hazard or other factor.

Notice of this notification is to be included on 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 may be subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land". (Western Australian Planning Commission)

13. Information is to be provided to demonstrate that the measures contained in Section 6; Table 5 of the bushfire management plan prepared by Emerge Associates, dated April 2019 (Project No: EP18-099(01) have been implemented during subdivisional works. This information should include a completed 'Certification by Bushfire Consultant' from the bushfire management plan. (Local Government)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

Western Australian Planning Commission

14. Local Development Plan(s) being prepared and approved for lots shown on the plan dated 11 March 2019 (attached) that address the following:

    a) Passive surveillance to public open space;

    b) Visually permeable and uniform fencing adjacent to public open space;

    c) Orientation of primary dwelling/s on corner lot/s;

    d) Designation of garage/carport locations;

    e) Vehicle access restrictions for corner lots;

    f) Setback and boundary wall requirements; and

    g) Construction standards in the Bushfire Hazard - Special Control Area.

    to the satisfaction of the Western Australian Planning Commission. (Local Government)

15. The landowner/applicant shall make arrangements to ensure that prospective purchasers of lots subject of a Local Development Plan are advised in writing that Local Development Plan provisions apply (Local Government).

16. The proposed reserve(s) shown on the plan dated 11 March 2019 (attached) as established by survey being shown on the diagram or plan of survey (deposited plan) as reserve(s) for foreshore management, recreation and drainage (as applicable) and vested in the Crown under Section 152 of *the Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Local Government)

17. The proposed reserve(s) shown on the plan dated 11 March 2019 (attached) as established by survey being shown on the diagram or plan of survey (deposited plan) as reserve(s) for Foreshore Management and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Western Australian Planning Commission)

18. Arrangements being made for the proposed public open space to be developed by the landowner/applicant to a minimum standard and maintained for two summers through the implementation of an approved landscape plan providing for the development and maintenance of the proposed public open space in accordance with the requirements of Liveable Neighbourhoods and to the specifications of the local government. (Local Government)

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ABN 35 482 341 493

Western Australian Planning Commission

19. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, to ensure that those lots not fronting an existing road are provided with frontage to a constructed road(s) connected by a constructed road(s) to the local road system and such road(s) are constructed and drained at the landowner/applicant's cost.

As an alternative, and subject to the agreement of the Local Government the Western Australian Planning Commission (WAPC) is prepared to accept the landowner/applicant paying to the local government the cost of such road works as estimated by the local government and the local government providing formal assurance to the WAPC confirming that the works will be completed within a reasonable period as agreed by the WAPC. (Local Government)

20. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:

a) street lighting is installed on all new subdivisional roads to the standards of the relevant licensed service provider;

b) roads that have been designed to connect with existing or proposed roads abutting the subject land are coordinated so the road reserve location and width connect seamlessly;

c) temporary turning areas are provided to those subdivisional roads that are subject to future extension;

d) embayment parking is provided within the road reserve abutting the proposed Public Open Space and Foreshore Reserve; and

e) street trees are established in the road reserve.

to the satisfaction of the Western Australian Planning Commission. (Local Government)

21. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, for the provision of shared paths through and connecting to the application area in accordance with the attached footpath plan dated 11 April 2019. The approved shared paths are to be constructed by the landowner/applicant. (Local Government)

22. All local streets within the subdivision being truncated in accordance with the Western Australian Planning Commission's *Liveable Neighbourhoods* policy (Local Government)

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ABN 35 482 341 493

Western Australian Planning Commission

23. Prior to commencement of subdivision works, investigation for soil and groundwater contamination is to be carried out to determine if remediation is required. If required, remediation, including validation of remediation, of any contamination identified shall be completed prior to the issuing of titles in consultation with Department of Biodiversity, Conservation and Attractions (Estuaries Division) and to the satisfaction of the Western Australian Planning Commission, to ensure that the lots created are suitable for the proposed use. Investigations and remediation are to be carried out in compliance with the *Contaminated Sites Act 2003* and current Department of Water and Environmental Regulation Contaminated Sites Guidelines. (Department of Water and Environmental Regulation)

24. An acid sulphate soils self-assessment form and, if required as a result of the self-assessment, an acid sulphate soils report and an acid sulphate soils management plan shall be submitted to and approved by the Department of Water and Environmental Regulation before any subdivision works or development are commenced. Where an acid sulphate soils management plan is required to be submitted, all subdivision works shall be carried out in accordance with the approved management plan. (Department of Water and Environmental Regulation)

25. All septic sewer systems including all tanks and pipes and associated drainage systems (soak wells or leach drains) and any stormwater disposal systems are to be decommissioned, in accordance with the Health (Treatment of Sewerage and Disposal of Effluent and Liquid Waste) Regulations 1974, removed, filled with clean sand and compacted. Proof of decommissioning is to be provided in the form of either certification from a licensed plumber or a statutory declaration from the landowner/applicant, confirming that the site has been inspected and all septic tanks, soak wells, leach drains and any associated pipework have been removed. (Local Government)

26. Arrangements being made to the satisfaction of the Western Australian Planning Commission and to the specification of Western Power for the provision of an underground electricity supply to the lot(s) shown on the approved plan of subdivision. (Western Power)

27. Arrangements being made to the satisfaction of the Western Australian Planning Commission and to the specification of Western Power for the removal, relocation and/or replacement of electricity supply infrastructure, including plant and/or equipment located on or near the lots shown on the approved plan of subdivision. (Western Power)

28. The transfer of land as a Crown reserve free of cost to Western Power for the provision of electricity supply infrastructure. (Western Power)

29. Arrangements being made with a licenced water provider for the provision of a suitable water supply service to the lot(s) shown on the approved plan of subdivision. (Water Corporation)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

Western Australian Planning Commission

30. Arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lots shown on the approved plan of subdivision. (Water Corporation)

ADVICE:

1. Prior to the commencement of subdivisional works, the landowner/applicant is advised to investigate whether or not approval is required pursuant to the *Aboriginal Heritage Act 1972.* The landowner/applicant should conduct a search of the Register of Aboriginal Sites to determine if any aboriginal sites have been recorded in the vicinity of their application, and this heritage information should be submitted to the Department of Planning Lands and Heritage (Indigenous Affairs) with a request for advice.

2. Condition 4 has been imposed in accordance with *Better Urban Water Management Guidelines (WAPC 2008).* Further guidance on the contents of urban water management plans is provided in *'Urban Water Management Plans: Guidelines for preparing and complying with subdivision conditions' (Published by the then Department of Water 2008).* Any swales to be designed and planted in accordance with Vegetation Guidelines for Stormwater Biofilters in the South

3. In regard to Condition 8, the Management Plan will need to demonstrate that site works will not interfere, alter or pollute any wetland, watercourse, surface water expression or groundwater in the area, or alter the water quality of such waters. The Management Plan should include details of onsite storage of materials and equipment, waste management (including how any fill, building materials, rubbish and other deleterious matter will be prevented from being deposited on the foreshore reserve, or allowed to enter the waterways as a result of the subdivision), management of stormwater and associated sedimentation and complaints/incidents.

4. In regard to Condition 9, the Foreshore Management Plan should be prepared in accordance with relevant guidelines including Operational policy 4.3: Identifying and establishing waterways foreshore areas (DWER, 2012) and Guidelines for developing foreshore management plans in the Swan Canning Riverpark (Swan River Trust, 2012).

5. In regard to Condition 16, the location of the foreshore reserve is to be confirmed prior to ground disturbing activities on abutting land. The foreshore reserve is to be protected from disturbance during subdivisional works.

6. In relation to Condition 23, And in accordance with regulation 31(1)(c) of the *Contaminated Sites Regulations 2006*, a Mandatory Auditor's Report, prepared by an accredited contaminated sites auditor, will need to be submitted to the Department of Water and Environmental Regulation as evidence of compliance with Condition 23. A current list of accredited auditors is available from www.dwer.wa.gov.au

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Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
e-mail: info@dplh.wa.gov.au; web address http://www. dplh.wa.gov.au
ABN 35 482 341 493

7. Condition 24 refers to an 'acid sulphate soils self-assessment form'. This form can be downloaded from the Western Australian Planning Commission's website www.dplh.wa.gov.au.

   The 'acid sulphate soils self-assessment form' makes reference to the Department of Water and Environment Regulation's 'Identification and Investigation of Acid Sulphate Soils' guideline. This guideline can be obtained from the Department of Water and Environment Regulation's website.www.dwer.wa.gov.au

8. In regard to Condition 26, Western Power provides only one underground point of electricity supply per freehold lot.

9. In regard to Conditions 29 and 30, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.

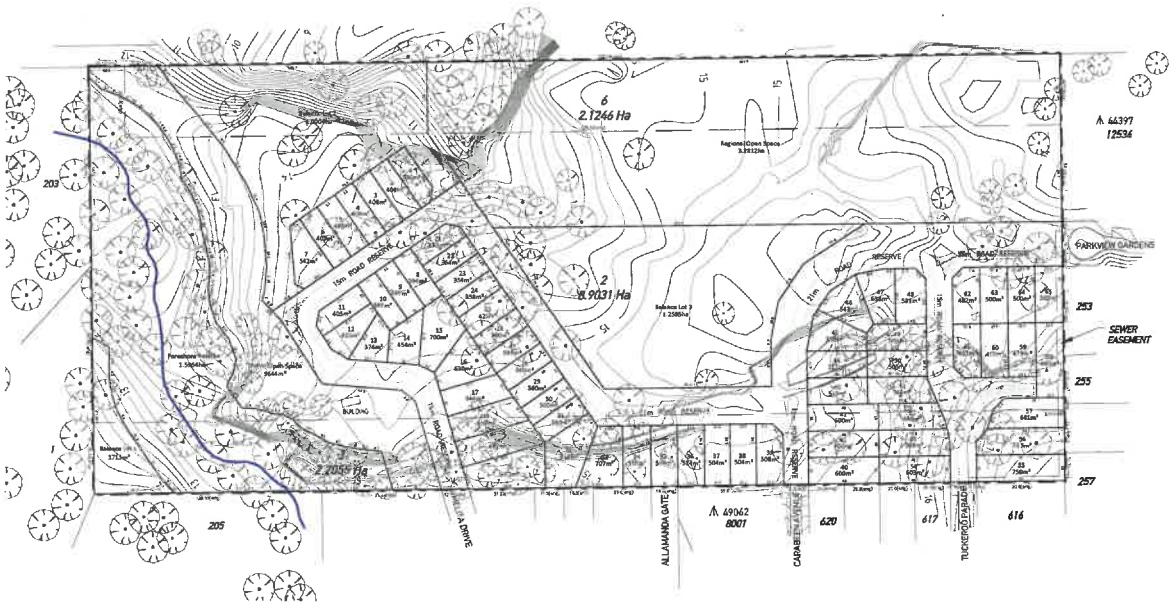
10. The Department of Biodiversity, Conservation and Attractions (Estuaries Division) provides the following advice to the applicant - any future development on the lots abutting the Swan Canning Development Control Area (DCA) will be subject to Department of Biodiversity, Conservation and Attractions policies including Policy Statement 48 - *Planning for Development Setback Requirements Affecting the Swan Canning Development Control Area*, which requires a development setback of 10 metres or 20% of the average depth of the lot, whichever is the lesser, from the landward boundary of the DCA.

    Retaining walls and boundary fences in proximity to the DCA are to adhere to Policy Statement 48 locational requirements for setbacks, height and construction standards. The Department of Biodiversity, Conservation and Attractions also recommends fence styles, colours, and materials which complement the riverine environment.

Ms Sam Fagan
Secretary
Western Australian Planning Commission
29 July 2019

Enquiries : David Sands (Ph 6551 9270)

140 William Street, Perth, Western Australia 6000, Locked Bag 2506 Perth, 6001
Tel: (08) 6551 8002; Fax: (08) 6551 9001; Infoline: 1800 626 477
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ABN 35 482 341 493



LEGEND

- Area subject of subdivision application
- Existing cadastre
- Proposed lot
- Contour
- Kadina Brook

DEVELOPMENT SUMMARY

EXISTING LOTS		
Lot 2 on Diagram 3284		8.9031ha
Lot 3 on Diagram 3958		2.2059ha
Lot 6 on Diagram 3259		2.1246ha
PROPOSED SUBDIVISION		
Residential	65 lots	3.2945ha (24.9%)
Balance Lot	3 lots	2.4310ha (18.4%)
Public Open Space	1 lot	0.9644ha (7.3%)
Foreshore Reserve	1 lot	1.5956ha (12.0%)
Regional Open Space	1 lot	3.2612ha (24.6%)
Road		1.6653ha (12.6%)

Subdivision Plan

Lots 2, 3 & 6 Midland Road, Helena Valley

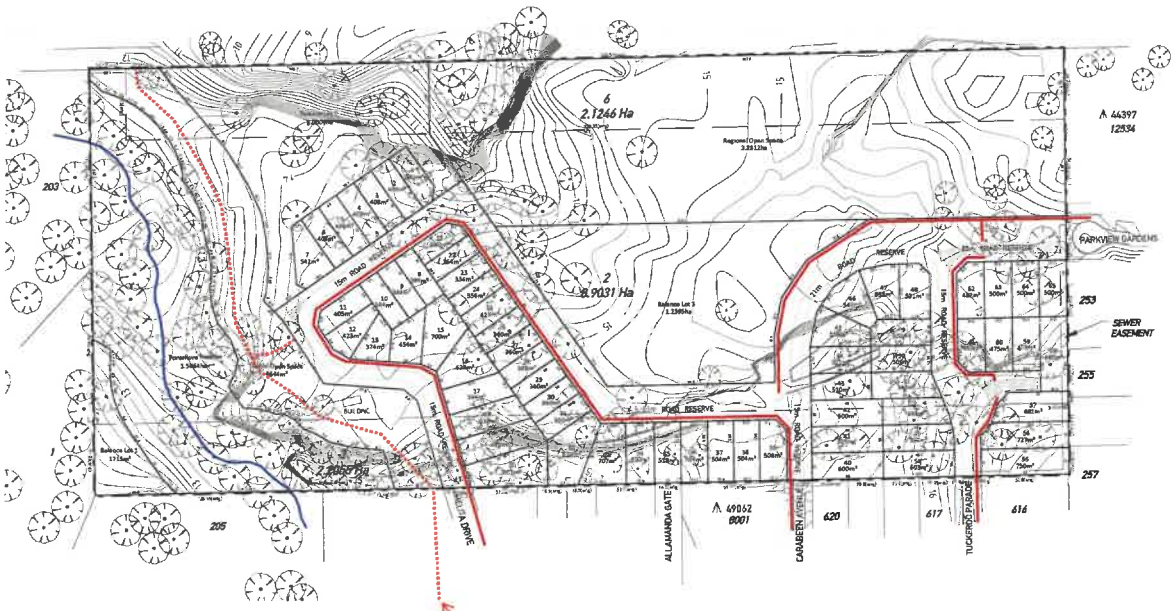
date 27 February 2019 | scale 1:2000 @ A3 | drawn MD | checked MD | staff MD/LC | file 17-809 SU1C

element.

© Element AU

Footpath Plan

11/04/2019



LEGEND

- Area subject of subdivision application
- Existing cadastre
- Proposed lot
- Contour
- Kadina Brook

DEVELOPMENT SUMMARY

EXISTING LOTS		
Lot 2 on Diagram 3284		8.9031ha
Lot 3 on Diagram 3958		2.2055ha
Lot 6 on Diagram 3259		2.1246ha
PROPOSED SUBDIVISION		
Residential	65 lots	3.2945ha (24.9%)
Balance Lot	3 lots	2.4314ha (18.4%)
Public Open Space	1 lot	0.9662ha (7.3%)
Foreshore Reserve	1 lot	1.5966ha (12.0%)
Regional Open Space	1 lot	3.2812ha (24.8%)
Road		1.6653ha (12.6%)

Footpath through POS is in an indicative location and is subject to the preperation, approval and implementation of a Foreshore Management Plan

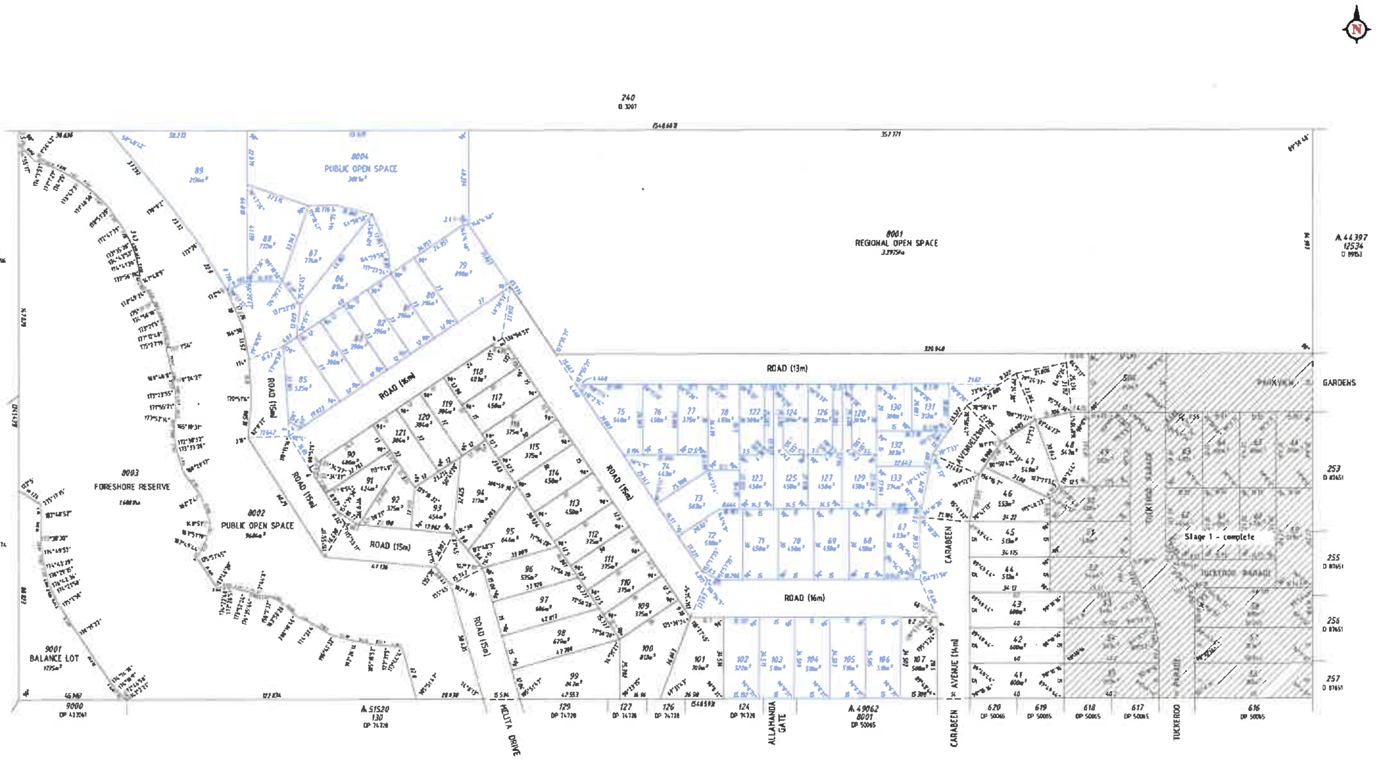
In determining the location for the footpath, consideration shall be given to the objectives of the Foothills Growth Strategy and connectivity to the development site to the north (lot 799 Katharine Street, Bellevue)

Subdivision Plan

Lots 2, 3 & 6 Midland Road, Helena Valley

date 21 February 2019 | scale 1:2000 @ A3 | file 17-809 SU1C | drawn MDA/C | checked MD

element.



NOTES.

- PROPOSED ROADS ONLY PARTIALLY APPROVED. REMAINING PROPOSED ROADS REQUIRES GNC ROAD NAME APPROVAL.
- FORESHORE BOUNDARIES ADOPTED FROM MNG PRECAL PLAN VERSION B.
- BOUNDARIES CREATED FROM FORESHORE MANAGEMENT PLAN PREPARED BY EMERGE ASSOCIATES CONFIRMED BY ELEMENT PLANNING.
- SUBJECT TO APPROVED ENGINEERS DESIGNS. ADDITIONAL EASEMENTS/ ENCUMBRANCES MAY BE REQUIRED.
- BLUE LINES REPRESENT LINEWORK UPDATED BY LAND SURVEYS. ALL OTHER LINEWORK IS FROM PRECAL REV 'B'

REV	DESCRIPTION	DRN	DATE	APP
D	MADE LOT 105 & 106 16m WIDE AND REDUCED LOT 152	[illegible]	[illegible]	TH
C	CHANGES FROM ELEMENT CONCEPT PLAN FILE 20-088 CP[illegible] DATED [illegible]-ONLY LOTS 67-72 & 75-80 & ROADS HAVE BEEN MODIFIED	[illegible]	[illegible]	TH
A B	PREPARED BY MNG SURVEYS			

Land Surveys

SURVEYED BY:
SURVEYED ON:
DRAWN BY: NN
DRAWN ON: 08/05/24
HOR DATUM:
VERT DATUM:

PRECALCULATION PLAN

LOTS 6, 9001 & 9002
MIDLAND ROAD
HELENA VALLEY

CLIENT:
CITYPLAZA ATF THE CITYPLAZA LAND TRUST

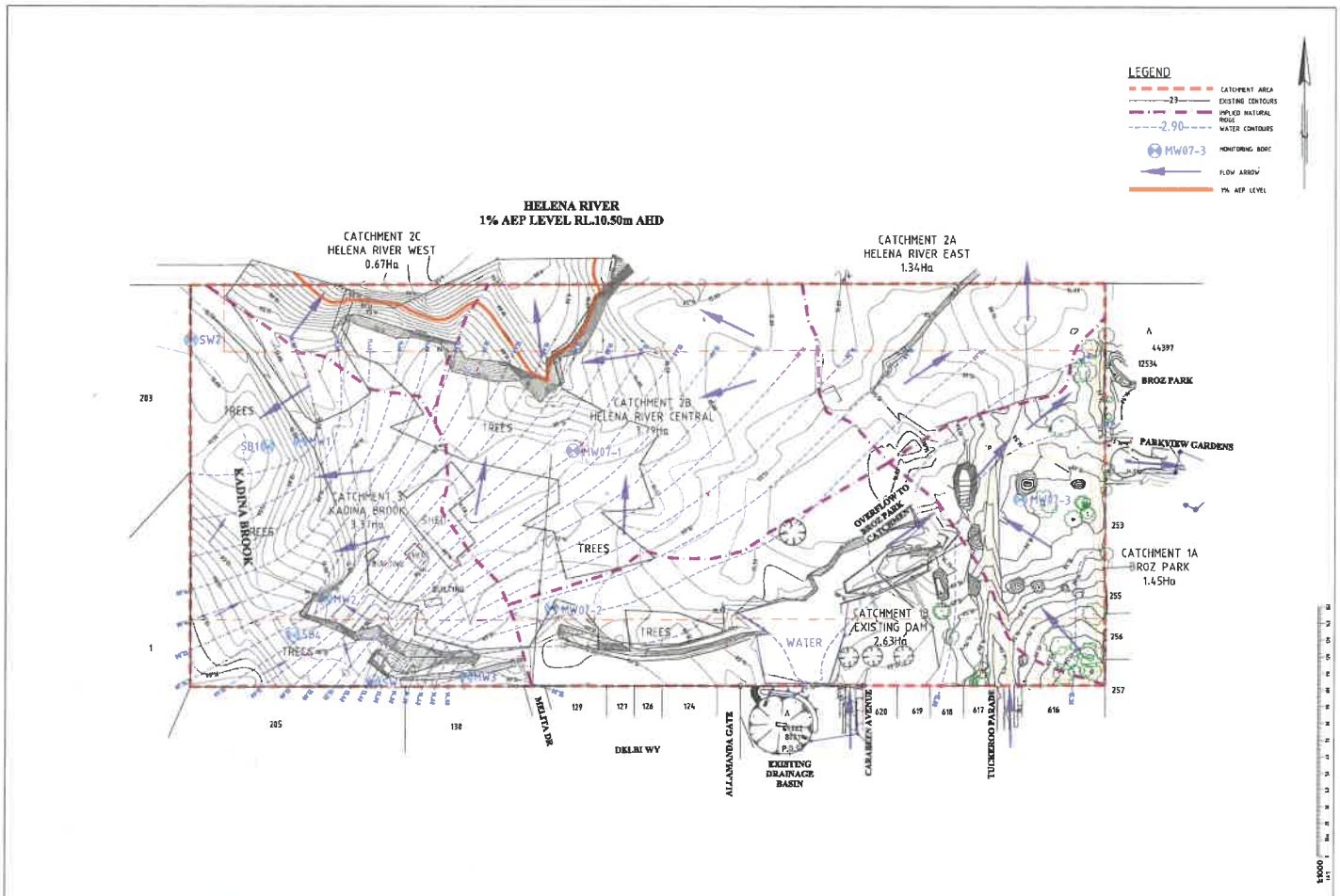
JOB No	PLAN	DRG	REV	SHEET
2400205 -	PR -	002 -	D	1 OF 1

LS P 219

DEVELOPMENT
ENGINEERING
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APPENDIX B – DRAINAGE STRATEGY PLANS

- **Drawing U-03 – Pre Development catchment Plan**
- **Drawing U-04 – Post Development Catchment Plan and 5 Year Event Plan**



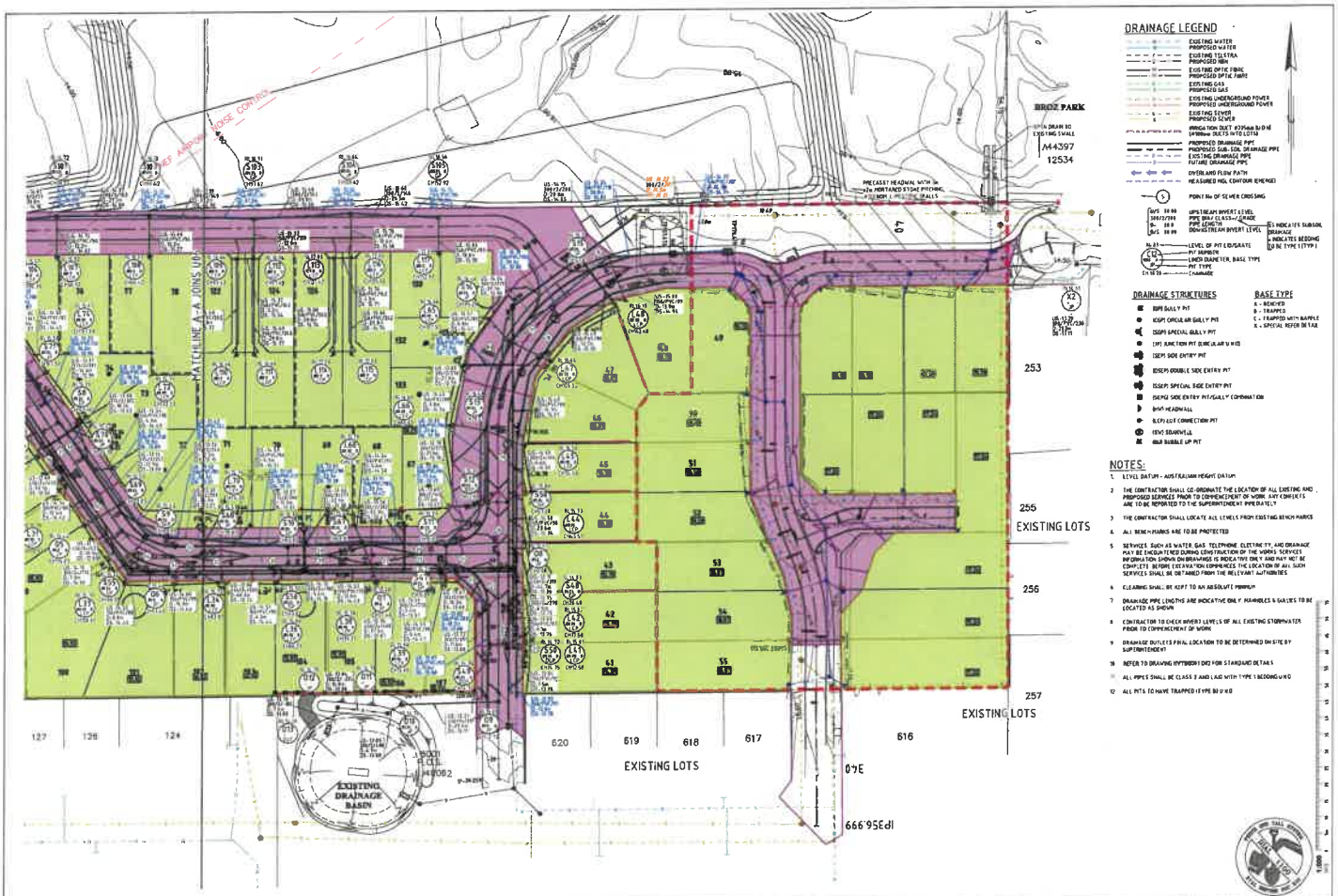
CLIENT: NOBLE HODGE PTY LTD	DEVELOPMENT ENGINEERING CONSULTANTS	PROJECT: LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY W.A.P.C. No. - 156989	DRAWING: URBAN WATER MANAGMENT PLAN PRE DEVELOPMENT CATCHMENT PLAN
			DRAWING NUMBER: HVYBG001 U03
			REV No.: A


BASIN 1 DETAILS
TOTAL IMPERVIOUS AREA (ha) 8.64
T.W.L. (m AHD) 11.50
A.A.M.G.L. (m AHD) 11.00
5% AEP (1 IN 100 YEAR ARI)
STORAGE REQUIRED (m³) 350
AREA AT T.W.L. (m²) 949
T.W.L. (m AHD) 12.11
PEAK OUTFLOW (L/s) 232
20% AEP (1 IN 5 YEAR ARI)
STORAGE REQUIRED (m³) 535
AREA AT T.W.L. (m²) 891
T.W.L. (m AHD) 11.95
63.2% AEP (1 IN 1 YEAR ARI)
STORAGE REQUIRED (m³) 545
AREA AT T.W.L. (m²) 871
T.W.L. (m AHD) 11.76
REFER DWG'S 1008 & 1007
BASIN 2 DETAILS
TOTAL IMPERVIOUS AREA (ha) 2.31
T.W.L. (m AHD) 15.90
A.A.M.G.L. (m AHD) 15.65
5% AEP (1 IN 100 YEAR ARI)
STORAGE REQUIRED (m³) 50
AREA AT T.W.L. (m²) 180
T.W.L. (m AHD) 16.48
PEAK OUTFLOW (L/s) 17.31
20% AEP (1 IN 5 YEAR ARI)
STORAGE REQUIRED (m³) 10
AREA AT T.W.L. (m²) 76
T.W.L. (m AHD) 16.35
63.2% AEP (1 IN 1 YEAR ARI)
STORAGE REQUIRED (m³) 15
AREA AT T.W.L. (m²) 66
T.W.L. (m AHD) 16.20
REFER DWG'S 1008 & 1007
LEGEND
CATCHMENT AREA
23.00 FINISHED SURFACE CONTOURS
WATER CONTOURS
DRAINAGE BASIN
PROPOSED POST DEVELOPMENT MONITORING POINT
HELENA RIVER PRE-DEVELOPMENT 1% AEP LEVEL = R.L. 10.98m AHD
HELENA RIVER
NEW MONITORING BORE TO BE ESTABLISHED FOR POST DEVELOPMENT MONITORING
EXISTING MONITORING BORE MW07-1 TO BE USED FOR POST DEVELOPMENT MONITORING
KADINA BROOK
TREES
CATCHMENT 1
CATCHMENT 2
BROZ PARK
DELBI WY
EXISTING DRAINAGE BASIN
GROSS CATCHMENT AREA INFORMATION
CATCHMENT
TOTAL AREA (m²)
LOT AREA (m²) SUBJECT TO DETENTION
LOT AREA (m²) NOT SUBJECT TO DETENTION
ROAD RESERVE AREA (m²)
POS AREA (m²) EXCLUDING WATER BODIES
BASIN AREA (m²)
BASIN 1
BASIN 2
2796.99
0
1962
0
751
0
813
NOBLE HODGE PTY LTD
DEVELOPMENT ENGINEERING CONSULTANTS
SUITE 3, 125A COLIN ST, WEST PERTH 6005 WESTERN AUSTRALIA Ph (08) 9481 9988 Fax (08) 9481 9990
PROJECT LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY
W.A.P.C. No - 156989
DRAWING URBAN WATER MANAGEMENT PLAN POST DEVELOPMENT CATCHMENT PLAN
DATE MAY '21
DRAWN WJB
DESIGNED WJB
CHECK SRA
APPROVED SRA
SHEET NUMBER F
DRAWING NUMBER HVYBGO01 U04

DEVELOPMENT
ENGINEERING
CONSULTANTS

APPENDIX C – LANDSCAPE PROPOSALS FOR POS AND DETAILED ENGINEERING PLANS DRAINAGE

- **Drawing U-05 – Drainage Layout Plan Sheet 1 of 2**
- **Drawing U-06 – Drainage Layout Plan Sheet 2 of 2**
- **Drawing U-07 – Drainage Basin Details**
- **Drawing U-08 – Drainage General Details**
- **Drawing U-09 – Drainage Basin and Outlet Details**
- **Landscape Concept Plan**



E	16/11/22	NEW PRECAL DRAINAGE AMENDED TO SUIT	SRA
D	03/03/22	DTS & DRAINAGE LAYOUT AMENDED	SRA
C	16/02/22	PARKVIEW ROAD HEADWALL AND STONE PITCHING REDESIGN	SRA
B	25/03/22	PARKVIEW GARDENS BASIN AMENDED	SRA
A	22/05/21	INITIAL ISSUE	SRA

CLIENT: NOBLE HODGE PTY LTD

DEVELOPMENT ENGINEERING CONSULTANTS

SUITE 3, 123A COLIN ST, WEST PERTH, 6005, WESTERN AUSTRALIA
Ph (08) 9481 1988
Fax (08) 9481 1988

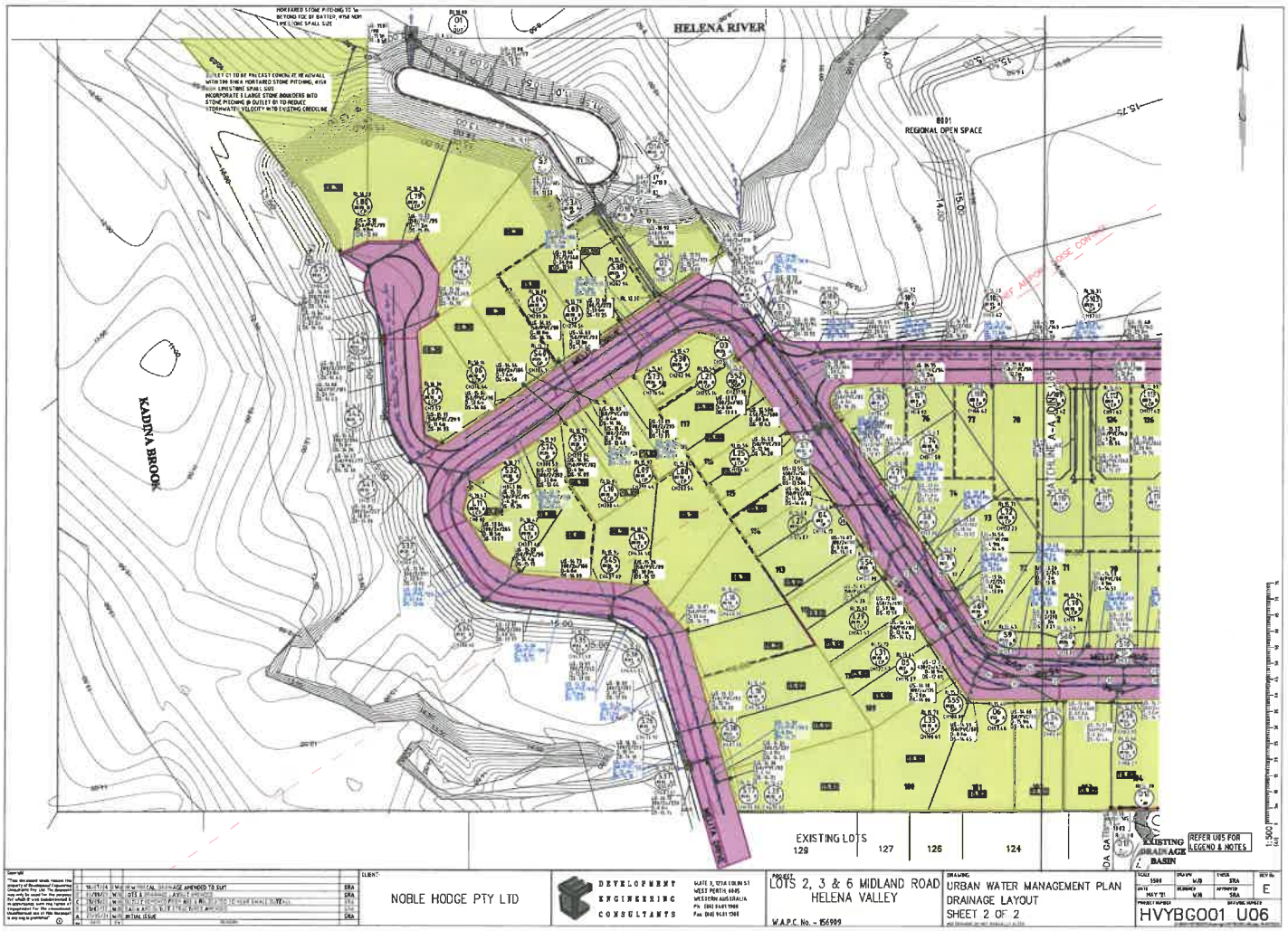
PROJECT: LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY

W.A.P.C No - 156909

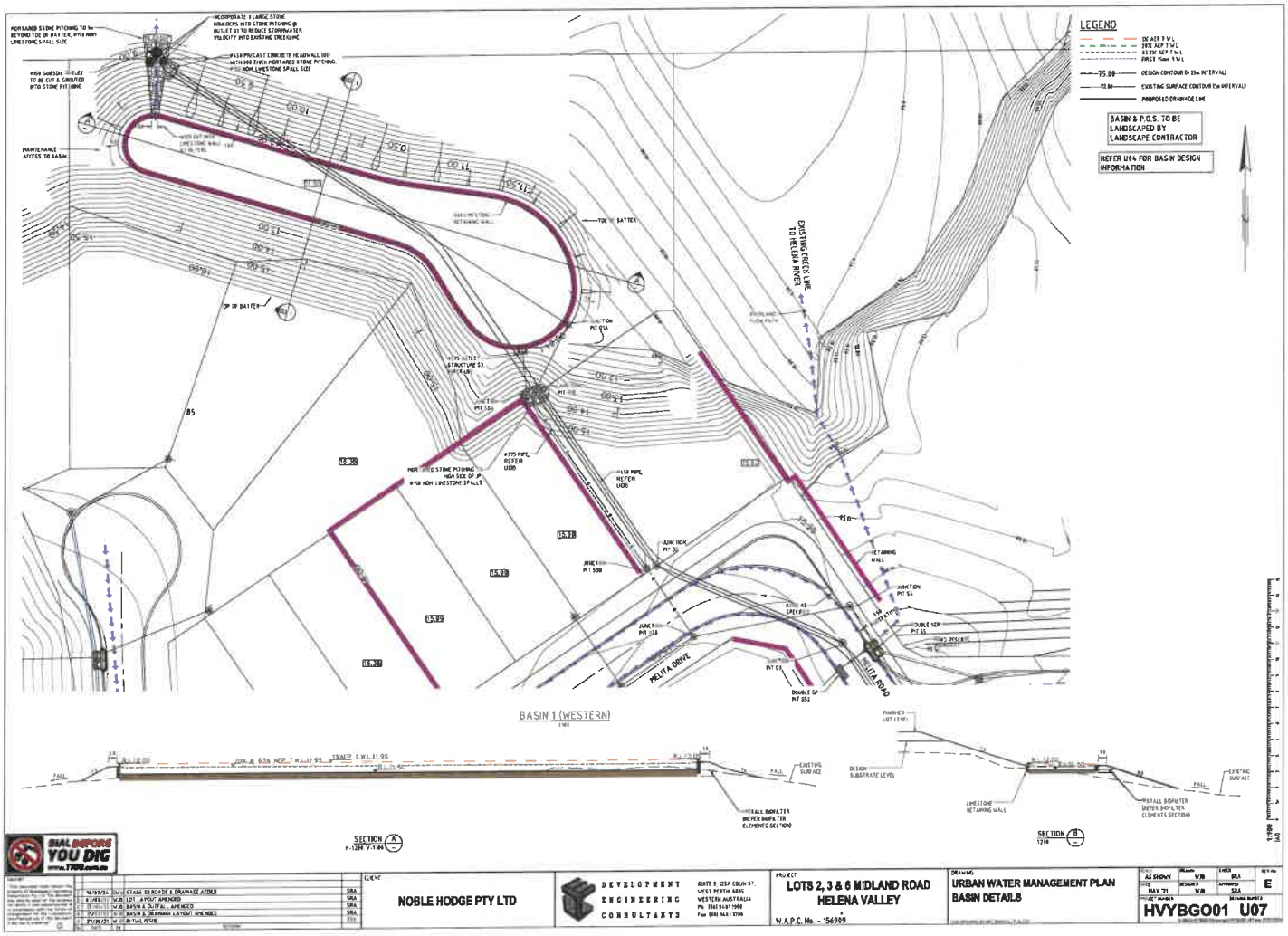
DRAWING: URBAN WATER MANAGEMENT PLAN
DRAINAGE LAYOUT
SHEET 1 OF 2

DRAWING NO: HVYBG001 U05

REVISION: E



CLIENT: NOBLE HODGE PTY LTD	DEVELOPMENT ENGINEERING CONSULTANTS	PROJECT: LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY W.A.P.C. No. - 156989	DRAWING: URBAN WATER MANAGEMENT PLAN DRAINAGE LAYOUT SHEET 2 OF 2
			SCALE: 1:500 DRAWN: MB CHKD: STA REV No: E
			DATE: MAY '21 SURVEY: MB APPROVED: SRA
			PROJECT REFNO: HVYBG001 DRAWING REFNO: U06



DIAL BEFORE YOU DIG www.1100.com.au

2	10/03/21	MW	STAGE 1D ROADS & DRAINAGE AMD'D
1	01/03/21	MW	LOT LAYOUT AMENDED
0	19/01/21	MW	BASIN & OUTFALL AMENDED
A	15/01/21	MW	BASIN & DRAINAGE LAYOUT AMENDED
	21/10/21	MW	INITIAL ISSUE

CLIENT: NOBLE HODGE PTY LTD

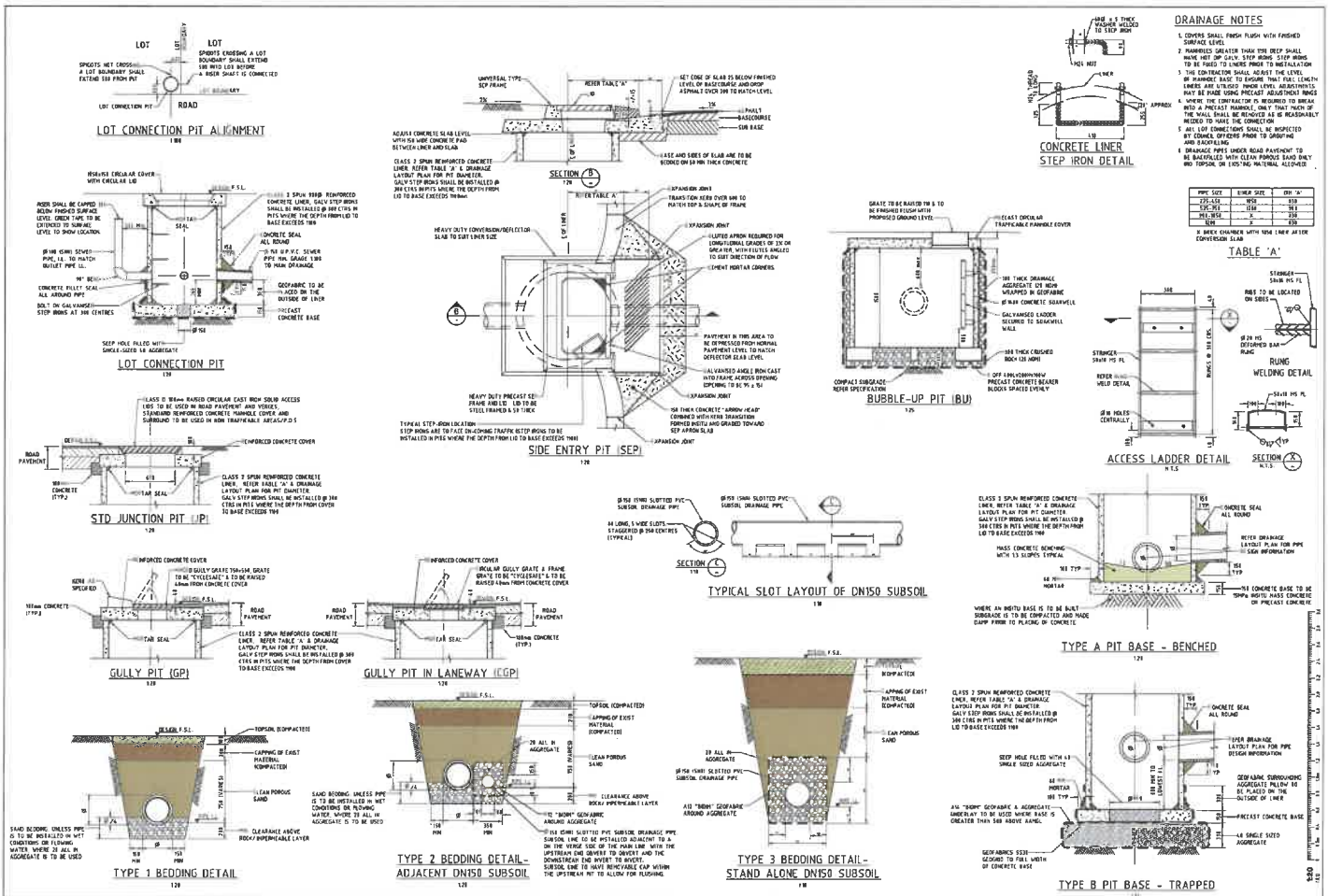
DEVELOPMENT ENGINEERING CONSULTANTS
SUITE 3, 123A COLIN ST, WEST PERTH, 6005, WESTERN AUSTRALIA
Ph. (08) 9481 1900
Fax (08) 9481 9766

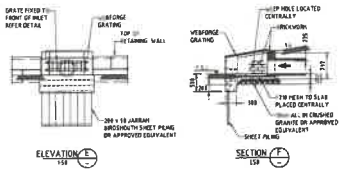
PROJECT: LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY
W.A.P.C. No. - 156989

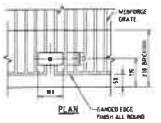
DRAWING: URBAN WATER MANAGEMENT PLAN BASIN DETAILS

SCALE: AS SHOWN	DRAWN: MW	CHECK: SRA	QTY No.
DATE: MAY '21	DESIGNED: MW	APPROVED: SRA	E

DRAWING NUMBER: HVYBG001 U07

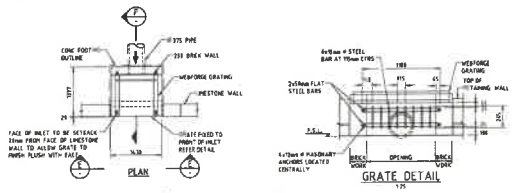

LOT CONNECTION PIT ALIGNMENT
LOT CONNECTION PIT
LOT CONNECTION PIT
SEWER F.S.L.
TOPSOIL (COMPACTED)
CAPPING OF EXIST MATERIAL COMPACTED
LEAN POROUS SAND
CLEARANCE ABOVE ROCK/ IMPERMEABLE LAYER
SAND BEDDING: UNLESS PIPE IS TO BE INSTALLED IN WET CONDITIONS OR FLOWING WATER, WHERE 20 ALL IN AGGREGATE IS TO BE USED
TYPE 1 BEDDING DETAIL
TYPE 2 BEDDING DETAIL- ADJACENT DN150 SUBSOIL
TYPE 3 BEDDING DETAIL- STAND ALONE DN150 SUBSOIL
STD JUNCTION PIT (JP)
GULLY PIT (GP)
GULLY PIT IN LANEWAY (GGP)
SIDE ENTRY PIT (SEP)
BUBBLE-UP PIT (BU)
TYPICAL SLOT LAYOUT OF DN150 SUBSOIL
ACCESS LADDER DETAIL
RUNG WELDING DETAIL
TYPE A PIT BASE - BENCHED
TYPE B PIT BASE - TRAPPED
CONCRETE LINER STEP IRON DETAIL
TABLE 'A'
DRAINAGE NOTES
1. COVERS SHALL FINISH FLUSH WITH FINISHED SURFACE LEVEL
2. MANHOLES GREATER THAN 1200 DEEP SHALL HAVE HOT DIP GALV. STEP IRONS. STEP IRONS TO BE FIXED TO LINERS PRIOR TO INSTALLATION
3. THE CONTRACTOR SHALL ADJUST THE LEVEL OF MANHOLE BASE TO ENSURE THAT FULL LENGTH LINERS ARE UTILISED. MINOR LEVEL ADJUSTMENTS MAY BE MADE USING PRECAST ADJUSTMENT RINGS
4. WHERE THE CONTRACTOR IS REQUIRED TO BREAK INTO A PRECAST MANHOLE, ONLY THAT PART OF THE WALL SHALL BE REMOVED AS IS REASONABLY NEEDED TO MAKE THE CONNECTION
5. ALL LOT CONNECTIONS SHALL BE INSPECTED BY COUNCIL OFFICERS PRIOR TO GROUTING AND BACKFILLING
6. DRAINAGE PIPES UNDER ROAD PAVEMENT TO BE BACKFILLED WITH CLEAN POROUS SAND ONLY AND TOPSOIL OR EXISTING MATERIAL ALLOWED
NOBLE HODGE PTY LTD
DEVELOPMENT ENGINEERING CONSULTANTS
LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY
W.A.P.C. No. - 156909
URBAN WATER MANAGMENT PLAN
STANDARD DETAILS
SHEET 1 OF 2
HVYBG001 U08



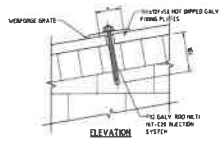


OUTLET STRUCTURE NOTES:

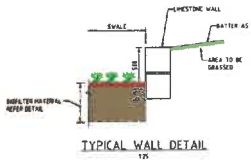
1. GRATING
   WEBFORGE GRATING TYPE W4033 SERIES TWO PANELS MAX LENGTH OF PANEL TO BE 1000mm WITH MIDM 10mm GAP BETWEEN PANELS REFER MANUFACTURERS DETAILS FOR FIXING
2. WALLS TO BE BRICKED IN RED BRICK TYPICAL OF BRICK MANHOLES TOP COURSE TO BE LAID AS ON FULL BRICKS ON THEIR EDGES
3. ALL STEELWORK TO BE HOT DIP GALVANISED IN ACCORDANCE WITH AS1397-2011 COATING MASS SHOULD NOT BE LESS THAN 500gm/m² IN ACCORDANCE WITH AS/NZS4680-2006
4. CONCRETE
   TO BE CLASS N25 TO AS3600-2009
5. BRICKS
   FACING OR COMMON BURNT CLAY OR SHALE METRIC STANDARD BRICK MINIMUM GRADE 'B' TO AS1225
6. MORTAR
   1 PART CEMENT 3 PARTS SAND



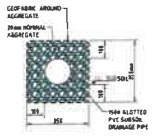
Ø375 OUTLET STRUCTURE (PIT S3)
1:50



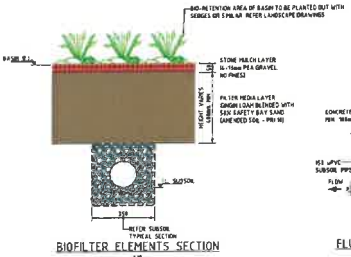
FIXING PLATE DETAIL
1:5



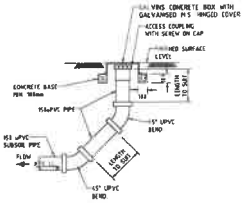
TYPICAL WALL DETAIL
1:25



SWALE SUBSOIL DRAINAGE TYPICAL SECTION
1:10



BIOFILTER ELEMENTS SECTION
1:10



FLUSHING POINT DETAIL - END
1:20

DIAL BEFORE YOU DIG www.1100.com.au

	31/05/21	WB	DETAILS AMENDED TO SUIT UPDATED BASIN DESIGN	SRA	
	21/05/21	WB	INITIAL ISSUE	SRA	

CLIENT: NOBLE HODGE PTY LTD

DEVELOPMENT ENGINEERING CONSULTANTS
SUITE 3, 1234 LOLM ST, WEST PERTH, 6005 WESTERN AUSTRALIA
Ph (08) 9481 1900
Fax (08) 9481 1900

PROJECT: LOTS 2, 3 & 6 MIDLAND ROAD HELENA VALLEY
W.A.P.C. No. - 156909

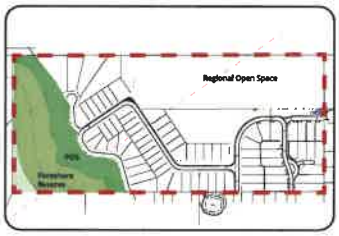
DRAWING: URBAN WATER MANAGEMENT PLAN STANDARD DETAILS SHEET 2 OF 2

SCALE	DRAWN	CHECK	KEY No.
AS SHOWN	MJB	SRA	B
DATE	DRAWN	APPROVED	
MAY '21	MJB	SRA	

DRAWING NUMBER: HVYBG001 U09

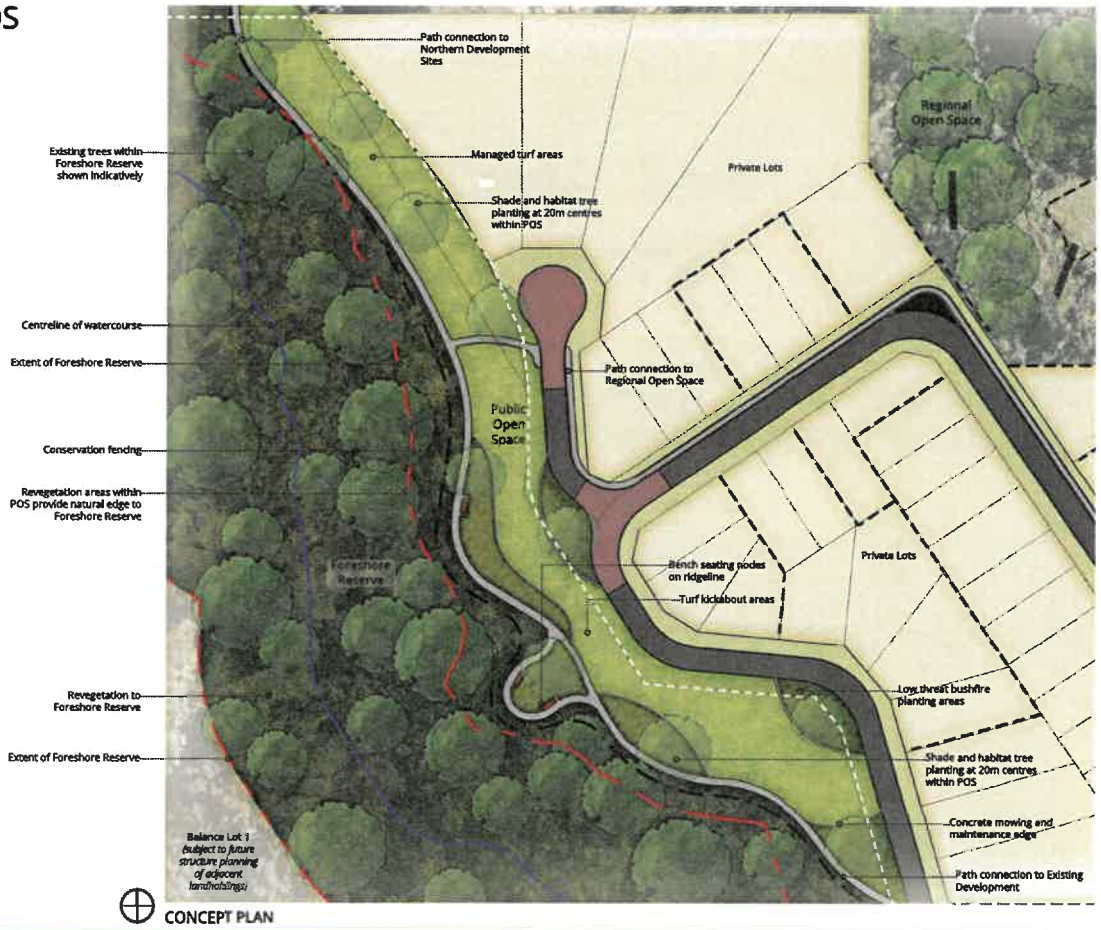
Foreshore Reserve & POS

LOCATION PLAN



LEGEND

- Foreshore Reserve Boundary
- Centreline of Watercourse
- POS Lot Boundary
- Conservation Fencing
- Existing Native Tree Planting
- Shade and Habitat Tree at 20m spacings
- Native Low fire Threat Shrub Planting Areas
- Revegetation Planting
- 2.1m Wide Concrete Path
- Informal / Bench Seating
- Turf areas
- Concrete Mowing/ Maintenance edge
- Road Treatments



CONCEPT PLAN

DWG - RNV-004-MP
REV - B
DATE - July 2021
SCALE - 1:1000 on A3

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LOTS 2, 3 & 6 MIDLAND ROAD, HELENA VALLEY

FORESHORE & PUBLIC OPEN SPACE PLAN

emerge

DEVELOPMENT
ENGINEERING
CONSULTANTS

APPENDIX D – DRAINAGE CALCULATIONS

Development Engineering Consultants - Drainage Basin Spreadsheet

Project: Noble Hodge
Client: Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley
Location: Drainage Basin 1 - Near Helena River (North)
Designer: SRA

DEVELOPMENT ENGINEERING CONSULTANTS

Location:	**Parkview Gardens Helena valley**			
Nearest grid cell:	**Latitude**	**-31.9125**	**Longitude**	**116.0375**

Data to be Input

				ARI	v Descriptor v
Rainfall AEP (Percentage)			1	100	Infrequent
63.2% AEP - 1hr Impervious Catchment(Ha)			1.06		
Required Bio-retention Area (2% Imp.) (m^2)			213		
Required Storage (First 15mm) (m^3)			159		
Available Storage (m^3)			558		
Soakage Outflow (l/s/m^2)			0.0001	85.44	
Likely Subsoil Flow (m^3/day)			219.38		
Likely Subsoil Flow (l/s)			2.54		
Allowable Outflow (l/s) (1EY)	3.13	l/s/ha	16.66		
Allowable Outflow (l/s) (20%AEP)	11.19	l/s/ha	59.49		
Allowable Outflow (l/s) (10% AEP)	14.93	l/s/ha	79.32		
Allowable Outflow (l/s) (1% AEP)	43.73	l/s/ha	232.41	(Per Agreed Outflow Capacity for Lot 207 Helena Valley Development)	

AEP	Equivalent Impervious Area (Ha)
63.2%	1.80
20%	2.37
1%	3.05

Catchment Details	Roads	Standard Lots (Unconnected)	Standard Lots (Connected <350m2)	Standard Lots (Connected <250m2)	POS	Drainage Basin	Total
Gross Catchment Area	**1.52**	**0**	**3.7152**	**0**	**0.0000**	**0.0810**	**5.31**
Runoff Coefficient (C_{10})	0.70	0.34	0.39	0.74	0.01	1.00	
ARI Multiplier	1.00	1.29	1.31	1.00	0.62	1.00	
Runoff Coefficient (C_y)	0.70	0.44	0.51	0.74	0.01	1.00	
Impervious Area (Ha)	**1.06**	**0.00**	**1.90**	**0.00**	**0.00**	**0.08**	**3.04**

Effective C 0.57

Q_{allow} 232.4

T_C (mins)	T_C (hrs)	I (mm/hr)	Q_{IN} (l/s)	V_{IN} (m^3)	Preliminary height (m)	Q_{OUT} (soakage) (l/s)	V_{OUT} (soakage) (m^3)	Net storage (after soakage) (m^3)	Time of water in basin (hrs)	V_{OUT} required (m^3)	Q_{OUT} (l/s)
10	0.17	122.00	1031	619	0.25	0.1	0	618	9.2	61	101.1
15	0.25	97.80	828	744	0.25	0.1	0	744	9.2	186	206.5
20	0.33	82.40	696	835	0.25	0.1	0	835	9.2	278	231.3
30	0.50	64.10	542	975	0.25	0.1	0	975	9.2	417	231.7
45	0.75	49.50	418	1129	0.25	0.1	0	1129	9.2	571	211.6
60	1.00	41.30	349	1256	0.25	0.1	0	1256	9.2	698	193.9
90	1.50	32.10	271	1465	0.25	0.1	1	1464	9.2	906	167.9

Development Engineering Consultants - Drainage Basin Spreadsheet

Project: Noble Hodge
Client: Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley
Location: Drainage Basin 1 - Near Helena River (North)
Designer: SRA

DEVELOPMENT ENGINEERING CONSULTANTS

Location: Nearest grid cell:	Parkview Gardens Helena valley										
	Latitude	-31.9125	Longitude	116.0375							
120	2.00	27.00	228	1643	0.25	0.1	1	1642	9.2	1084	150.6
150	2.50	23.70	200	1802	0.25	0.1	1	1801	9.2	1244	138.2
180	3.00	21.30	180	1944	0.25	0.1	1	1843	9.2	1385	128.2
240	4.00	18.37	155	2235	0.25	0.1	2	2233	9.2	1675	116.4
300	5.00	16.03	135	2439	0.25	0.1	2	2437	9.2	1879	104.4
360	6.00	14.30	121	2610	0.25	0.1	2	2608	9.2	2050	94.9
480	8.00	12.23	103	2977	0.25	0.1	3	2974	9.2	2416	83.9
720	12.00	9.37	79	3420	0.25	0.1	5	3416	9.2	2858	66.2
960	16.00	7.87	66	3830	0.25	0.1	6	3824	9.2	3266	56.7
1440	24.00	5.78	49	4220	0.25	0.1	9	4210	9.2	3653	42.3
2880	48.00	3.32	28	4847	0.25	0.1	19	4829	9.2	4271	24.7
4320	72.00	2.37	20	5191	0.25	0.1	28	5163	9.2	4605	17.8

Calculation of Storage in Above Ground Basin

Lower Tier/Bio-retention Drainage Basin Dimensions:

Side Slopes 1:	Length (m)	Breadth (m)
0	75	10.8

RL (Base) 11.5

TWL (mAHD)	Height (m)	Area at TWL (m^2)	Average area	Volume (m^3)	Treated storage above LWL (m^3)	The Designated Height allows Storage for
11.5	0	810	3240	0	0	Static Water Level
12	0.5	810	3240	405	405	First 15mm / 63.2% AEP - 1hr

TOTAL STORAGE TO TOP OF LOWER TIER 405 m^3

Middle Tier Drainage Basin Dimensions:

Side Slopes 1:	Length (m)	Breadth (m)
6	75	10.8

RL (Base) 12

TWL (mAHD)	Height (m)	Total depth to TWL (m)	Area at TWL (m^2)	Average area	Volume (m^3)	Treated storage above LWL (m^3)	The Designated Height allows Storage for
12	0	0.5	810	3240	0	405	Bottom of Middle Tier
12	0	0.5	810	3240	0	405	63.2% AEP
12	0	0.5	810	3240	0	405	20% AEP

Development Engineering Consultants - Drainage Basin Spreadsheet

Project:	Noble Hodge
Client:	Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley
Location:	Drainage Basin 1 - Near Helena River (North)
Designer:	SRA
Location:	Parkview Gardens Helena valley
Nearest grid cell:	Latitude -31.9125 Longitude 116.0375

DEVELOPMENT ENGINEERING CONSULTANTS

12.01	0.01	0.51	820	3261	8	413	10% AEP
12.17	0.17	0.67	989	3594	153	558	1% AEP

Outflow Configuration

Flow over weir

$Q = 1.84 \times L \times (H)^{1.5}$

H: height of weir

L : width of weir

Q (m^3/s)	L (m)	H (m)	Allowable H	Level of weir	Weir overflow	
0.017	1.00	0.04	0.00	11.95	11.99	*63.2% AEP*
0.059	1.00	0.10	0.00	11.95	12.05	*20% AEP*
0.232	1.00	0.25	0.00	11.95	12.20	*1% AEP*

IL of Outlet Pipe - Allowing for Subsoil at Base of Basin 11.00

Flow through orifice

$Q = C_D \cdot A_O \cdot Sqrt(19.62 \cdot dH)$

C_D= 0.61

Q (m^3/s)	Width of hole (mm)	Depth of hole (mm)	A_O (sqm)	Equiv. Dia. (mm)	dH (m)	Allowable DH (m)	
0.232	282	282	0.079524	318	1.169873781	1.17	*1% AEP*

Minimum pipe size required 282mm dia. - specify 300mm dia.

Development Engineering Consultants - Drainage Basin Spreadsheet

Project:	**Noble Hodge**
Client:	**Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley**
Location:	**Drainage Basin 2 - Parkview Gardens (East)**
Designer:	**SRA**

DEVELOPMENT ENGINEERING CONSULTANTS

Location:	**Parkview Gardens Helena valley**			
Nearest grid cell:	**Latitude**	**-31.9125**	**Longitude**	**116.0375**

Data to be Input

				ARI	v Descriptor v
Rainfall AEP (Percentage)		1		100	Infrequent
63.2% AEP - 1hr Impervious Catchment(Ha)		0.05			
Required Bio-retention Area (2% Imp.) (m^2)		11			
Required Storage (First 15mm) (m^3)		8			
Available Storage (m^3)		30			
Soakage Outflow (l/s/m^2)		0.0001			
Likely Subsoil Flow (m^3/day)					
Likely Subsoil Flow (l/s)					
Allowable Outflow (l/s) (1EY)	3.13	l/s/ha	0.88		
Allowable Outflow (l/s) (20%AEP)	11.19	l/s/ha	3.15		
Allowable Outflow (l/s) (10% AEP)	14.93	l/s/ha	4.20		
Allowable Outflow (l/s) (1% AEP)	43.73	l/s/ha	12.31	**(Per Agreed Outflow Capacity for Lot 207 Helena Valley Development)**	

AEP	Equivalent Impervious Area (Ha)
63.2%	1.80
20%	2.37
1%	3.05

Catchment Details	Roads	Standard Lots (Unconnected)	Standard Lots (Connected <350m2)	Standard Lots (Connected <250m2)	POS	Drainage Basin	Total
Gross Catchment Area	**0.08**	**0**	**0.1982**	**0**	**0.0000**	**0.0078**	**0.28**
Runoff Coefficient (C_{10})	0.70	0.34	0.39	0.74	0.01	1.00	
ARI Multiplier	1.00	1.29	1.31	1.00	0.62	1.00	
Runoff Coefficient (C_Y)	0.70	0.44	0.51	0.74	0.01	1.00	
Impervious Area (Ha)	**0.05**	**0.00**	**0.10**	**0.00**	**0.00**	**0.01**	**0.16**

Effective C 0.58

Q_{allow} 12.3

T_C (mins)	T_C (hrs)	I (mm/hr)	Q_{IN} (l/s)	V_{IN} (m^3)	Preliminary height (m)	Q_{OUT} (soakage) (l/s)	V_{OUT} (soakage) (m^3)	Net storage (after soakage) (m^3)	Time of water in basin (hrs)	V_{OUT} required (m^3)	Q_{OUT} (l/s)
10	0.17	122.00	55	33	0.25	0.0	0	33	9.3	3	5.2
15	0.25	97.80	44	40	0.25	0.0	0	40	9.3	10	10.9
20	0.33	82.40	37	44	0.25	0.0	0	44	9.3	15	12.2
30	0.50	64.10	29	52	0.25	0.0	0	52	9.3	22	12.3
45	0.75	49.50	22	60	0.25	0.0	0	60	9.3	30	11.2
60	1.00	41.30	19	67	0.25	0.0	0	67	9.3	37	10.3
90	1.50	32.10	14	78	0.25	0.0	0	78	9.3	48	8.9

Development Engineering Consultants - Drainage Basin Spreadsheet

Project:	**Noble Hodge**
Client:	**Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley**
Location:	**Drainage Basin 2 - Parkview Gardens (East)**
Designer:	**SRA**

DEVELOPMENT ENGINEERING CONSULTANTS

Location:	**Parkview Gardens Helena valley**											
Nearest grid cell:	**Latitude**	**-31.9125**	**Longitude**	**116.0375**								
120	2.00	27.00	12	87	0.25	0.0	0	87	9.3	58	8.0
150	2.50	23.70	11	96	0.25	0.0	0	96	9.3	66	7.3
180	3.00	21.30	10	103	0.25	0.0	0	103	9.3	74	6.8
240	4.00	18.37	8	119	0.25	0.0	0	119	9.3	89	6.2
300	5.00	16.03	7	130	0.25	0.0	0	130	9.3	100	5.6
360	6.00	14.30	6	139	0.25	0.0	0	139	9.3	109	5.1
480	8.00	12.23	6	158	0.25	0.0	0	158	9.3	129	4.5
720	12.00	9.37	4	182	0.25	0.0	0	182	9.3	152	3.5
960	16.00	7.87	4	204	0.25	0.0	0	204	9.3	174	3.0
1440	24.00	5.78	3	225	0.25	0.0	0	224	9.3	195	2.3
2880	48.00	3.32	1	258	0.25	0.0	1	257	9.3	228	1.3
4320	72.00	2.37	1	276	0.25	0.0	1	275	9.3	246	0.9

Calculation of Storage in Above Ground Basin

Lower Tier/Bio-retention Drainage Basin Dimensions:

Side Slopes 1:	Length (m)	Breadth (m)
6	5	2.1

RL (Base) 13.9

TWL (mAHD)	Height (m)	Area at TWL (m^2)	Average area	Volume (m^3)	Treated storage above LWL (m^3)	The Designated Height allows Storage for
13.9	0	11	42	0	0	Static Water Level
13.9	0	11	42	0	0	First 15mm / 63.2% AEP - 1hr

TOTAL STORAGE TO TOP OF LOWER TIER **0** m^3

Middle Tier Drainage Basin Dimensions:

Side Slopes 1:	Length (m)	Breadth (m)
6	5	2.1

RL (Base) 13.9

TWL (mAHD)	Height (m)	Total depth to TWL (m)	Area at TWL (m^2)	Average area	Volume (m^3)	Treated storage above LWL (m^3)	The Designated Height allows Storage for
13.9	0	0	11	42	0	0	Bottom of Middle Tier
14.29	0.39	0.39	66	130	13	13	63.2% AEP
14.35	0.45	0.45	78	148	18	18	20% AEP

Development Engineering Consultants - Drainage Basin Spreadsheet

Project:	Noble Hodge
Client:	Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley
Location:	Drainage Basin 2 - Parkview Gardens (East)
Designer:	SRA

DEVELOPMENT ENGINEERING CONSULTANTS

Location: Nearest grid cell:	Parkview Gardens Helena valley						
	Latitude	-31.9125	Longitude	116.0375			
14.41	0.51	0.51	91	166	23	23	10% AEP
14.48	0.58	0.58	108	189	30	30	1% AEP

Outflow Configuration

Flow over weir

Q = 1.84 x L x (H)^1.5

H: height of weir

Q (m^3/s)	L : width of weir L (m)	H (m)	Allowable H	Level of weir	Weir overflow	
0.001	0.02	0.08	0.39	14.29	14.37	*63.2% AEP*
0.002	0.30	0.03	0.06	14.37	14.40	*20% AEP*
0.009	0.30	0.07	0.00	14.40	14.46	*1% AEP*

IL of Outlet Pipe - Allowing for Subsoil at Base of Basin 13.50

Flow through orifice

$Q = C_D A_o \text{Sqrt}(19.62 * dH)$

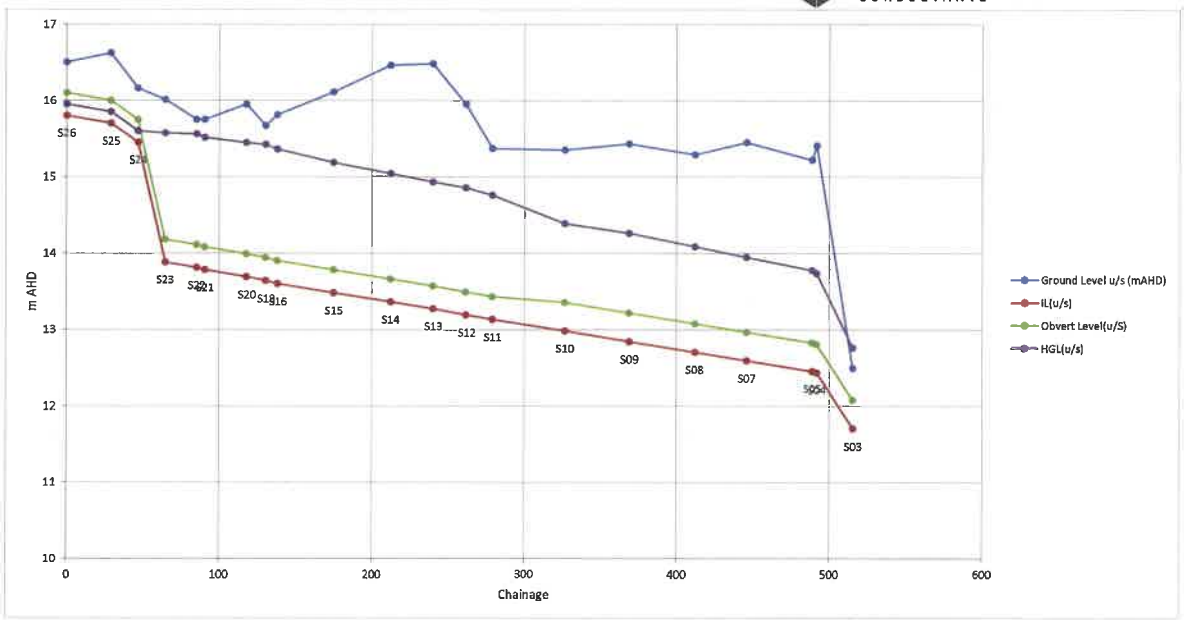
C_D= 0.61

Q (m^3/s)	Width of hole (mm)	Depth of hole (mm)	A_o (sqm)	Equiv. Dia. (mm)	dH (m)	Allowable DH (m)	
0.012	68	68	0.004624	77	0.970841002	0.98	*1% AEP*

Minimum pipe size required 287mm dia. - specify 300mm dia. With orifice at entry with 80mm hole

Client: **Noble Hodge**
Project: **Lots 2, 3 and 6 Helena valley Road**
Line: **Overflow Line froom Existing Drainage Basin**

DEVELOPMENT
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CONSULTANTS



Development Engineering Consultants - Drainage HGL Spreadsheet

Client: **Noble Hodge**
Project: **Lots 2, 3 and 6 Helena valley Road**
Line: **Overflow Line froom Existing Drainage Basin**
Location **Parkview Gardens Hel 0**
Nearest grid cell: **Latitude 32.3375(S) Longitude 115.8125(E)**

DEVELOPMENT ENGINEERING CONSULTANTS

Data to be Input			ARI	v Descriptor v
Rainfall AEP (Percentage)		20	4.48	Frequent
Run-off Coefficients - Road		0.7		
Run-off Coefficients - Lots (Connected)		0.06		
Minimum Tc(Mins)		5		
Minimum Cover(m)		0.4		
Min Pipe Grade (Gen)	1:	350		
Min Pipe Grade (Outlet)	1:	350		
Minimum Manhole Drop(m)		0.01		
Relative Roughness (K(mm))		0.3	0.0003	
HGL at Outlet (mAHD)		12.75		

Pit 1(u/s)	Pit 2(d/s)	Length(m)	Ground Level u/s (mAHD)	Ground Level d/s (mAHD)	Area In @ u/s Pit (m^2)	Area of Lots In @ u/s Pit (m^2)	Cumulative Area(Roads)	Cumulative Area(Lots)	Equiv.Imp. Area	Tc(mins)	I(mm/hr)	Q(l/s)	Extra Inflow(L/s)	Total Q(l/s)
S26	S25	29	16.5	16.62	0	1353	0	81.18	81.18	5.000	91.00	2.05	0.00	2.05
S25	S24	18	16.62	16.16	0	2548	0	234.06	234.06	5.634	87.98	5.72	0.00	5.72
S24	S23	17.9	16.16	16.01	188	2057	188	357.48	489.08	5.824	87.08	11.83	0.00	11.83
S23	S22	20.5	16.01	15.75	0	1058	188	420.84	552.44	6.071	85.90	13.18	0.00	13.18
S22	S21	5.4	15.75	15.75	1367	0	1555	420.84	1509.34	6.532	83.71	35.09	0.00	35.09
S21	S20	27.1	15.75	15.95	347	500	1902	450.84	1782.24	6.640	83.19	41.19	0.00	41.19
S20	S18	12.5	15.95	15.67	0	0	1902	450.84	1782.24	7.248	80.30	39.75	0.00	39.75
S18	S16	7.7	15.67	15.81	844	532	2746	482.76	2404.96	7.517	79.02	52.79	0.00	52.79
S16	S15	36.8	15.81	16.11	1003	0	3749	482.76	3107.06	7.668	78.30	67.58	0.00	67.58
S15	S14	37.5	16.11	16.46	0	547	3749	515.58	3139.88	8.309	75.25	65.63	0.00	65.63
S14	S13	27.8	16.46	16.48	0	550	3749	548.58	3172.88	8.982	72.04	63.50	0.00	63.50
S13	S12	21.8	16.48	15.95	0	1060	3749	612.18	3236.48	9.498	69.59	62.56	0.00	62.56
S12	S11	17.4	15.95	15.37	639	1580	4388	705.78	3777.38	9.905	67.65	70.99	0.00	70.99

Development Engineering Consultants - Drainage HGL Spreadsheet

Client:
Project:
Line:
Location
Nearest grid cell:

Pit 1(u/s)	Pit 2(d/s)	D(mm)	k(u/s)	V(Hyd)(m/s)	Nr	f	Slope of HGL(S_o)	Friction HeadLoss H_L(m)	Upstream Pit HeadLoss (m)	HGL(u/s)	HGL(d/s)	IL(u/s)	IL(d/s)	Pipe Grade(1:)
S26	S25	300	1	0.0290306	7.640E+03	0.035	201387.163	0.00	0.03	15.95	15.88	15.80	15.71	322.22
S25	S24	300	0.2	0.0809249	2.130E+04	0.028	32438.505	0.00	0.03	15.85	15.83	15.70	15.46	75
S24	S23	300	0.3	0.1673592	4.404E+04	0.025	8545.747	0.00	0.02	15.60	15.59	15.45	15.31	127.85
S23	S22	300	0.3	0.1864924	4.908E+04	0.024	6985.731	0.00	0.01	15.57	15.57	13.88	13.82	341.66
S22	S21	300	1.2	0.4964887	1.307E+05	0.022	1093.289	0.00	0.04	15.56	15.56	13.81	13.79	269.99
S21	S20	300	1.2	0.5826538	1.533E+05	0.022	803.473	0.03	0.03	15.51	15.48	13.78	13.70	338.75
S20	S18	300	0.3	0.5623957	1.480E+05	0.022	860.192	0.01	0.01	15.45	15.43	13.69	13.65	312.5
S18	S16	300	1.2	0.7467879	1.965E+05	0.021	497.186	0.02	0.04	15.42	15.41	13.64	13.61	256.66
S16	S15	300	1.2	0.9560693	2.516E+05	0.021	307.556	0.12	0.06	15.36	15.24	13.60	13.49	334.54
S15	S14	300	0.7	0.9284899	2.443E+05	0.021	325.606	0.12	0.03	15.19	15.07	13.48	13.37	340.9
S14	S13	300	0.7	0.8982972	2.364E+05	0.021	347.255	0.08	0.03	15.04	14.96	13.36	13.28	347.5
S13	S12	300	0.4	0.8850773	2.329E+05	0.021	357.421	0.06	0.02	14.93	14.87	13.27	13.20	308.57
S12	S11	300	0.7	1.0042569	2.643E+05	0.021	279.439	0.06	0.04	14.85	14.79	13.19	13.14	348

Development Engineering Consultants - Drainage Basin Spreadsheet

Client: Noble Hodge

Project: Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley

Location: At Lot Detention Calculations to Establish Runoff Coefficient - Connected Residential Lot

Designer: SRA

Location:	**Parkview Gardens Helena valley**			
Nearest grid cell:	**Latitude**	**-31.9125**	**Longitude**	**116.0375**

DEVELOPMENT ENGINEERING CONSULTANTS

Data to be Input

		ARI	v Descriptor v
Rainfall AEP (Percentage)	20	4.48	Frequent
63.2% AEP Impervious Catchment (Ha)	0.027		
Required Storage (63.2% AEP - 1hr) (m^3)	4.213		

Catchment Details	Paved Area	Unpaved area	Total
Lot Area (SQM)			**380.00**
Proportion Paved	**80%**	**20%**	**100%**
Area Paved (Ha)	**0.030**	**0.008**	**0.038**
Run-Off Co-efficient(C10)	0.90	0.00	
ARI Multiplier	1.00	1.00	
Run-Off Co-efficient(Cy)	0.90	0.00	
Impervious Area(Ha)	**0.027**	**0.000**	**0.027**

Effective C
0.72

AEP	ARI	Effective C	Multiplier
63.2	1	0.18	0.46
50	1.44	0.23	0.59
20	4.48	0.33	0.85
10	9.49	0.39	1.00
5	20	0.44	1.13
2	50	0.49	1.26
1	100	0.51	1.31

Volume and Dimensions of Available Storage

Area above ground inundated to 0.03m deep (backyard and front yard) (m^2)	-	0.03
Storage provided manholes/pipe (m^3)	-	
Number of Soakwells	2.00	
Diameter of soakwells (m)	1.50	
Depth of each soakwell (m)	1.20	
Storage required soakwells (m^3)	**4.24**	
Strorage provided (m^3)	4.24	
Soakage rate (l/s/m^2)	0.01	

Volume of storage required is 1m^3 per 89.60 m^2 of total lot area

Development Engineering Consultants - Drainage Basin Spreadsheet

Project: **Lots 2, 3 and 6 Tuckeroo Parade, Helena Valley**

Location: **At Lot Detention Calculations to Establish Runoff Coefficient - Connected Residential Lot**

T_C (mins)	T_C (hrs)	I (mm/hr)	Q_{IN} (l/s)	Total V_{IN} (m^3)	Q_{OUT} (soakage) (l/s)	V_{OUT} (soakage) (m^3)	Net storage (after soakage) (m^3)	V_{OUT} required (m^3)	Q_{OUT} (l/s)	Effective runoff C
10	0.17	67.20	5.1	3.06	0.13	0.08	2.99	0.00	0.00	0.00
15	0.25	54.10	4.1	3.70	0.13	0.12	3.58	0.00	0.00	0.00
20	0.33	45.80	3.5	4.18	0.13	0.16	4.02	0.00	0.00	0.00
30	0.50	35.60	2.7	4.87	0.13	0.24	4.63	0.39	0.22	0.06
45	0.75	27.50	2.1	5.64	0.13	0.35	5.29	1.05	0.39	0.13
60	1.00	22.80	1.7	6.24	0.13	0.47	5.77	1.53	0.42	0.18
90	1.50	17.50	1.3	7.18	0.13	0.71	6.48	2.23	0.41	0.22
120	2.00	14.50	1.1	7.93	0.13	0.94	6.99	2.75	0.38	0.25
150	2.50	12.60	1.0	8.62	0.13	1.18	7.44	3.20	0.36	0.27
180	3.00	11.20	0.9	9.19	0.13	1.41	7.78	3.54	0.33	0.28
240	4.00	9.51	0.7	10.41	0.13	1.88	8.53	4.29	0.30	0.30
300	5.00	8.20	0.6	11.22	0.13	2.35	8.86	4.62	0.26	0.30
360	6.00	7.26	0.6	11.92	0.13	2.82	9.09	4.85	0.22	0.29
480	8.00	6.19	0.5	13.54	0.13	3.77	9.78	5.53	0.19	0.29
720	12.00	4.72	0.4	15.50	0.13	5.65	9.85	5.61	0.13	0.26
960	16.00	4.01	0.3	17.54	0.13	7.53	10.01	5.77	0.10	0.24
1440	24.00	3.03	0.2	19.90	0.13	11.30	8.60	4.36	0.05	0.16
2880	48.00	1.90	0.1	24.95	0.13	22.60	2.36	0.00	0.00	0.00
4320	72.00	1.44	0.1	28.37	0.13	33.90	-5.53	0.00	0.00	0.00

DEVELOPMENT
ENGINEERING
CONSULTANTS

APPENDIX E – GEOTECHNICAL REPORT

- **JDSI Geotechnical Report June 2017**

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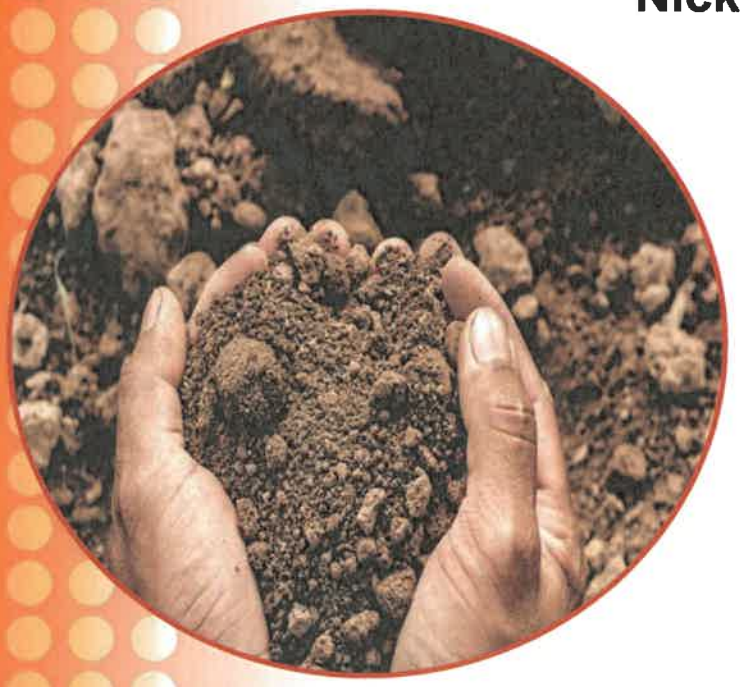
jdsi.com.au

GEOTECHNICAL SITE INVESTIGATION

Lots 2, 3 and 6 Helena Valley Road

Helena Valley

John Stefanelli, Joe Stefanelli, Nick Di Candilo and Others



JDS161188
June 2017

INTEGRITY

We are open, honest, and consistent in our principles and conduct, so we're able to build trusted relationships with our clients and partners.

RESPECT

We treat everyone with respect and dignity and develop relationships founded on understanding and trust.

ACCOUNTABILITY

We always assume responsibility for our actions and make decisions in line with our economic, social, and ethical obligations.

EXCELLENCE

We pursue excellence in everything we do, challenging ourselves to look beyond the obvious and ensure ongoing improvement.

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Geotechnical Site Investigation
Lots 2, 3 and 6 Helena Valley Road
Helena Valley

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13 June 2017

Document authorisation

For and on behalf of JDSi Ground Engineering Ltd



Dr Richard Moyle

Principal Geotechnical Engineer

Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
Rev0	DRAFT	28 April 2017	RM	CD	RM
Rev1	Final	23 May 2017	RM	CD	RM
Rev2	Additional information included	13 June 2017	RM	CD	RM

Distribution

Report Status	No. of copies	Format	Distributed to	Date
Rev2	1	PDF	John Stefanelli, Joe Stefanelli, Nick Di Candilo and Others	13 June 2017
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IMPORTANT INFORMATION SHEETS

"*Your Geotechnical Report*"

FIGURES

Figure 1 – Site Investigation Layout

Figure 2 – Fill Areas

APPENDICES

Appendix A – Douglas Partners Borehole logs

Appendix B – Douglas Partners Test Pit Logs

Appendix C – JDSi Test Pit Logs

Appendix D – Laboratory Test Results

1 Introduction

This report presents the geotechnical site investigation carried out by JDSi Ground Engineering Pty Ltd (JDSi) for John Stefanelli, Joe Stefanelli, Nick Di Candilo and Others (John Stefanelli and Others) for the proposed residential subdivision development located at Lots 2, 3 and 6 Helena Valley Road, Helena Valley. This work was commissioned by Mr John Stefanelli on 19 January via a signed Client Acceptance Form.

The site is rectangular in shape, covering an area of about 13.2 ha and is bound by existing residential development to the east and south of the site and undeveloped land to the west and north. The eastern portion of the site has historically been used for clay extraction and inert landfilling. We understand that the proposed earthworks on the site will consist of small amounts of cut over the site, and between 1m and 3m of fill to be imported to form the final fill level. The approximate subdivision layout and location is shown on ***Figure 1***, attached to this report.

JDSi has previously undertaken a desktop review of site, including a site walkover. The intent of the desktop review was to quantify the extent of the fill and (likely) fill constituents. The results of the desktop review are presented in our report (reference: JDS161188-R01-Rev0) dated February 2017.

Emerge Associates Pty Ltd (Emerge) carried out an environmental investigation for the proposed development; during which JDSi was on site to observe materials intersected in test pits, provide engineering logs of the materials encountered and limited geotechnical interpretation.

Emerge has also installed groundwater monitoring wells across the site. JDSi was not on site during the installation of the wells, however the logs of the wells (in the form of thickness of fill) has been provided by Emerge and used in this assessment.

This report, and the information presented herein, must be read in conjunction with the previous desktop study report and JDSi's *"Your Geotechnical Report"* information sheets attached to this report.

2 Site history

2.1 Summary of historical land use

Based on Emerge report (reference: EP13-031(01))—002) dated August 2015, a summary of the historical land use at the site is as follows:

- 1912 to 1975 – Site was used as a brick works including clay extraction and brick manufacture;
- 1975 to 1982 – Site was used for the following operations:
    - Salvage yard;
    - Construction of transportable buildings;
    - Repair and renovation of buildings transported to the site;
    - Recycling of dry demolition rubble and material for resale; and
    - Disposal of dry demolition rubble.
- 1982 to Present – the site was used for the following operations:
    - An inert landfill from 1982 to 1993;

- A tire shredding facility;
- A hay processing facility for preparing bales for international transport; and
- Currently used as a laydown and storage facility for drilling equipment and machinery.

2.2 Summary of historical aerial photographs

Based on Emerge report (reference: EP13-031(01))—002) dated August 2015, a summary of the historical aerial photographs at the site is as follows:

- The site was operational as a brick works at the time of the earliest photograph in 1953;
- A large portion of the site was included in the clay extraction area and formed a large surface water body prior to filling;
- The void formed by the clay extraction was filled between 1977 and 1995;
- Since 2000 the site has largely consisted of a laydown and storage area; and,
- Between 2009 and 2010 additional sand / sandy clay was imported to the north eastern portion of the site and some filling works were completed.

2.3 Recent investigation

On 7 April 2017, JDSi was provided with a geotechnical investigation report by Douglas Partners Pty Ltd (DP) (reference 88790.01 dated February 2017) for a proposed gravity sewer main.

Part of the proposed sewer main traverses the eastern portion of the proposed development along the planned extension to Tuckeroo Parade and Carabeen Avenue. DP undertook six boreholes along this alignment (BH16 to BH19B) and the engineering logs for these holes have been included in ***Appendix A*** together with the site plan of the investigation. The locations of the DP boreholes have been included on ***Figure 1*** of this report.

The DP boreholes logs indicate the following:

- Boreholes BH16, BH17 and BH18 encountered between 0.7 and 1.75m of Fill overlying Clayey Sand to borehole termination depth.
- Boreholes BH19 and BH19A refused in Fill at depths of 2.7m and 3.7m, respectively. The reason for refusal was reported by DP to be on concrete.
- Borehole BH19B encountered 4.3m of Fill overlying (natural) Clayey Sands.
- Groundwater was reported in BH19B at a depth of 3.5m.

On 16 May 2017, JDSi were provided with a subsequent report by DP (reference 88790.03 dated April 2017) for a Targeted Contamination Assessment of the proposed gravity sewer. As part of the May 2017 investigation, DP undertook six test pits along the proposed alignment. The test pit logs and site plans have been included in ***Appendix B***. The locations of the DP test pits have been included on ***Figure 1*** of this report.

The DP test pit logs indicate the following:

- The test pits encountered between 0.7m and 1.6m of Fill overlying Clayey Sand through to the maximum termination depth of 2.5m.
- Test pit 104 encountered Sandy Clay between 2.2m and 3.3m.

The results from the April 2017 investigations by DP were significantly different to those reported by DP in February 2017. For example, BH19 and BH19B recorded up to 4.3m of Fill; whereas the only 1.6m was reported by DP in the adjacent test pit (TP105). Similarly DP recorded 3.7m of fill in borehole 19A prior to refusal; whereas DP reported 0.5m of fill in the adjacent test pit (TP106). The DP April 2017 report did not provide specific comment on the variability in thickness of Fill encountered in the different investigations other than noting "*deeper pockets of uncontrolled filling along the sewer along the sewer alignment than those encountered during the test pitting cannot be ruled out*".

Based on the information provided, JDSi cannot determine the reason for the reported variability in Fill thickness over such short distances. The reason for the variability should be confirmed by DP.

Emerge installed groundwater monitoring wells on 5 May 2017 across the proposed development site, the locations of which is presented on ***Figure 1***. A summary of the groundwater wells and the depths of Fill encountered is presented in Table 1.

Table 1 – Summary of groundwater well installation

Groundwater Well	Depth of Fill (m)	Groundwater well	Depth of Fill (m)
MW A	8.0	LFG G	0
MW B	7.8	LFG H	0.05
MW C	2.3	ESB 01	4.2
MW D	0	ESB 02A	4.1
LFG A	2.0	ESB 02B	3.5
LFG B	0.1	ESB 02C	3.1
LFG C	2.0	ESB 03	4.1
LFG D	0	ESB 04	2.2
LFG E	4	ESB 05	0
LFG F	3.9	ESB 06	3.1

Note: All depths reported are metres below ground surface level at the time of installation of the wells.

3 Geotechnical investigations

3.1 Geotechnical investigations

The geotechnical investigations undertaken as part of this study were completed in general accordance with AS 1726 "*Geotechnical Site Investigations*" and included the excavation of 12 test pits to depths of between 1.5m to 2.6m.

Engineering logs of the materials encountered within the test pits are presented in ***Appendix C***, along with explanatory notes of the description methods used.

The locations of the test pits are shown on ***Figure 1***, with the overlay of the proposed subdivision layout.

3.2 Laboratory testing

Laboratory testing for the geotechnical investigation was carried out in accordance with the general requirements of AS 1289 by Material Consultants Pty Ltd at their NATA registered soils laboratory.

A summary of the laboratory testing completed for this study is presented in Table 2 and the laboratory test certificates are included in ***Appendix D***.

Table 2 – Extent of laboratory testing

Type of Test	Test Method Reference	Number of Tests Completed
Particle Size Distribution	AS 1289.3.6.1	3
Atterberg Limits	AS 1289.3.1.1 – 3.4.1	3
Standard Compaction	AS 1289.5.1.1	1
Modified Compaction (MMDD)	AS1289.5.2.1	1

4 Results of the geotechnical investigations

4.1 Published geology

The 1:50,000 Environmental Geology Series map (Perth) indicates that the site is expected to be underlain by pebbly silt of the Guildford Formation. This unit is described as "*strong brown silt with common, fine to occasionally coarse-grained, sub-rounded laterite quartz, heavily weathered granite pebble, some fine to medium quartz sand of alluvial origin*".

The map also indicates the presence of quarry of pit activity and a lake feature in the in the north eastern portion of the site.

4.2 Published Groundwater Data

The Perth Groundwater Map (http://www.water.wa.gov.au/) provides historical groundwater contours for the Perth Metropolitan area. This dataset indicates that groundwater levels were at about 8m to 9m AHD in 2003 (end of summer) which is about 6m to 7m below existing site levels.

It must be noted that the depth of groundwater and localised groundwater response will have been altered by the historic land use. Fluctuations in groundwater levels must be expected.

4.3 Historic investigations

WorleyParsons Services Pty Ltd (WorleyParsons) completed a number of geotechnical and environmental investigations at the site during which the boundaries of the former inert landfill were defined. The depth of the pit prior to backfilling is unknown and estimated to have a depth of between 10 and 20m, but possibly deeper.

The results of the most recent WorleyParsons investigation divide the site into zones. A summary of the zones is provided in Table 3.

Table 3 – Zone description

Zone	Zone Description
Zone 1	**Deep Fill Area: Excavation/backfilled area**; comprising highly variable and highly compressible uncontrolled fill to depths exceeding 3.0m. The uncontrolled fill in this zone is understood to comprise a variety of deleterious materials including concrete, bricks, plastic, tyres, rubber, steel and other miscellaneous debris;
Zone 1.5	**Excavation/backfilled area**; comprising highly variable and highly compressible uncontrolled fill up to a maximum depth of 1.5m. The uncontrolled fill in this zone is consistent with Zone 1 but is shallow in depth;
Zone 2	**Non-excavated/backfilled area**: a transition area between the boundary of the former excavation and where small amounts of uncontrolled fill were placed beyond the edge of the excavation overlying the natural ground surface. The uncontrolled fill in this zone comprises predominately brick fragments and concrete. The maximum depth of fill encountered during investigation of Zone 2 was 1.8m;
Zone 2a	**Generally similar in characteristics to Zone 2**, however fill material associated with the previous brick works operation were identified to a maximum depth of 7.0m in borehole MW_07_01;
Zone 3	**Natural Ground: Non-excavated/non backfilled area**: defined as an area outside the boundaries of any fill placement. This was assumed to be natural ground at the site; and
Zone 4	**Inaccessible area**; no investigation was possible in this area due to the presence of dense vegetation and disused machinery. There is evidence of previous earthmoving activities in this zone, therefore the potential presence of fill should be considered for future development.

Zone boundaries in relation to the proposed subdivision layout are included in our desktop report dated February 2017. Also included in our desktop report are geological descriptions of each zone.

4.4 Current geotechnical investigations

Overview

Based on the geotechnical investigations undertaken, the typical profile encountered comprised of uncontrolled fill overlying medium plasticity Clay. Some of the test pits intersected Sandy Clay overlying the medium plasticity Clay.

A summary of the thicknesses of the uncontrolled fill materials encountered during the JDSi and DP investigations is presented in Table 4.

Table 4 – Summary of uncontrolled fill thickness

Test Pit	Thickness of Fill (m)		Test Pit	Thickness of Fill (m)
TP1	1		TP7	0.4
TP2	0		TP8	0.3
TP3	2		TP9	0.5
TP4	1.8		TP10	>2.6
TP5	0		TP11	1.4
TP6	0.9		TP12	0.2
DP BH16	0.75		DP TP101	0.7
DP BH17	0.7		DP TP102	0.9
DP BH18	1.75		DP TP103	1.0
DP BH19	>2.7m		DP TP104	0.6
DP BH19A	>3.7m		DP TP105	1.6
DP BH19B	4.3m		DP TP106	0.5

Groundwater was not intersected during the recent geotechnical investigation. Historic information presented by Worley Parsons (included in the JDSi desktop study report) indicates that groundwater was encountered approximately 5m below ground surface level. More recent groundwater monitoring by Emerge indicates that groundwater depth could vary from approximately 0.1m to 2.5m below ground surface level.

As noted previously, groundwater depths must be expected to vary due to subsurface conditions, climatic conditions and earthworks.

Uncontrolled Fill material

The Uncontrolled Fill material intersected consisted of a mixture of construction rubble (such as bricks, concrete, steel, gravels etc.), sands and clay.

Natural profile

The natural profile consists of a low plasticity Sandy Clay (or Clayey Sand), of varying thickness, overlying a medium plasticity Clay.

During wetter months, groundwater is expected to perch at the boundary between the Fill and natural profile, particularly with the nature of the Fill. This could possibly explain the difference in groundwater levels recorded by Emerge and WorleyParsons.

5 Geotechnical assessment

5.1 General

Based on our review of the client supplied information, the geotechnical investigations completed and our understanding of the proposed development, the proposed development has been delineated into three areas, based on the subsurface conditions.

These are:

- ***Natural Areas:*** Natural Areas are parts of the site where no fill material has been intersected, or the fill will be removed during the bulk earthworks phase;
- ***Shallow Fill Areas:*** Shallow Fill Areas contain uncontrolled fill material where the thickness is less than 1m;
- ***Filled Areas:*** Filled Areas contain uncontrolled fill material where the thickness is more than 1m but less than 2m; and,
- ***Deep Fill Areas:*** Deep Fill Areas contain uncontrolled fill material where the thickness is greater than 2m.

The delineation of these areas is presented on ***Figure 2***.

5.2 Proposed development

The layout of the proposed development has been provided for this report, however consideration will need to be given to the following key elements:

- Proposed Site Classification in accordance with AS 2870 – 2011 "*Residential Slabs and Footings*" for the proposed development and cost / benefit analysis of varying the lots;
- Proposed levels of the development, including thickness of fill materials;
- Acceptance of caveats on the lots (such as limitations on the depth of excavations, for example);
- Performance expectation of the roads and any limitation on the use of construction materials beneath roads from ultimate asset owners (crushed brick or concrete, for example);
- Proposed sewer alignment, including depth of sewer;

- Proposed stormwater management system and development requirements; and
- Timing and interaction with surrounds, including proposed sewer alignment noted in the DP February 2017 report.

5.3 Preliminary earthworks strategy

Bearing in mind that the refinement of the development, as noted in Section 5.2, the following earthworks strategy has been provided for the different fill areas.

It should be noted that all fill work noted below should be undertaken using clean inert fill and placed and compacted in accordance with the requirements of AS 3798 – 2007 "*Guidelines on Earthworks for Commercial and Residential Developments*".

Natural Areas

Based on the WorleyParsons report, the natural materials at the site would be expected to result in a ***Class M*** site in accordance with AS 2870 – 2011 "*Residential Slabs and Footings*".

According to WorleyParsons, the site classification could be amended to a ***Class S*** with the addition of at least 1.2m of compacted clean sand fill over the natural soil profile. To achieve a ***Class A*** site, at least 1.8m of clean sand fill would be required over the natural soil profile.

Shallow Fill Areas

In areas containing <1m of uncontrolled fill preference would be given to excavation of the uncontrolled fill material and placement in the northern areas of the site (away from the proposed development). This would allow lots to be developed as a "natural" lot, with structural fill placed to the design surface level.

Where this is not possible (due to environmental or economic reasons); or where the thickness of structural fill will be >1.8m, consideration could be given to impact rolling the area to compact the uncontrolled fill. An engineering specified geofabric layer would then need to be placed over the compacted uncontrolled fill and material imported to fill the site to the design surface level.

An economic assessment should be undertaken by the Civil Engineer appointed to design the works and should consider the effect of "non-geotechnical" issues of leaving existing fill materials in place. Specialist environmental advice should also be sought from an Environmental Consultant in regards to any issues associated with excavation and placement of uncontrolled fill materials in other parts of the site (away from the development).

Consideration would need to be given to the potential intersection of services with the geofabric layer and fill areas (containing building rubble).

Filled Areas

Based on our experience, in areas where the uncontrolled fill thickness is >2m, it is uneconomical to excavate and replace this material. This assumption should be reviewed / considered from both an economic and environmental point of view.

Assuming that the uncontrolled fill will be left in place, the uncontrolled fill materials could be proof rolled and treated using an impact roller over the entire area to compact and improve the load bearing properties of the uncontrolled fill. As per the Shallow Fill Area, an engineering specified geofabric layer should be placed over the impact rolled areas prior to filling the site to the design levels with approved structural fill.

The amount of settlement induced by the proof rolling process will be highly variable as it depends on the nature of the material and the manner in which it was placed. Typically, the amount of settlement could be up to 5% of the fill thickness. This would need to be confirmed by site trials.

Depending on the thickness of approved structural fill to be placed (i.e. the distance between existing surface level and the design surface levels), the following points should be considered:

- A surface corridor should be excavated and backfilled with approved structural fill during the bulk earthworks phase. This will allow civil services to be constructed in "clean" fill (rather than the uncontrolled fill on site);
- Where the thickness of approved structural fill will be less than 2m, consideration should be given to over-excavating the uncontrolled fill and and replacing it with approved structural fill. This option would need to be assessed by the Civil Engineer who should consider the economic viability of undertaking the over-excavation works.
- A compacted limestone layer and/or an engineering specified geogrid layer could be included where the thickness of approved structural fill will be less than 2m to provide a stiffer "soil raft" for the development.
- Where the thickness of approved structural fill will be greater than 2m, "*alternative fill materials*" may be used provided they are placed >2m from design finish level. The "*alternative fill materials*" could be screened / processed uncontrolled fill; clay fill or other potential sources. It is recommended that the specification and compaction requirements of the "*alternative fill materials*" be reviewed on a lot-specific and material specific basis.
- The Civil Engineer and Environmental Consultant would need to provide advice on potential caveats on titles (depending on the depth of approved structural fill and inclusion of "*alternative fill materials*");
- Location of soakwells and interaction with geofabric layer; uncontrolled fill or deep fills.

Deep Fill Areas

The Deep Fill Areas are limited to a discrete areas that would affect the proposed northern road alignment, and three or four housing lots.

Based on recent discussions about the earthworks strategy for the proposed development, the following is recommended:

- Excavation of the deep fill areas to nominally 2m above the base of the fill;
- Impact rolling over the excavated areas, and any loose areas excavated and replaced with clean fill;
- A surface corridor should be excavated and backfilled with approved structural fill during the bulk earthworks phase. This will allow civil services to be constructed in "clean" fill (rather than the uncontrolled fill on site);
- Bulk earthworks to be undertaken to backfill the site to the design surface level. The upper 2m (at least) should be approved structural fill. As for the Filled Areas, "*alternative fill materials*" may be incorporated into the profile provided they are placed to an appropriate earthworks specification and located at a depth of more than 2m below design surface level.

6 Concluding comments

The final selection of the geotechnical strategy for the proposed development will be dependent upon environmental consideration (such as the disposal of fill elsewhere on site) and the financial feasibility of the earthworks strategy.

We understand that detailed review of the earthworks strategy (and feasibility) will be undertaken by the Civil Engineer (McDowall Affleck Pty Ltd) as part of the project. Other points to note regarding the earthworks strategy include:

- Topsoil materials should be stripped and stockpiled in accordance with the requirements of the Superintendent. Topsoil material is typically not suitable for use as approved structural fill.
- The requirements for grading of clay layers and the need for any subsoil drainage should be designed by the Civil Engineer.
- The earthworks specification would need to be developed specifically for the material being used as approved structural fill. "*Alternative fill materials*" would need to be clearly defined regarding their engineering properties, placement in the (subsurface) profile and compaction requirements.
- The earthworks verification strategy would need to be developed in conjunction with the earthworks design and specifications, and be suitable for the material being tested.

Upon completion of the design, and prior to commencement of construction, it is recommended the earthworks strategy be reviewed and monitored during construction.

As part of that works, a ground improvement specification and verification methodology should also be developed at the initial phase of the construction works. The ground improvement specification should be monitored during the works by a competent and independent geotechnical engineer experienced in ground improvement works.



"Your Geotechnical Report"

1 Introduction

The information contained in this document is to inform JDSi's clients of the reasonable expectations of a geotechnical report and options to mitigate geotechnical risks and consequences. This information is provided to help clients understand where JDSi's responsibility as a geotechnical engineer, acting reasonably, begin and end. In doing so, it also highlights the responsibility of our client and third parties.

Please contact the JDSi Project Director should you not understand the report and the limitations of the information provided.

2 Collection and Interpretation of Data

Geotechnical investigations identify subsurface conditions only at the point of investigation. The material encountered during the investigation is recorded on logs and based on a visual assessment and (if undertaken) supported by laboratory test results. In the case of an Electric Friction Cone Penetrometer Test (CPT), the data recorded is a tip pressure and sleeve friction on a rod; from which ground conditions are inferred.

Actual conditions may differ from those encountered during the investigations and / or inferred a distance from the investigation stations. In addition, the actual interface between materials or units may be gradual or more abrupt than inferred from the results of the investigation.

A Chartered Geotechnical Engineer and / or Engineering Geologist should be retained through the various stages of the project to identify variances, conduct additional tests if required, and provide recommendations to address geotechnical / geological issues identified on site. The Chartered Geotechnical Engineer / Engineering Geologist should also review the actual conditions encountered to confirm that they are consistent with those inferred in this report.

3 Change in Subsurface Conditions

The geotechnical recommendations and parameters provided in this report are based on the ground conditions encountered at the time of the geotechnical investigation. Changes in the ground conditions can occur over time and include, but are not limited to, the following:

- Filling or excavation works (or other anthropologic events);
- Flooding;
- Groundwater fluctuations;
- Earthquakes or other such events;
- Works on neighbouring sites impacting on the subject site; and,
- Migration of pollutants from neighbouring properties.

JDSi should be consulted if there is any protracted delay in the issue of this report and the use of the recommendations provided.

It is important to note that where ground conditions have changed, additional geotechnical investigations and testing may be required to assess the impacts of the changed ground conditions.

4 Specificity of Report

This geotechnical report has been prepared for a specific project and design; therefore, it has been written to address specific geotechnical issues. In doing so, the following has been taken into account:

- The project objectives as described in the report;
- The client's budget and programme constraints;
- The specific site mentioned in the report; and,
- The nature and extent of the development at the site.

This report should not be used for any other purpose other than what has been specifically described and should not be relied upon if:

- The report was not written for you;
- The report was not written for your specific site;
- The report does not address your specific development;
- There is a significant delay between undertaking the report and developing the site; or,
- Significant changes to the site have occurred.

Where the information and recommendations contained within this report are being used by others, JDSi should be engaged during the design process to engage with the other members of the design team and review works being produced by the other design team members to confirm that it is consistent with the geotechnical report.

5 Environmental Issues

Unless specifically addressed in this report, environmental and contamination considerations are not included. The investigation methods required for environmental investigation often differ to those used for geotechnical investigations and the information contained within this report may not be appropriate for use by environmental engineering consultants and scientists.

This report was not prepared to address environmental issues and the client is responsible to ensure environmental considerations have been taken into account for the project. JDSi can provide information on environmental engineering consultants, should this be required.

6 Construction

The method of ground investigation used for geotechnical investigations limits JDSi's ability to know every detail about the ground conditions on site. JDSi use reasonable engineering judgement to form an assessment of the subsurface conditions at the site based on information obtained at specific locations.

Ground conditions may be encountered during construction that were not anticipated during the geotechnical investigation. Should this be the case, JDSi should be engaged to provide construction support as a means of mitigating the consequence of encountering unexpected ground conditions.

7 Responsibility of Others

JDSi has prepared this report for the use by our client. JDSi does not accept any responsibility from any third party, other than our client, who uses the information contained in this report. JDSi takes no responsibility for any damages suffered by any third party as a consequence of any decisions or action that have been made based on this report.

Further information regarding the responsibility of clients and other third parties should also be obtained from the following:

- "Guidelines for the Provision of Geotechnical Information in Construction", published by the Institution of Engineers Australia;
- Australian Standard AS 2870 – 2011, Residential Slabs and Footings;
- Australian Standard, AS 5100 – 2004, Bridge Design Set; and,
- Any other Standard or Code of Practice applicable to the development.

Figures

Figure 1 – Site Investigation Layout

Figure 2 – Fill Areas



SITE LOCATION



LOCALITY PLAN

NOTES

SUBDIVISION LAYOUT SOURCED FROM MCDOWALL AFFLECK PTY LTD PRELIMINARY DRAWING REFERENCE NOS 12149-SK02 REV D AND 12149-SK04 REV A

LEGEND

- SITE BOUNDARY
- PROPOSED SUBDIVISION LAYOUT
- PIT REFERENCE — TEST PIT LOCATION
- PIT REFERENCE — BOREHOLE LOCATION (BY DOUGLAS PARTNERS)
- PIT REFERENCE — GROUND WATER WELL LOCATIONS (BY EMERGE ASSOCIATES)
- PIT REFERENCE — TEST PIT LOCATIONS (BY DOUGLASS PARTNERS)

JDSi GROUND ENGINEERING

JDS161188
LOTS 2 3 AND 6 HELENA VALLEY ROAD, HELENA VALLEY
FIGURE 1 - SITE INVESTIGATION LAYOUT
JDS161188-R02-Figure1-Rev1





LOCALITY PLAN

NOTES

SUBDIVISION LAYOUT SOURCED FROM MEDDWALL APFLECK PTY LTD PRELIMINARY DRAWING REFERENCE NOS 12749-SK02 REV D AND 12349-SK04 REV A

LEGEND

SITE BOUNDARY

PROPOSED SUBDIVISION LAYOUT

PIT REFERENCE — TEST PIT LOCATION

PIT REFERENCE — BOREHOLE LOCATION (BY DOUGLAS PARTNERS)

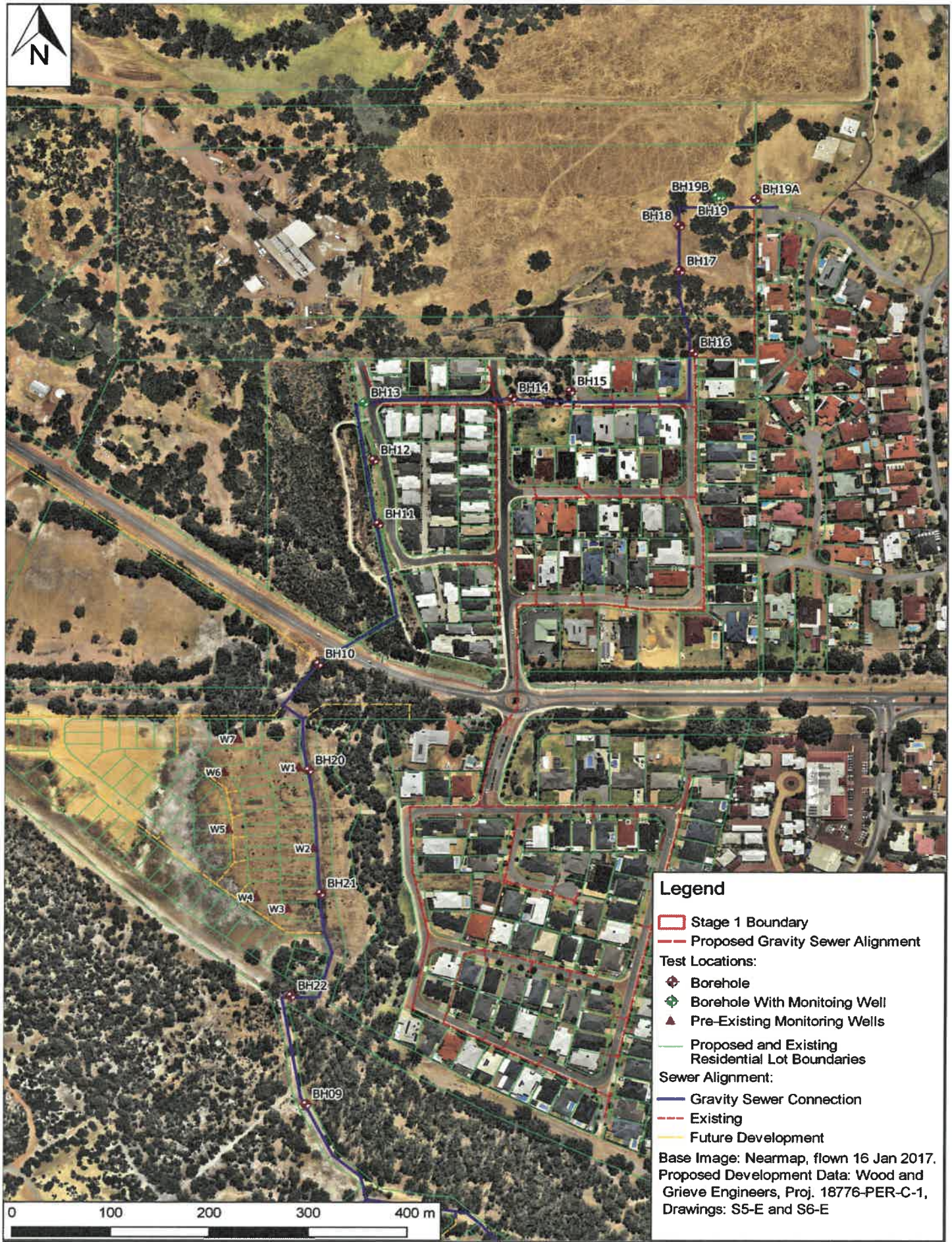
FILLED AREAS

SHALLOW FILL

FILLED AREAS

DEEP FILL

Appendix A – Douglas Partners Borehole logs



Douglas Partners Geotechnics ! Environment ! Groundwater	CLIENT: Dunland Property Pty Ltd		Test Locations, Site Features and Proposed Development	PROJECT: 88790.01
	OFFICE: PERTH	DRAWN BY: MAB	Geotechnical Investigation	DWG No. 1
	SCALE: As Shown	DATE: 16/02/2017	Stage 1 Bushmeade Estate, Midland Road, Hazelmere, WA	REV No. Rev0

BOREHOLE LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Geotechnical Investigation
LOCATION: Bushmead Estate, Midland Road, Hazelmere, WA

SURFACE LEVEL: 16.5 AHD
EASTING: 408065
NORTHING: 6468907
DIP/AZIMUTH: 90°/--

BORE No: BH16
PROJECT No: 88790.01
DATE: 23/1/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.75	FILLING (SAND) - dense, brown, fine to medium grained, sand with some gravel, dry. Gravel is fine to coarse sized laterite.		ASS	0.5	155			
15	1	CLAYEY SAND - dense / hard, yellow-orange-brown, fine to medium grained, clayey sand, with a trace of fine to coarse sized gravel and a trace of silt, dry to moist.		ASS	1.0	156			
		- gravel becoming finer sized from 1.25 m.		ASS	1.5	157			
				D					
14	2			ASS	2.0	158			
				ASS	2.5	159			
13	3	- becoming moist from 2.75 m.		ASS	3.0	160			
		- becoming brown from 3.25 m.		ASS	3.5	161			
12	4	- becoming grey-brown from 3.75 m.		ASS	4.0	162			
				ASS	4.5	163			
11	5	- becoming grey from 4.75 m.		D	4.75				
				ASS	5.0	164			
		- becoming grey-brown from 5.25 m.		ASS	5.5	165			
10	6	- becoming brown mottled grey-green from 5.75 m.		ASS	6.0	166			
		- becoming grey mottled orange-brown from 6.25 m.		ASS	6.5	167			
				D					
9	7	7.0 Bore discontinued at 7.0m (target depth).		ASS	7.0	168			
8	8								
8	9								

RIG: GeoProbe 7822DT **DRILLER:** Direct Push Probing **LOGGED:** M. Brooker **CASING:**

TYPE OF BORING: Solid Flight Auger

WATER OBSERVATIONS: Drilling method precluded accurate measurement of groundwater.

REMARKS: Location coordinates are in MGA94 Zone 50. ^ Surface level interpolated from a survey plan provided by the client. Borehole advanced using solid auger drilling techniques.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⊻	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Geotechnical Investigation
LOCATION: Bushmead Estate, Midland Road, Hazelmere, WA

SURFACE LEVEL: 16.0 AHD
EASTING: 408053
NORTHING: 6468984
DIP/AZIMUTH: 90°/--

BORE No: BH17
PROJECT No: 88790.01
DATE: 20/1/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16	0.15	TOPSOIL (SAND) - grey-brown, fine to medium grained sand with some silt and some rootlets, dry.							
		FILLING (GRAVELLY SAND) - dense, brown, fine to medium grained, gravelly sand filling, dry. Gravel is fine to coarse sized laterite and bricks with some brick cobbles.		D	0.4				
				D	0.5	169			
	0.7			ASS	0.6				
15	1	CLAYEY SAND - very dense, yellow-brown mottled orange, fine to medium grained, clayey sand with some gravel, humid. Gravel is fine to coarse sized laterite.		ASS	1.0	170			1
	1.2				1.3				
		GRAVELLY CLAYEY SAND - very dense, orange-yellow clayey sand mottled with light grey gravelly clayey sand. Gravel is fine to coarse sized quartz, humid.		D					
				ASS	1.5	171	pp >600		
				D	1.6		9,3		
				S			refusal		
14	2	- push probe refusal at 1.9 m.			1.9				2
				ASS	1.95	172	pp = 150		
				D	2.0				
					2.2				
				ASS	2.5	173			
13	3			ASS	3.0	174			3
		- becoming grey mottled red-brown and orange with a trace of gravel from 3.1 m.		D					
				S	3.3				
				D	3.4	175			
		- becoming red-brown with some fine to coarse sized laterite gravel from 3.6 m.		ASS	3.45				
				D	3.5				
12	4	- becoming grey sandy clay with a trace of gravel from 3.8 m.			3.75				4
				ASS	4.0	176			
				ASS	4.5	177	pp = 75		
	4.6	SAND - medium dense, grey, fine to medium grained, sand with a trace of silt and clay, wet.		D			7,8,5		
				S			N = 13		
11	5			ASS	4.95	178			5
				D	5.0				
					5.25				
				ASS	5.5	179			
10	6			ASS	6.0	180			6
		- becoming red-brown from 6.0 m.		D			5,12,14		
				S			N = 26		
		- becoming orange brown mottled red and grey, with a trace of gravel from 6.25 m. Gravel is fine to coarse sized brown cemented sand.		ASS	6.45	181			
				D	6.5				
					6.75				
9	7			ASS	7.0	182			7
				ASS	7.5	183			
	7.6	SLIGHTLY CLAYEY SAND - medium dense, grey fine to medium grained, slightly clayey sand, wet.		D			2,6,11		
				S			N = 17		
8	8			ASS	7.95	184			8
					8.0				
				ASS	8.5	185			
				D					
7	9								9
	9.0	Bore discontinued at 9.0m (target depth).		ASS	9.0	186	pp = 175		

RIG: GeoProbe 7822DT **DRILLER:** Direct Push Probing **LOGGED:** M. Brooker **CASING:**

TYPE OF BORING: Solid Flight Auger & SPT

WATER OBSERVATIONS: Drilling method precluded accurate measurement of groundwater.

REMARKS: Location coordinates are in MGA94 Zone 50. ^ Surface level interpolated from a survey plan provided by the client. Borehole advanced using solid auger drilling techniques.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Geotechnical Investigation
LOCATION: Bushmead Estate, Midland Road, Hazelmere, WA

SURFACE LEVEL: 15.0 AHD
EASTING: 408052
NORTHING: 6469027
DIP/AZIMUTH: 90°/–

BORE No: BH18
PROJECT No: 88790.01
DATE: 20/1/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0	GRAVELLY SAND - very dense, red-orange-brown, fine to medium grained, gravelly sand with a trace of clay, a trace of silt, dry. Gravel is fine to coarse sized quartz.			0.4				
				D	0.5	187			
				ASS	0.6				
14	1	- becoming brown from 0.75 m.		ASS	1.0	188			1
		- becoming dark brown with a trace of gravel from 1.25 m.		ASS	1.5	189			
	1.75	CLAYEY SAND - yellow-orange-brown, fine to medium grained clayey sand, with some fine gravel, humid.			1.75				
13	2			D					
				ASS	2.0	190			2
		- becoming orange-brown with some fine to coarse sized laterite gravel from 2.25 m.		ASS	2.5	191			
		- becoming light brown clayey sand with a trace of gravel from 2.75 m.		D					
12	3			ASS	3.0	192			3
				D					
				ASS	3.5	193			
		- becoming orange-brown from 3.75 m.							
11	4			ASS	4.0	194			4
		- becoming moist from 4.25 m.							
				ASS	4.5	195			
				D					
		- becoming grey and saturated from 4.8 m.			4.75				
10	5			ASS	5.0	196			5
				ASS	5.5	197			
9	6			ASS	6.0	198			6
		- becoming grey mottled orange-brown from 6.0 m.							
				ASS	6.5	199			
				D					
		- becoming orange-brown mottled grey 6.75 m.							
8	7			ASS	7.0	200			7
	7.0	Bore discontinued at 7.0m (target depth).							
7	8								8
6	9								9

RIG: GeoProbe 7822DT **DRILLER:** Direct Push Probing **LOGGED:** M. Brooker **CASING:**

TYPE OF BORING: Solid Flight Auger

WATER OBSERVATIONS: Drilling method precluded accurate measurement of groundwater.

REMARKS: Location coordinates are in MGA94 Zone 50. ^ Surface level interpolated from a survey plan provided by the client. Borehole advanced using solid auger drilling techniques.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Geotechnical Investigation
LOCATION: Bushmead Estate, Midland Road, Hazelmere, WA

SURFACE LEVEL: 15.0 AHD
EASTING: 408087
NORTHING: 6469055
DIP/AZIMUTH: 90°/--

BORE No: BH19
PROJECT No: 88790.01
DATE: 20/1/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
14	1	FILLING (GRAVELLY SAND) - loose, red-brown, fine to medium grained, gravelly sand filling. Gravel is fine to coarse sized ceramic, brick, laterite, metal. Whole bricks and other demolition materials were also observed at ground surface near the borehole location.		D	0.9 1.1				
13	2			S	1.5 1.95		6,7,2 N = 9		
	2.7	Bore discontinued at 2.7m(refusal - concrete).							
12	3								
11	4								
10	5								
9	6								
8	7								
7	8								
6	9								

RIG: GeoProbe 7822DT **DRILLER:** Direct Push Probing **LOGGED:** M. Brooker **CASING:**

TYPE OF BORING: Solid Flight Auger & SPT

WATER OBSERVATIONS: Drilling method precluded accurate measurement of groundwater.

REMARKS: Location coordinates are in MGA94 Zone 50. ^ Surface level interpolated from a survey plan provided by the client. Borehole advanced using solid auger drilling techniques.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Geotechnical Investigation
LOCATION: Bushmead Estate, Midland Road, Hazelmere, WA

SURFACE LEVEL: 15.0 AHD
EASTING: 408117
NORTHING: 6469053
DIP/AZIMUTH: 90°/--

BORE No: BH19A
PROJECT No: 88790.01
DATE: 20/1/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
15	0	FILLING (GRAVELLY SAND) - medium dense, light brown, fine to medium grained, sand with some silt and some gravel, dry. Gravel is fine to coarse sized laterite and brick fragments.		ASS	0.5				
				D					
14	1	- traces of clay from 1.1 m.		ASS	1.0				1
		- some clay from 1.4 m.		ASS	1.5				
		- some fragments of concrete, brick, charred wood from 1.5 m.		D S			4,9,10 N = 19		
13	2	- brick and concrete fragments from 2.0 m		ASS	1.95 2.0				2
				D					
		- becoming brown slightly clayey sand from 2.5 m.		ASS	2.5				
				D					
12	3	- becoming very loose from 3.15 m.		D (S)	3.0 3.45		6,2,1 N = 3		3
	3.7	Bore discontinued at 3.7m(refusal - concrete).							
11	4								4
10	5								5
9	6								6
8	7								7
7	8								8
6	9								9

RIG: GeoProbe 7822DT **DRILLER:** Direct Push Probing **LOGGED:** M. Brooker **CASING:**

TYPE OF BORING: Push Probe (95mm Ø), Solid Flight Auger & SPT

WATER OBSERVATIONS: Drilling method precluded accurate measurement of groundwater.

REMARKS: Location coordinates are in MGA94 Zone 50. ^ Surface level interpolated from a survey plan provided by the client. Borehole advanced using push probing and solid auger on refusal.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Geotechnical Investigation
LOCATION: Bushmead Estate, Midland Road, Hazelmere, WA

SURFACE LEVEL: 15.0 AHD
EASTING: 408084
NORTHING: 6469055
DIP/AZIMUTH: 90°/--

BORE No: BH19B
PROJECT No: 88790.01
DATE: 20/1/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
15	0.1	TOPSOIL (SAND) - dense, brown-grey, fine to medium grained, sand with some silt, some rootlets, humid.							
		FILLING (GRAVELLY SAND) - dense, red-brown, fine to medium grained, gravelly sand filling, humid. Gravel is fine to coarse sized metal, laterite, brick, ceramic. Three lengths of re-bar became entangled on the auger.		ASS	0.5	201			
14	1	- becoming medium dense from 0.75 m.		ASS	1.0	202			1
				ASS	1.5	203			
				S			6,7,2 N = 9		
13	2			ASS	1.95 2.0	204			2
				ASS	2.5	205			
12	3			ASS	3.0	206			3
				S					
		- becoming gravelly clayey sand from 3.5 m.		ASS	3.45 3.5	207		01-02-17	
11	4			ASS	4.0	208			4
	4.3	CLAYEY SAND - medium dense / very stiff, grey mottled red-brown, fine to medium grained clayey sand, moist.		ASS	4.5	209			
				S			4,6,12 N = 18		
10	5	- becoming red-brown mottled grey from 4.75 m.		ASS	4.95 5.0	210	pp = 375		5
		- trace of weakly cemented sandy gravel and becoming moist to wet from 5.2 m.		ASS	5.5	211	pp = 350		
9	6			ASS	6.0	212			6
				ASS	6.5	213			
8	7			ASS	7.0	214			7
				S			10,12,15 N = 27		
				ASS	7.45 7.5	215			
7	8			ASS	8.0	216			8
				ASS	8.5	217			
6	9	9.0 Bore discontinued at 9.0m (target depth).		ASS	9.0	218			9

RIG: GeoProbe 7822DT **DRILLER:** Direct Push Probing **LOGGED:** M. Brooker **CASING:**

TYPE OF BORING: Solid Flight Auger & SPT

WATER OBSERVATIONS: Groundwater observed at 3.5 m below the surface on 1 February 2017.

REMARKS: Location coordinates are in MGA94 Zone 50. ^ Surface level interpolated from a survey plan provided by the client. Borehole advanced using solid auger drilling techniques.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix B – Douglas Partners Test Pit Logs



Base Image Source: Nearmap, flown February 2017.

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Dunland Property Pty Ltd		**Test Location Plan**	Project	86790.03
	OFFICE: Perth	DRAWN BY: RW	Targeted Contamination Assessment	Drawing No:	3
	SCALE: As shown	DATE: April 2017	Lot 3 Helena Valley Road, Hazelmere, WA	Revision:	0

TEST PIT LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Targeted Contamination Assessment
LOCATION: Lot 3 Helena Valley Drive, Hazelmere, WA

SURFACE LEVEL: 15 AHD
EASTING: 408047
NORTHING: 6469042

PIT No: TP101
PROJECT No: 88790.03
DATE: 21/3/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
15		FILLING (CLAYEY SAND) - orange-brown, fine to medium grained clayey sand filling with a trace of bitumen pieces and fine to medium sized laterite gravel, dry.		B D E	0.0		No PACM observed.		
					0.3				
	0.5	FILLING (SAND) - grey, fine to medium grained sand filling with some bricks and brick pieces, dry.		B D E	0.5		PACM observed.		
	0.7	CLAYEY SAND - orange-brown, fine to medium grained clayey sand, dry.			0.7				
14	1								1
13	2								2
	2.3	Pit discontinued at 2.3m (slow digging).							
12	3								3

RIG: 33 tonne excavator with 1200 mm flat blade bucket.

LOGGED: R Walker

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Surface level interpolated from Google Earth.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Targeted Contamination Assessment
LOCATION: Lot 3 Helena Valley Drive, Hazelmere, WA

SURFACE LEVEL: 15 AHD
EASTING: 408053
NORTHING: 6469023

PIT No: TP102
PROJECT No: 88790.03
DATE: 21/3/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
15		FILLING (CLAYEY SAND) - grey-orange, fine to medium grained clayey sand filling with a trace of brick pieces, dry.		B	0.0		No PACM observed.		
		- with some rootlets to 0.1 m.		D					
		- becoming orange-brown from 0.15 m.		E	0.3				
	0.4	FILLING (SAND) - grey-brown, fine to medium grained sand filling with some bricks and pieces of brick, concrete and metal, dry.			0.4		PACM observed.		
				B					
				D					
				E	0.7				
		- becoming dark grey-black from 0.8 m.		E	0.8				
	0.9				0.9				
14	1	CLAYEY SAND - light grey mottled orange, fine to medium grained clayey sand, dry.							1
13	2	2.0 Pit discontinued at 2.0m (slow digging).							2
12	3								3

RIG: 33 tonne excavator with 1200 mm flat blade bucket.

LOGGED: R Walker

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Surface level interpolated from Google Earth.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Targeted Contamination Assessment
LOCATION: Lot 3 Helena Valley Drive, Hazelmere, WA

SURFACE LEVEL: 16 AHD
EASTING: 408053
NORTHING: 6469004

PIT No: TP103
PROJECT No: 88790.03
DATE: 21/3/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
16		FILLING (CLAYEY SAND) - orange-brown, fine to medium grained clayey sand filling, dry. - with some rootlets to 0.1 m.		B D E	0.0		No PACM observed.		
					0.3				
	0.5	FILLING (SAND) - orange, fine to medium grained sand filling with bricks, dry.		B D E	0.5		No PACM observed.		
					0.8				
15	1.0	CLAYEY SAND - red mottled orange, fine to medium grained clayey sand, dry.		B E	1.0		No PACM observed.		1
					1.2				
14	2								2
	2.4	Pit discontinued at 2.4m (slow digging).							
13	3								3

RIG: 33 tonne excavator with 1200 mm flat blade bucket.

LOGGED: R Walker

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Surface level interpolated from Google Earth.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Targeted Contamination Assessment
LOCATION: Lot 3 Helena Valley Drive, Hazelmere, WA

SURFACE LEVEL: 15 AHD
EASTING: 408066
NORTHING: 6469046

PIT No: TP104
PROJECT No: 88790.03
DATE: 21/3/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
15		FILLING (SAND) - brown, fine to medium grained sand filling with some bricks and pieces of concrete and metal, dry.		B D E	0.0		PACM observed.		
					0.3				
				E	0.4				
	0.6	CLAYEY SAND - brown-yellow, fine to medium grained clayey sand, dry.			0.6				
					0.7		No PACM observed.		
14	1			B E	1.0				1
13	2								2
	2.2	SANDY CLAY - grey mottled yellow, low plastic sandy clay, dry.							
12	3								3
	3.3	Pit discontinued at 3.3m (slow digging).							

RIG: 33 tonne excavator with 1200 mm flat blade bucket.

LOGGED: R Walker

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Surface level interpolated from Google Earth.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Targeted Contamination Assessment
LOCATION: Lot 3 Helena Valley Drive, Hazelmere, WA

SURFACE LEVEL: 15 AHD
EASTING: 408085
NORTHING: 6469046

PIT No: TP105
PROJECT No: 88790.03
DATE: 21/3/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
15	0	FILLING (CLAYEY SAND) - orange-brown, fine to medium grained clayey sand filling, dry. - with some rootlets to 0.1 m.		B D E	0.0		No PACM observed.		
					0.4				
	0.6	FILLING (SAND) - grey, fine to medium grained sand filling with some bricks and concrete pieces, dry.			0.7		PACM observed.		
14	1			B D E					1
					1.1				
				E	1.3				
					1.5				
	1.6	CLAYEY SAND - yellow-orange, fine to medium grained clayey sand, dry.			1.6		No PACM observed.		
13	2			B E					2
					1.9				
	2.5	Pit discontinued at 2.5m (slow digging).							
12	3								3

RIG: 33 tonne excavator with 1200 mm flat blade bucket.

LOGGED: R Walker

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Surface level interpolated from Google Earth.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Dunland Property Pty Ltd
PROJECT: Targeted Contamination Assessment
LOCATION: Lot 3 Helena Valley Drive, Hazelmere, WA

SURFACE LEVEL: 15 AHD
EASTING: 408107
NORTHING: 6469046

PIT No: TP106
PROJECT No: 88790.03
DATE: 21/3/2017
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm)
15		FILLING (CLAYEY SAND) - brown-yellow, fine to medium grained clayey sand filling, dry.		B D E	0.0		No PACM observed.		
	0.3	FILLING (SAND) - grey-brown, fine to medium grained sand filling with some bricks and pieces of brick, concrete and bitumen, dry.		B D E	0.3		No PACM observed.		
	0.5	CLAYEY SAND - yellow-orange, fine to medium grained clayey sand, dry.		D E E	0.4 0.5				
14	1	- becoming yellow mottled red from 1.7 m.		E	0.6				1
13	2 2.0	Pit discontinued at 2.0m (slow digging).							2
12	3								3

RIG: 33 tonne excavator with 1200 mm flat blade bucket.

LOGGED: R Walker

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed.

REMARKS: Surface level interpolated from Google Earth.

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix C – JDSi Test Pit Logs

EXPLANATORY NOTES - SOIL DESCRIPTION

JDSi GROUND ENGINEERING


FILL


SAND (SP OR SW)


CLAY (CL, CI OR CH)


COBBLES OR BOULDERS


GRAVEL (GP OR GW)


SILT (ML OR MH)


ORGANIC SOILS (OL, OH OR PT)

Cominations of these basic symboles can be used to indicate mixed materials (eg. Clayey Gravel)

GP	Poorly Graded Gravel	SM	Silty Sand	CH	High Plasticity Clay
GW	Well Graded Gravel	SC	Clayey Sand	OL	Organic Soils (LP)
GM	Silty Gravel	ML	Low Plasticity Silt	OH	Organic Soils (HP)
GC	Clayey Gravel	MH	High Plasticity Silt	PT	Peat
SP	Poorly Graded Sand	CL	Low Plasticity Clay	Describe	Cobbles and Boulders
SW	Well Graded Sand	CI	Medium Plasticity Clay	Fill	Fill

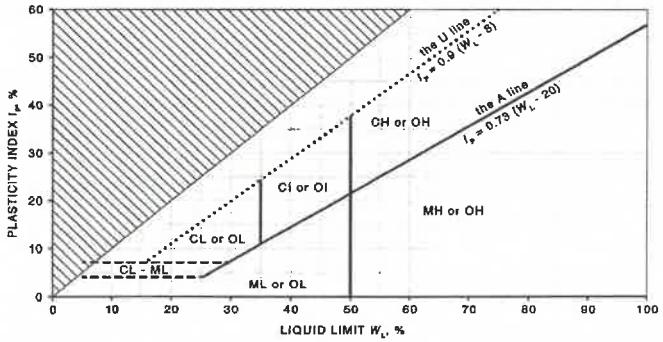
SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726:2017, Section 6.2. Material properties are assessed in the filed by visual/tactile methods in combination with field testing techniques (where used).

PARTICLE SIZE

Soil Name		Particle Size (mm)
BOULDERS		>200
COBBLES		63 to 200
GRAVEL	Coarse	20 to 63
	Medium	6 to 20
	Fine	2 to 6
SAND	Coarse	0.6 to 2.0
	Medium	0.2 to 0.6
	Fine	0.075 to 0.2
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

PLASTICITY PROPERTIES



MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties if primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

RESISTENCE TO EXCAVATION

Symbol	Term	Description
VE	Very easy	All resistences are relative to the selected method of excavation.
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

MOISTURE CONDITION AS1726-1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery
M	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY AS1726-1993

Symbol	Term	Undrained Shear Strength (kPa)	SPT "N"	DCP blows per 100mm
VS	Very soft	0 to 12	0 to 2	<1
S	Soft	12 ti 25	2 to 4	<1
F	Firm	25 to 50	4 to 8	1 to 2
St	Stiff	50 to 100	8 to 15	3 to 4
VSt	Very Stiff	100 to 200	15 to 30	5 to 10
H	Hard	>200	>30	>10

Symbol	Term	Density Index (%)	SPT "N"	DCP blows per 100mm	PSP blows per 300mm
VL	Very Loose	<15	0 to 4	<1	0 to 2
L	Loose	15 to 35	4 to 10	1 to 2	2 to 6
MD	Medium Dense	35 to 65	10 to 30	2 to 3	6 to 8
D	Dense	65 to 85	30 to 50	4 to 8	8 to 15
VD	Very Dense	>85	>50	>8	>15

Note: PSP correlations only valid 450mm depth

Consistency and density may also be inferred from excavation performance and material behaviour.

TEST PIT NUMBER: TP1

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**
ELEVATION:
EASTING (m): **407773**
NORTHING (m): **6468939**

EQUIPMENT: **JCB 3CX**
EXCAVATION LENGTH: **3 m**
EXCAVATION WIDTH: **1 m**
EXCAVATION ORIENTATION:

DATE STARTED: **28/03/2017**
DATE COMPLETED: **28/03/2017**
LOGGED BY: **JC**
CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered		0.5				FILL: Mixture of brick, sand and silt / clay. Fine to coarse grained sand, low to medium plasticity clay, brown, red brown and black mottled.	M		Predominantly brick. Roots observed in base of layer.
				1.0				1.00m CLAYEY SAND: Fine to coarse grained, yellow, low plasticity clay.	M	D	
				1.5			SC				
								1.70m			
							CI	SANDY CLAY: Low to medium plasticity, yellow grey, fine to coarse grained sand. 1.80m	M	F	
				2.0				Hole Terminated at 1.80 m Target depth			
				2.5							
				3.0							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

JDSI LIBRARY REV 1.GLB Log JDSI TEST PIT JDS161188 - GINT LOGS.GPJ <<DrawingFile>> 29/04/2017 15:40 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: JDSI 1.00 2015-12-09 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP2

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**	EQUIPMENT: **JCB 3CX**	DATE STARTED: **28/03/2017**
ELEVATION:	EXCAVATION LENGTH: **3 m**	DATE COMPLETED: **28/03/2017**
EASTING (m): **408013**	EXCAVATION WIDTH: **1 m**	LOGGED BY: **JC**
NORTHING (m): **6468977**	EXCAVATION ORIENTATION:	CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered		0.0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	M		Trace of rootlets and roots up to 20mm diameter throughout.
								0.10m SAND: Fine to coarse grained, grey, becoming clayey in base.			
				0.5			SP-SC		M	D	
								0.70m CLAY: Low to medium plasticity, orange brown and grey mottled, fine to coarse grained sandy in part.			
			1.00m	1.0							
			B	1.5			CI		M	D	
			2.00m	2.0				2.10m Hole Terminated at 2.10 m Target depth			
				2.5							
				3.0							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H — No Resistance

WATER
- 10 Oct., 73 Water Level on Date shown
- water inflow
- water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY / RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP3

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**
ELEVATION:
EASTING (m): **407968**
NORTHING (m): **6468994**

EQUIPMENT: **JCB 3CX**
EXCAVATION LENGTH: **3 m**
EXCAVATION WIDTH: **1 m**
EXCAVATION ORIENTATION:

DATE STARTED: **28/03/2017**
DATE COMPLETED: **28/03/2017**
LOGGED BY: **JC**
CHECKED BY: **RM**

EXCAVATION | MATERIAL

PENETRATION (VE E F H)	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered		0.0				TOPSOIL / FILL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	M		
								0.10m FILL / SANDY CLAY: Low plasticity, brown, fine to coarse grained sand, with some concrete blocks and bricks (up to 20mm), trace of fine to coarse grained gravel.	M		Large block of concrete 80cm across excavated from this layer.
				0.5							
								0.80m FILL: Mixture of sand and brick, grey, fine to coarse grained sand, trace of plastics, wire, steel drum, wood, concrete pipe.	M		Brick - weak sand / cement angular blocks up to 40cm across.
				1.0							
				1.5							
				2.0				2.00m CLAY: Medium plasticity, brown.	M	St	Possible natural ground. Difficult to access due to collapse of test pit. Layer description based on material observed on teeth of backhoe bucket.
							CI	2.20m Hole Terminated at 2.20 m Collapse			
				2.5							
				3.0							

METHOD
N Natural Exposure
X Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP4

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**

PROJECT NAME: **Proposed Subdivision**

PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**	EQUIPMENT: **JCB 3CX**	DATE STARTED: **28/03/2017**
ELEVATION:	EXCAVATION LENGTH: **3 m**	DATE COMPLETED: **28/03/2017**
EASTING (m): **407851**	EXCAVATION WIDTH: **1 m**	LOGGED BY: **JC**
NORTHING (m): **6468937**	EXCAVATION ORIENTATION:	CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / E / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
				0.0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	D		Grass at surface.
								0.10m FILL: Mixture of bricks and sand. Fine to coarse grained, sub-angular sand, brown, trace of low plasticity fines, trace of rope, wire, glass.			Rootlets throughout.
	No Support	Not Encountered	0.50m	0.5							
			B	1.0					D		
			1.50m	1.5							
			1.80m					1.80m SANDY CLAY: Low to medium plasticity, yellow grey, fine to coarse grained sand.			Depth to natural soil varies across the side wall of test pit between 1.4m and 2.1m.
			B								
			2.00m	2.0			CI		M	F to St	
								2.20m Hole Terminated at 2.20 m Target depth			
				2.5							
				3.0							

METHOD

- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT

- T Timbering

PENETRATION

VE E H VH — No Resistance

WATER

- 10 Oct., 73 Water Level on Date shown
- water inflow
- water outflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION

Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP5

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**
ELEVATION:
EASTING (m): **407812**
NORTHING (m): **6468935**

EQUIPMENT: **JCB 3CX**
EXCAVATION LENGTH: **3 m**
EXCAVATION WIDTH: **1 m**
EXCAVATION ORIENTATION:

DATE STARTED: **28/03/2017**
DATE COMPLETED: **28/03/2017**
LOGGED BY: **JC**
CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
				0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	D		Roots and rootlets up to 100mm visible between 0 and 0.5m depth.
				0.10m							
							CL	SANDY CLAY: Low to medium plasticity, yellow, fine to coarse grained sand.	M	St to VSt	
				0.50m							
				0.5				CLAY: Medium plasticity, yellow grey mottled, with some fine to coarse grained sand, trace of iron staining.			
	No Support	Not Encountered	1.00m B	1.0			CI		M	St to VSt	
			1.50m	1.5							
				2.0							
				2.30m				Hole Terminated at 2.30 m Target depth			
				2.5							
				3.0							

METHOD
N Natural Exposure
X Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP6

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**

PROJECT NAME: **Proposed Subdivision**

PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**	EQUIPMENT: **JCB 3CX**	DATE STARTED: **28/03/2017**
ELEVATION:	EXCAVATION LENGTH: **3 m**	DATE COMPLETED: **28/03/2017**
EASTING (m): **407796**	EXCAVATION WIDTH: **1 m**	LOGGED BY: **JC**
NORTHING (m): **6468951**	EXCAVATION ORIENTATION:	CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / E / F / H PENETRATION	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered		0.0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	D		
				0.10m				FILL: Mixture of sand and bricks. Sand is fine to coarse grained, grey red.	D		
				0.40m				FILL: Mixture of clay and bricks. Clay is medium plasticity, brown and dark grey.	M		
				0.5							
				0.90m				CLAY: Medium plasticity, grey and brown mottled, with some fine to coarse grained sand.			
				1.0							
				1.5			CI		M	St	
				2.0							
				2.30m				Hole Terminated at 2.30 m Target depth			
				2.5							
				3.0							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION

VE E F H — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY / RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP7

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**
ELEVATION:
EASTING (m): **407770**
NORTHING (m): **6468973**

EQUIPMENT: **JCB 3CX**
EXCAVATION LENGTH: **2.5 m**
EXCAVATION WIDTH: **1 m**
EXCAVATION ORIENTATION:

DATE STARTED: **28/03/2017**
DATE COMPLETED: **28/03/2017**
LOGGED BY: **JC**
CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE PENETRATION E F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered		0.0				FILL / CLAYEY SAND: Fine to coarse grained, dark grey and red brown, low plasticity clays, trace of plastic, rope and bricks.	M		Fill varies from 0.4m to 0.9m thick across test pit.
								... ... Pockets of crushed brick visible.			
								0.40m			
				0.5			SP	SAND: Fine to medium grained, yellow grey.	M	D	
								0.70m			
								SANDY CLAY: Low to medium plasticity, yellow grey orange mottled, fine to coarse grained sand.			
				1.0			CL	... ... Fine to coarse grained, grey sand lense 50mm thick at 1.1m.	M	VSt	
				1.5				1.50m			
								Hole Terminated at 1.50 m Refusal			
				2.0							
				2.5							
				3.0							

METHOD
N Natural Exposure
X Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP8

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**	EQUIPMENT: **JCB 3CX**	DATE STARTED: **28/03/2017**
ELEVATION:	EXCAVATION LENGTH: **3 m**	DATE COMPLETED: **28/03/2017**
EASTING (m): **407745**	EXCAVATION WIDTH: **1 m**	LOGGED BY: **JC**
NORTHING (m): **6469023**	EXCAVATION ORIENTATION:	CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered		0.0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	D	D	Low strength, off white, cemented material at surface. Possibly disused drilling mud.
				0.10m				FILL: mixture of clayey sand and sandy clay.	M		
				0.30m				CLAYEY SAND: Fine to coarse grained, yellow and grey mottled, low plasticity.			
			0.50m	0.5							
			B	1.0			SC		M	D	
			1.50m	1.5							
			1.60m								
			B				CI	CLAY: Medium plasticity, grey and brown mottled.	M	F to St	
			2.00m	2.0				2.00m			
								Hole Terminated at 2.00 m Target depth			
				2.5							
				3.0							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H — No Resistance

WATER
- 10 Oct., 73 Water Level on Date shown
- water inflow
- water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP9

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**
ELEVATION:
EASTING (m): **407777**
NORTHING (m): **6469022**

EQUIPMENT: **JCB 3CX**
EXCAVATION LENGTH: **3 m**
EXCAVATION WIDTH: **1 m**
EXCAVATION ORIENTATION:

DATE STARTED: **28/03/2017**
DATE COMPLETED: **28/03/2017**
LOGGED BY: **JC**
CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / E / F / H PENETRATION	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered		0.0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	M		
								0.10m FILL: Interbedded layers of sand and clay. Fine to coarse grained, pale grey sand. Medium plasticity, orange brown clay. Trace of brick fragments and concrete throughout.	M		
				0.5				0.50m CLAYEY SAND: Fine to coarse grained, yellow and grey mottled, low plasticity clay, weakly cemented.	M	D	
				1.0			SC				
				1.5				1.30m CLAY: Medium plasticity, grey brown mottled.	M	F	
				2.0			CI				
				2.5				2.20m Hole Terminated at 2.20 m Target depth			
				3.0							

METHOD
N Natural Exposure
X Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

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TEST PIT NUMBER: TP10

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**

PROJECT NAME: **Proposed Subdivision**

PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**	EQUIPMENT: **JCB 3CX**	DATE STARTED: **28/03/2017**
ELEVATION:	EXCAVATION LENGTH: **3 m**	DATE COMPLETED: **28/03/2017**
EASTING (m): **407766**	EXCAVATION WIDTH: **1 m**	LOGGED BY: **JC**
NORTHING (m): **6469075**	EXCAVATION ORIENTATION:	CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / E PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY/ RELATIVE DENSITY	STRUCTURE & Other Observations
				0.0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	M		
				0.10m				FILL / CLAYEY SAND: Fine to coarse grained, orange brown and grey brown mottled, trace of bricks throughout.			Roots and rootlets present throughout. Roots up to 100mm diameter.
	No Support	Not Encountered	0.50m	0.5				... ... Metal sheet visible at 0.1m.			
			B	1.0					M		
				1.5				... ... Pockets of pale grey, off white silt (possibly ash) on side of test pit.			
			2.00m	2.0							
				2.5				... ... Bricks excavated from base of test pit.			
				2.60m				Hole Terminated at 2.60 m Target depth			
				3.0							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

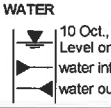
SUPPORT
- T Timbering

PENETRATION



No Resistance

WATER



10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remoulded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

JDSI LIBRARY REV 1.GLB Log JDSI TEST PIT JDS161188 - GINT LOGS.GPJ <<DrawingFile>> 29/04/2017 15:41 8.30.004 Datgel Lab and In Situ Tool - DGSI | Lib: JDSI | 00 2015-12-09 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP11

PAGE 1 OF 1

PROJECT NUMBER: **JDS161188**
PROJECT NAME: **Proposed Subdivision**
PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**
ELEVATION:
EASTING (m): **407744**
NORTHING (m): **6469075**

EQUIPMENT: **JCB 3CX**
EXCAVATION LENGTH: **3 m**
EXCAVATION WIDTH: **1 m**
EXCAVATION ORIENTATION:

DATE STARTED: **28/03/2017**
DATE COMPLETED: **28/03/2017**
LOGGED BY: **JC**
CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
				0				TOPSOIL / SANDY SILT: Non-plastic, brown, fine to coarse grained sand.	M		Grass at surface.
				0.10m				FILL / SANDY CLAY / CLAYEY SAND: Low to medium plasticity, fine to coarse grained, red brown, with some bricks throughout, trace of cloth and rope.	M		Roots up to 30mm diameter throughout layer. Layering visible.
	No Support	Not Encountered		0.5							
				1.0							
				1.40m				SANDY CLAY: Low to medium plasticity, yellow grey mottled, fine to coarse grained sand.	M	St	
				1.5			CI				
				2.0							
				2.10m				Hole Terminated at 2.10 m Target depth			
				2.5							
				3.0							

METHOD
N Natural Exposure
X Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

JDSI LIBRARY REV 1.GLB Log JDSI TEST PIT JDS161188 - GINT LOGS.GPJ <<DrawingFile>> 29/04/2017 15:41 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: JDSI 1.00 2015-12-09 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP12

PAGE: 1 OF 1

PROJECT NUMBER: **JDS161188**

PROJECT NAME: **Proposed Subdivision**

PROJECT LOCATION: **Helena Valley**

JDSi GROUND ENGINEERING

DATUM: **MGA94 Zone 50**	EQUIPMENT: **JCB 3CX**	DATE STARTED: **28/03/2017**
ELEVATION:	EXCAVATION LENGTH: **3 m**	DATE COMPLETED: **28/03/2017**
EASTING (m): **407726**	EXCAVATION WIDTH: **1 m**	LOGGED BY: **JC**
NORTHING (m): **6469051**	EXCAVATION ORIENTATION:	CHECKED BY: **RM**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components and Minor Components	MOISTURE CONDITION	CONSISTENCY/ RELATIVE DENSITY	STRUCTURE & Other Observations
	No Support	Not Encountered	0.50m B 1.40m	0.5 1.0 1.5 2.0 2.5 3.0			SC	FILL / CLAYEY SAND: Fine to coarse grained, red brown, medium plasticity clay, crushed brick.	M		
								0.20m CLAYEY SAND: Fine to coarse grained, yellow grey mottled, low plasticity clays.	M	D	
							CI	1.50m CLAY: Medium plasticity, yellow grey mottled.	M	St	
								1.80m Hole Terminated at 1.80 m Target depth			

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H — No Resistance

WATER
- 10 Oct., 73 Water Level on Date shown
- water inflow
- water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

JDSI LIBRARY REV 1.GLB Log JDSI TEST PIT JDS161188 - GINT LOGS.GPJ <<DrawingFile>> 29/04/2017 15:41 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: JDSI 1.00 2015-12-09 Prj: JDSI 1.00 2015-12-09



Appendix D – Laboratory Test Results

MATERIALS CONSULTANTS PTY. LTD.

INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

CONSISTENCY LIMIT - ATTERBERG

TEST METHODS: AS 1289.3.1.1, AS 1289.3.2.1, AS 1289.3.3.1, AS 1289.3.4.1, MOISTURE CONTENT : AS 1289.2.1.1

CLIENT:	JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849
JOB NO.:	149_49
SAMPLE NO.:	73
CLIENT REFERENCE:	TP5 - 1.0m to 1.5m
DATE TESTED:	10.04.2017
SAMPLE DESCRIPTION:	Clay
PROJECT:	JDSi Job No: JDS161188 - Helena Valley Development

LIQUID LIMIT	**61 %**
PLASTIC LIMIT	**24 %**
PLASTICITY INDEX	**37 %**
LINEAR SHRINKAGE	**11.0 %**

Sampling Procedures:	Tested as received.
Remarks:	Oven dried (50° C) Dry sieved.
	Curling & Cracking present in Linear Shrinkage

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR **TECHNICAL COMPETENCE**

Approved

M Snow, Signatory

Date: 11.04.2017

CERTIFICATE NO. MC 149_49_1 **ISSUE 1**

MATERIALS CONSULTANTS PTY. LTD.

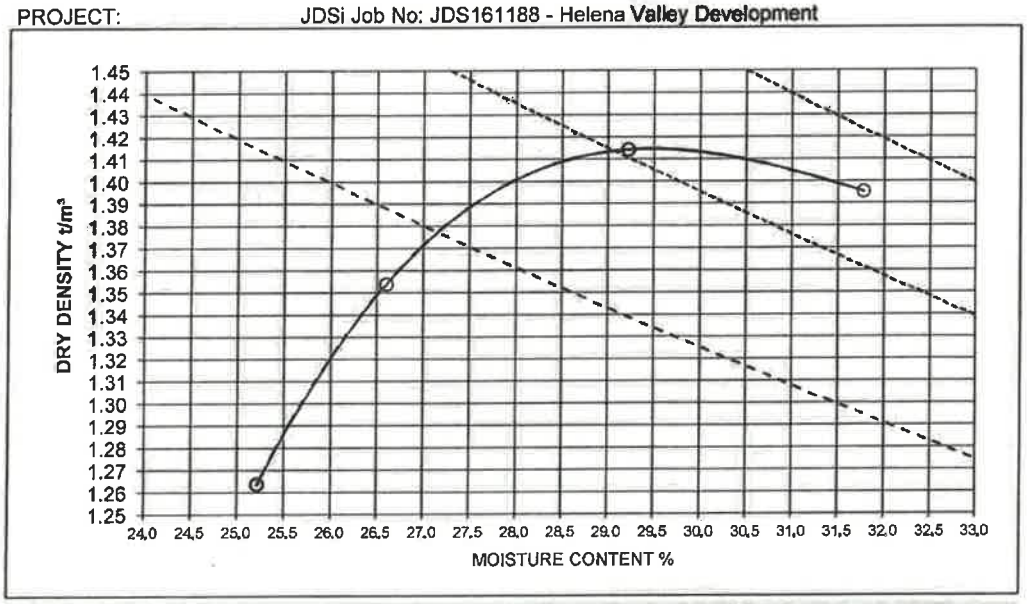
INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

DETERMINATION OF THE DRY DENSITY/MOISTURE CONTENT RELATIONSHIP OF A SOIL USING STANDARD COMPACTIVE EFFORT: AS1289.5.1.1

CLIENT:	JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849
JOB NO.:	149_49
SAMPLE NO.:	73
CLIENT REFERENCE:	TP5 - 1.0m to 1.5m
DATE TESTED:	06.04.2017
SAMPLE DESCRIPTION:	Clay
FEATURE:	-
PROJECT:	JDSi Job No: JDS161188 - Helena Valley Development



MAXIMUM DRY DENSITY	**1.42 t/m³**
OPTIMUM MOISTURE CONTENT	**29.5 %**
PER CENT RETAINED 19.0 mm SIEVE	**0 %**
PER CENT RETAINED 37.5 mm SIEVE	**0 %**

SAMPLING PROCEDURES: Tested as received.

REMARKS: Type A Mould (1 litre) used for this test.

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR **TECHNICAL COMPETENCE**

APPROVED :

M Snow, Signatory

DATE : 11.04.2017

CERTIFICATE NO. MC 149_49 _2 **ISSUE 1**

MATERIALS CONSULTANTS PTY. LTD.

INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

STANDARD METHOD OF ANALYSIS BY SIEVING : AS 1289.3.6.1

CLIENT: JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849

JOB NO. : 149_49

SAMPLE NO. : 73

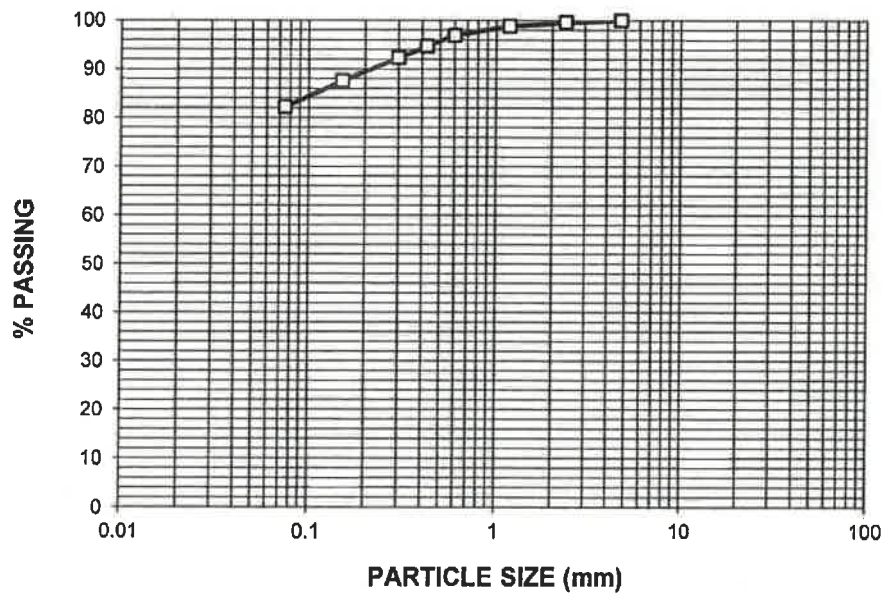
CLIENT REFERENCE : TP5 - 1.0m to 1.5m

DATE TESTED : 05.04.2017 & 11.04.2017

SAMPLE DESCRIPTION : Clay

PROJECT : JDSi Job No: JDS161188 - Helena Valley Development

Particle Size Distribution - Graphical Representation



SIEVE SIZE (mm)	% PASSING
4.75	100
2.36	100
1.18	99
0.600	97
0.425	95
0.300	92
0.150	88
0.075	82

Sampling Procedures: Tested as received.

Remarks: Wet sieved.

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Approved :

M Snow, Signatory

Date: 11.04.2017

CERTIFICATE NO. MC 149_49 _3 **ISSUE 1**

MATERIALS CONSULTANTS PTY. LTD.

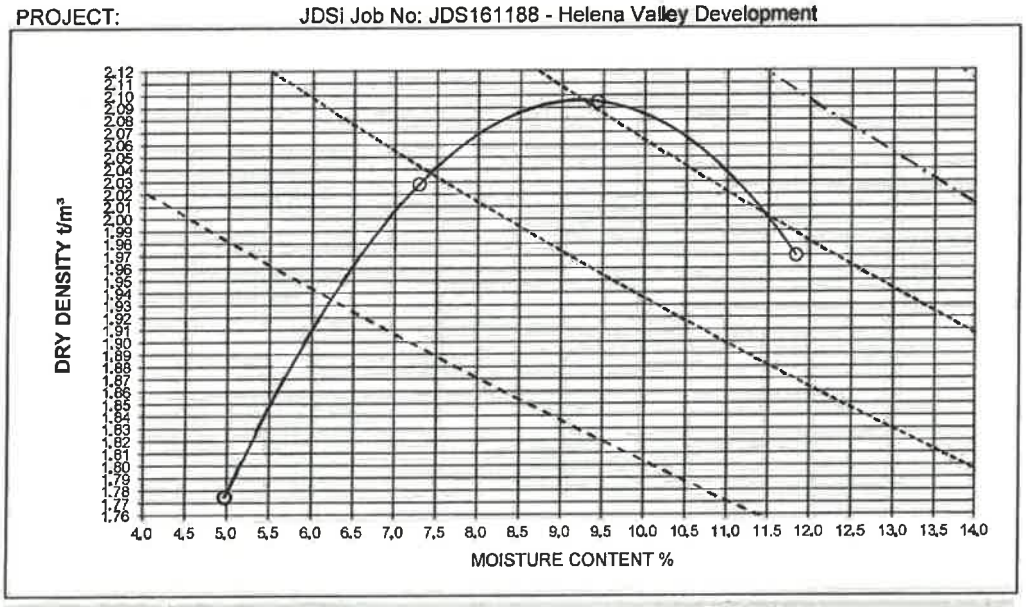
INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

DETERMINATION OF THE DRY DENSITY/MOISTURE CONTENT RELATIONSHIP OF A SOIL USING MODIFIED COMPACTIVE EFFORT : AS1289.5.2.1

CLIENT:	JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849
JOB NO.:	149_50
SAMPLE NO.:	74
CLIENT REFERENCE:	TP8 - 0.5m to 1.5m
DATE TESTED:	03.04.2017
SAMPLE DESCRIPTION:	Clayey Sand
FEATURE:	-
PROJECT:	JDSi Job No: JDS161188 - Helena Valley Development



MAXIMUM DRY DENSITY	**2.10 t/m³**
OPTIMUM MOISTURE CONTENT	**9.0 %**
PER CENT RETAINED 19.0 mm SIEVE	**0 %**
PER CENT RETAINED 37.5 mm SIEVE	**0 %**

SAMPLING PROCEDURES: Tested as received.

REMARKS: Type A Mould (1 litre) used for this test.

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR **TECHNICAL COMPETENCE**

APPROVED:

M Snow, Signatory

DATE : 11.04.2017

CERTIFICATE NO. MC 149_50 _1 **ISSUE 1**

MATERIALS CONSULTANTS PTY. LTD.

INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

STANDARD METHOD OF ANALYSIS BY SIEVING : AS 1289.3.6.1

CLIENT: JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849

JOB NO. : 149_50

SAMPLE NO. : 74

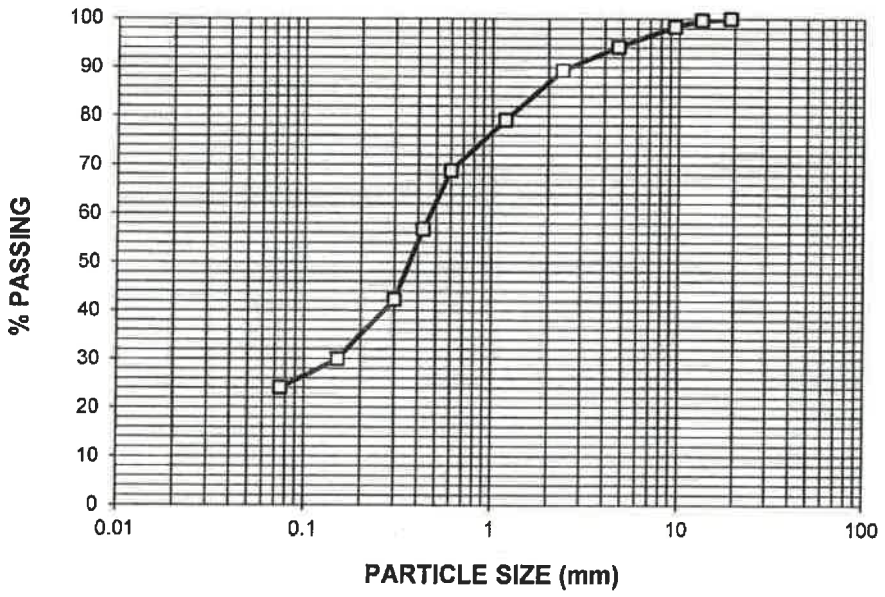
CLIENT REFERENCE : TP8 - 0.5m to 1.5m

DATE TESTED : 03.04.2017

SAMPLE DESCRIPTION : Clayey Sand

PROJECT : JDSi Job No: JDS161188 - Helena Valley Development

Particle Size Distribution - Graphical Representation



SIEVE SIZE (mm)	% PASSING
19.0	100
13.2	100
9.5	98
4.75	94
2.36	89
1.18	79
0.600	69
0.425	57
0.300	42
0.150	30
0.075	24

Sampling Procedures: Tested as received.

Remarks: Wet sieved.

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Approved :

M Snow, Signatory

Date: 11.04.2017

CERTIFICATE NO. MC 149_50 _2 **ISSUE 1**

MATERIALS CONSULTANTS PTY. LTD.

INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

CONSISTENCY LIMIT - ATTERBERG

TEST METHODS: AS 1289.3.1.1, AS 1289.3.2.1, AS 1289.3.3.1, AS 1289.3.4.1, MOISTURE CONTENT : AS 1289.2.1.1

CLIENT:	JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849
JOB NO.:	149_50
SAMPLE NO.:	74
CLIENT REFERENCE:	TP8 - 0.5m to 1.5m
DATE TESTED:	07.04.2017
SAMPLE DESCRIPTION:	Clayey Sand
PROJECT:	JDSi Job No: JDS161188 - Helena Valley Development

LIQUID LIMIT	**28 %**
PLASTIC LIMIT	**14 %**
PLASTICITY INDEX	**14 %**
LINEAR SHRINKAGE	**6.5 %**

Sampling Procedures:	Tested as received.
Remarks:	Oven dried (50° C) Dry sieved.

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR **TECHNICAL COMPETENCE**

Approved

M Snow, Signatory

Date: 11.04.2017

CERTIFICATE NO. MC 149_50 _3 **ISSUE 1**

MATERIALS CONSULTANTS PTY. LTD.

INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

PARTICLE SIZE DISTRIBUTION

STANDARD METHOD OF ANALYSIS BY SIEVING : AS 1289.3.6.1

CLIENT: JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849

JOB NO. : 149_51

SAMPLE NO. : 75

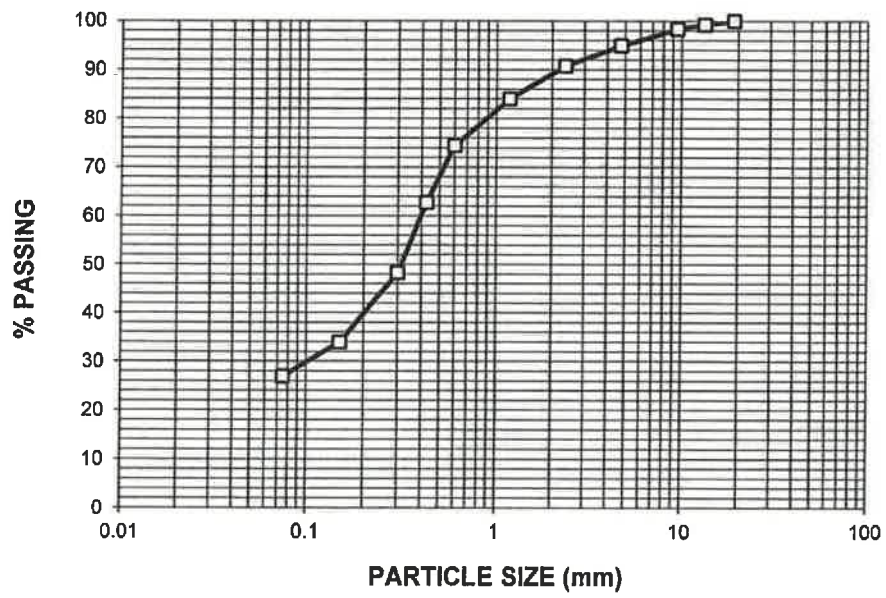
CLIENT REFERENCE : TP12 - 0.5m to 1.4m

DATE TESTED : 05.04.2017 & 11.04.2017

SAMPLE DESCRIPTION : Clayey Sand

PROJECT : JSDi Job No: JDS161188 - Helena Valley Development

Particle Size Distribution - Graphical Representation



SIEVE SIZE (mm)	% PASSING
19.0	100
13.2	99
9.5	98
4.75	95
2.36	91
1.18	84
0.600	74
0.425	63
0.300	48
0.150	34
0.075	27

Sampling Procedures: Tested as received.

Remarks: Wet sieved.

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Approved :

M Snow, Signatory

Date: 11.04.2017

CERTIFICATE NO. MC 149_51 _1 ISSUE 1

MATERIALS CONSULTANTS PTY. LTD.

INDEPENDENT TESTING LABORATORIES: NATA ACCREDITATION No 1763 : ABN 67 126 947 386

72 COLLINGWOOD STREET, OSBORNE PARK WA 6017 TELEPHONE: (08) 9244 3080 FACSIMILE: (08) 9446 6753
Email : admin@matcons.com.au

TEST CERTIFICATE

CONSISTENCY LIMIT - ATTERBERG

TEST METHODS: AS 1289.3.1.1, AS 1289.3.2.1, AS 1289.3.3.1, AS 1289.3.4.1, MOISTURE CONTENT : AS 1289.2.1.1

CLIENT:	JDSi Ground Engineering Pty Ltd, PO Box 8523, Perth BC, WA, 6849
JOB NO.:	149_51
SAMPLE NO.:	75
CLIENT REFERENCE:	TP12 - 0.5m to 1.4m
DATE TESTED:	07.04.2017
SAMPLE DESCRIPTION:	Clayey Sand
PROJECT:	Quality Control - JDSi Job No: JDS161188 - Helena Valley Development

LIQUID LIMIT	**31 %**
PLASTIC LIMIT	**12 %**
PLASTICITY INDEX	**19 %**
LINEAR SHRINKAGE	**4.5 %**

Sampling Procedures:	Tested as received.
Remarks:	Oven dried (50° C) Dry sieved.

NATA

Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR **TECHNICAL COMPETENCE**

Approved

M Snow, Signatory

Date: 11.04.2017

CERTIFICATE NO. MC 149_51 _2 **ISSUE 1**

APPENDIX F – GROUNDWATER LICENCE

File No:
DWERVT8093

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Instrument No. CAW206307(1)

LICENCE TO CONSTRUCT OR ALTER WELL

Granted by the Minister under section 26D of the Rights in Water and Irrigation Act 1914

Licensee(s)	Cityplaza Pty Ltd
Description of Water Resource	Perth Perth - Superficial Swan
Location of Well(s)	LOT 3 ON PLAN 3958 - Volume/Folio 1409/592 - Lot 3

Authorised Activities	**Activity**	**Location of Activity**
	Construct one non-artesian well(s).	LOT 3 ON PLAN 3958 - Volume/Folio 1409/592 - Lot 3
Duration of Licence	From 1 September 2021 to 31 August 2022	

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

1. The well must be constructed by a driller having a current class 1 water well drillers certificate issued by the Western Australian branch of the Australian Drilling Industry Association or equivalent certification recognised nationally by the Australian Drilling Industry Association.

2. The depth of the well(s) shall be limited to the superficial aquifer.

3. The licensee shall construct the well using materials and methods for single aquifer wells described in 'Minimum construction requirements for water bores in Australia, Fourth Edition, 2020'

4. Any well that is to be permanently decommissioned shall within 30 days of decommissioning, be sealed and filled to prevent the surface entry of contaminants and the vertical movement of water in the well, using methods described in 'Minimum construction requirements for water bores in Australia, Fourth Edition, 2020'

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

element.

APPENDIX 5

Bushfire Management Plan

Bushfire Management Plan

Local Structure Plan and Subdivision Application
Midland Road, Helena Valley

Western Environmental Pty Ltd
(08) 6162 8980
PO Box 437, Leederville, WA 6903
enquiries@westenv.com.au
westenv.com.au

Bushfire Management Plan

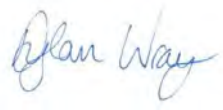
Local Structure Plan and Subdivision Application
Midland Road, Helena Valley

Report No:
A24.202-BMP_0_DRAFT
Issue Date:
21-Oct-2024
Status
FINAL

Prepared for:
Cityplaza Pty Ltd
88 Marine Terrace
Fremantle WA 6160

Prepared by
Western Environmental Approvals Pty Ltd
Unit 5, 162 Colin Street
West Perth WA 6005
westenv.com.au

Internal Review

Author	Reviewed by	Approved by
		
Dylan Wray Associate Level 2 BPAD 44656	**Daniel Panicker** Senior Principal / Partner Level 3 BPAD 37802	**Daniel Panicker** Senior Principal / Partner Level 3 BPAD 37802
10-Oct-2024	**11-Oct-2024**	**21-Oct-2024**

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Statement of Limitations

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WEPL disclaims any and all liability with respect to any use of or reliance upon this report for any other purpose whatsoever.

In particular, it should be noted that this report is based on a scope of services defined by the Client, and is limited by budgetary and time constraints, the information supplied by the Client (and its agents) and, in some circumstances, access and/or site disturbance constraints.

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The conclusions must also be considered in light of the agreed scope of services (including any constraints or limitation therein) and the methods used to carry out those services, both of which are as stated or referred to in this report.

Bushfire Protection

The bushfire management measures and risk treatments proposed in this document do not guarantee that buildings or infrastructure will not be damaged in a bushfire, nor that there will be no injuries or fatalities either on the site or offsite while evacuating. Primarily, this is due to the unpredictable nature and behaviour of fire and fire weather conditions. In addition, implementation of the required bushfire management measures (including construction standards, maintenance etc.) and any other required or recommended measures, will depend upon, among other things, the ongoing actions of landowners and/or operators over which WEPL has no control.

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Other Limitations

This report is intended to be read in its entirety, and sections or parts of this report should therefore not be read and relied on out of context.

WEPL will not be liable to update or revise this report to take into account any events or circumstances or facts becoming apparent after the date of this report.

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1. Introduction

1.1 Proposal Details

Jardim Property is seeking to amend the previously endorsed local structure plan (LSP) and approved subdivision plan for Lots 2, 3 and 6 Midland Road, Helena Valley (hereby referred to as the subject site, Figure 1). The previous LSP and subdivision approval for the subject site included the creation of 65 lots which are intended to be delivered across multiple stages, with Stage 1 completed, Stage 2 soon to be released and Stage 3 soon to be developed. The LSP and subdivision plan is being amended to include Stage 4 on balance lot 9003 which will include an additional 28 lots (Figure 2).

The subject site is within a designated bushfire prone area as per the *Western Australia State Map of Bush Fire Prone Areas* (DFES 2024; Figure 3), which triggers bushfire planning requirements under *State Planning Policy 3.7 Bushfire* (SPP 3.7; WAPC, 2024a) and the associated *Planning for Bushfire Guidelines* (the Guidelines; WAPC, 2024b).

Western Environmental Approvals Pty Ltd (WEPL) was commissioned to prepare a Bushfire Management Plan (BMP) to accompany the submission of the LSP and subdivision application. This BMP has been prepared by Associate Bushfire Consultant Dylan Wray (FPAA BPAD Level 2 Certified Practitioner No. BPAD44656) and reviewed by Senior Principal Bushfire Consultant Daniel Panickar (FPAA BPAD Level 3 Certified Practitioner No. BPAD37802).

1.1.1 Site context

The subject site is located within Shire of Mundaring and is zoned 'Development' and 'Rural Residential' under Local Planning Scheme No. 4 and 'Urban' and 'Parks and Recreation' under the Metropolitan Region Scheme. The subject site contains a mixture of unmanaged, classifiable vegetation along with areas which have been cleared under previous subdivision stages. The subject site is bound by Kadina Brook to the west, vacant paddock to the north and existing residential areas to the south and east.

1.2 Purpose and Application of the BMP

This BMP has been prepared in accordance with SPP 3.7 and the Guidelines to support the assessment of the LSP and subdivision application for the subject site.

In addition, this BMP provides strategies and guidance to reduce the level of bushfire risk exposure for the subject site through implementation of a range of bushfire management measures in accordance with the Guidelines.

1.3 Environmental Considerations

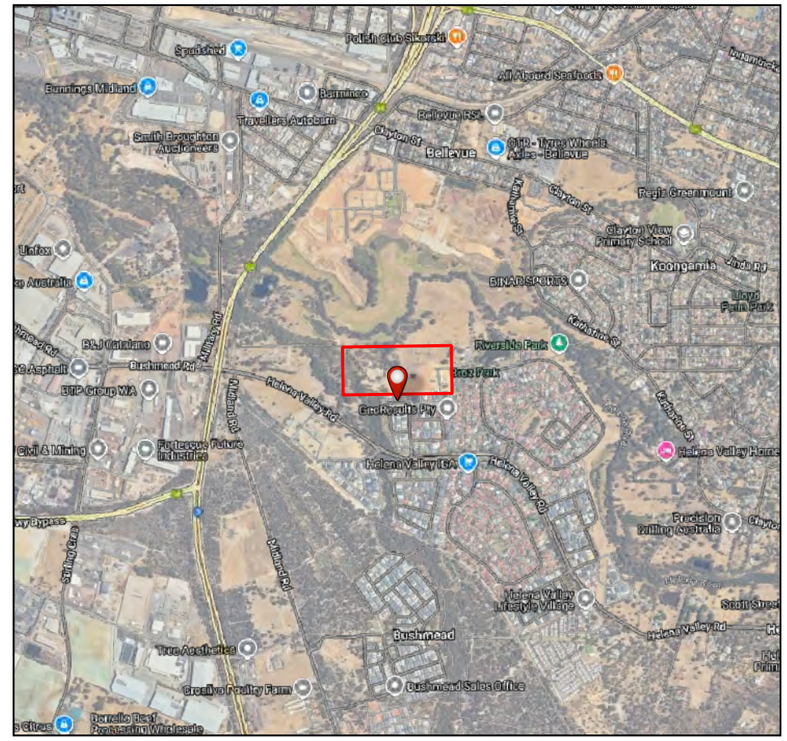
SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values.

The environmental considerations for the subject site have been previously considered under the LSP which identified areas for foreshore, public open space (POS), regional open space (ROS) reserves. The bushfire assessment contained within this BMP considers the environmental values identified for the subject site, specifically:

- Existing vegetation within the Kadina Brook foreshore reserve will be retained and revegetated to Class A Forest, as detailed on the Foreshore and Public Open Space Plan (Appendix A; Emerge Associates, 2021);
- Proposed landscaping and retained vegetation within the POS reserves will be maintained in a low threat state, as detailed on the Foreshore and Public Open Space Plan (Appendix A; Emerge Associates, 2021); and
- Proposed landscaping and retained vegetation within the ROS reserve will be maintained in a low threat state.

WEPL is not aware of any outstanding environmental approvals required for development to proceed.





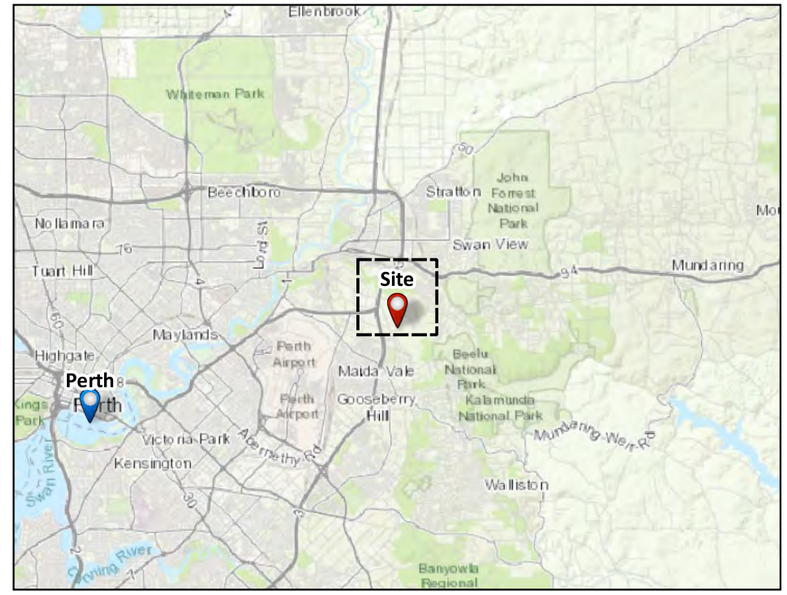


Figure 1: Site Overview

N

0 50 100 150 200 m

PROJECT/REPORT NAME	Bushfire Management Plan- Local Structure Plan and Subdivision Application Lots 2, 3 and 6 Midland Road, Helena Valley
SCALE	1:3,481
SHEET SIZE	A3 COLOUR
CLIENT	Cityplaza Pty Ltd
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
PROJECT NUMBER	A24.202
VERSION	0
DATA SOURCE	Nearmap Imagery (02 September 2024)
DRAWN BY / REVIEWED BY	JP/DW
DATE	14/10/2024

Legend

- Subject Site
- Buffer 100m
- Buffer 150m

No	Description	Drawn	Approved	Date
A	Original issue	JP	DW	14/10/2024

NOTES:

Cadastral boundary (LGATE-002). Base map ESRI Topo. Townsites (LGATE-248).

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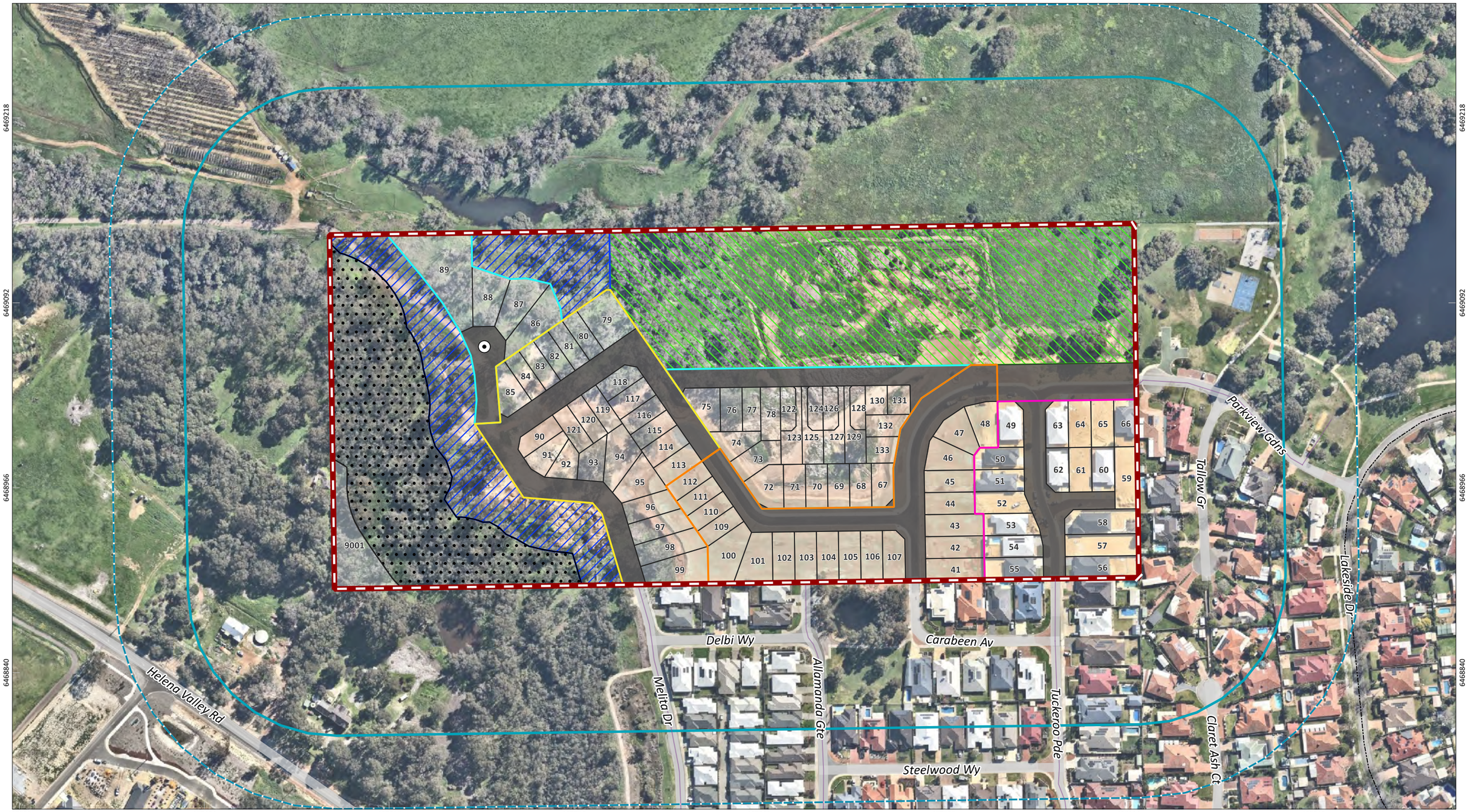


Figure 2: Subdivision Plan

N; 0 37 74 111 148 m		PROJECT/REPORT NAME: Bushfire Management Plan- Local Structure Plan and Subdivision Application Lots 2, 3 and 6 Midland Road, Helena Valley	
SCALE: 1:2,527	SHEET SIZE: A3 COLOUR	CLIENT: Cityplaza Pty Ltd	
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50		PROJECT NUMBER: A24.202	VERSION: 0
DATA SOURCE: Nearmap Imagery (02 September 2024)		DRAWN BY / REVIEWED BY: JP/DW	DATE: 14/10/2024

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Stage 1
- Stage 2
- Stage 3
- Stage 4
- Lots
- POS
- ROS
- Road
- Foreshore Reserve
- Cul-de-sac

No	Description	Drawn	Approved	Date
A	Original issue	JP	DW	14/10/2024

NOTES:

Cadastral boundary from LANDGATE 2022. Label corresponds to the vegetation association number.

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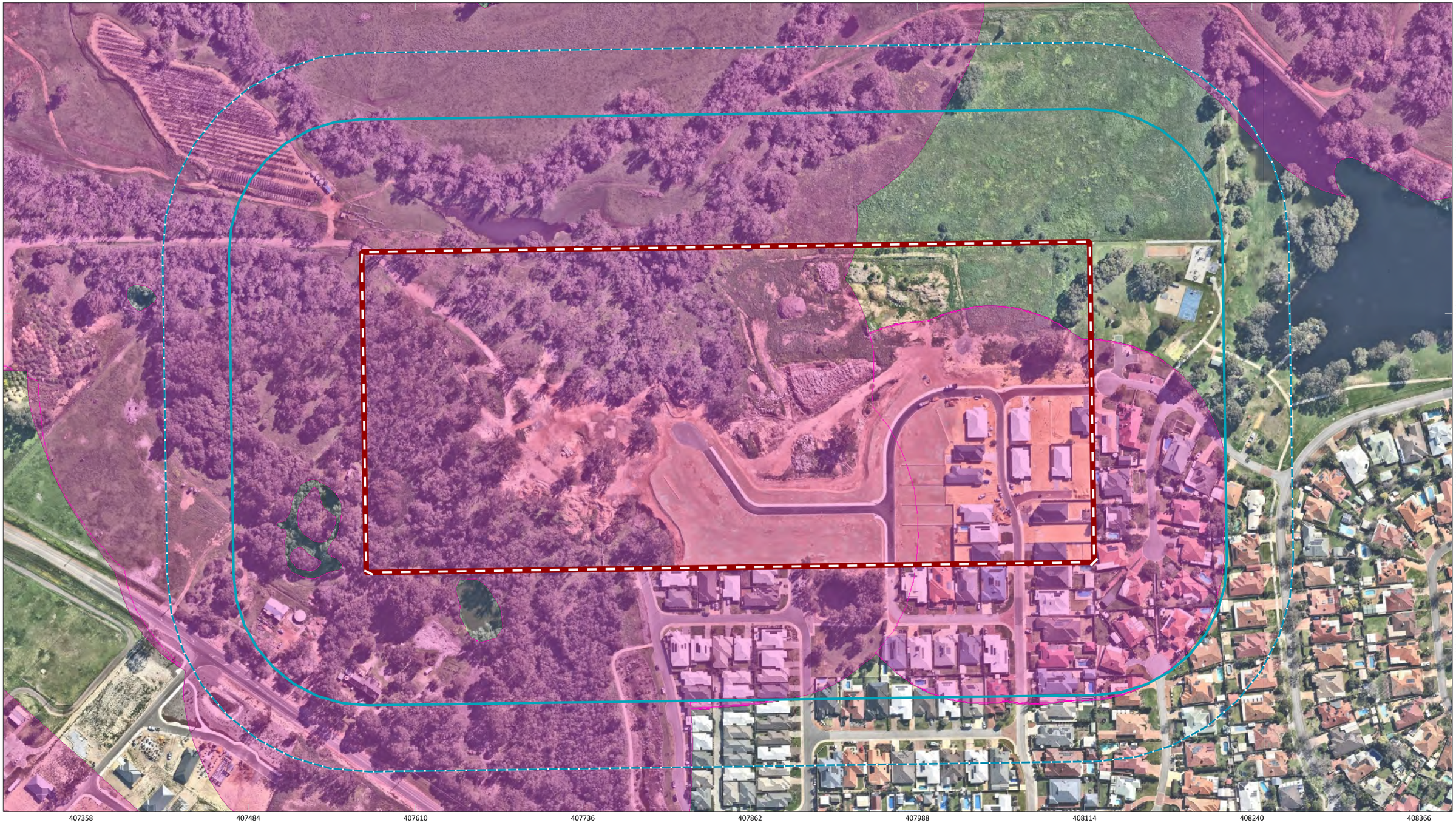


Figure 3: Bushfire Prone Areas

N

0 40 80 120 160 m

SCALE	1:2,803
SHEET SIZE	A3 COLOUR
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
DATA SOURCE	Nearmap Imagery (02 September 2024)

PROJECT/REPORT NAME	Bushfire Management Plan- Local Structure Plan and Subdivision Application Lots 2, 3 and 6 Midland Road, Helena Valley
CLIENT	Cityplaza Pty Ltd
PROJECT NUMBER	A24.202
VERSION	0
DRAWN BY / REVIEWED BY	JP/DW
DATE	14/10/2024

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Bush Fire Prone Area 2 (OBRM-023)

No	Description	Drawn	Approved	Date
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2. Bushfire Assessment Results

2.1 Bushfire Assessment Inputs

A bushfire assessment has been undertaken for the proposed subdivision in accordance with the Guidelines. Inputs to this assessment are detailed below.

2.1.1 Fire Danger Index

A blanket Fire Danger Index (FDI) 80 is adopted for Western Australia, as outlined in *Australian Standard AS 3959: 2018 Construction of Buildings in Bushfire Prone Areas* (AS 3959: 2018; SA, 2018).

2.1.2 Vegetation Classification and Slope under Vegetation

Vegetation and effective slope (i.e. slope under vegetation) within the subject site and surrounding 150 m (the assessment area) were assessed on 18/09/2024 in accordance with the Guidelines and AS 3959: 2018.

The classified vegetation and effective slope for the site from each of the identified vegetation plots are identified below in Table 1 and Figure 4 based on the existing site conditions.

Table 1: Classified Vegetation as per AS 3959: 2018

Plot	Vegetation classification	Effective slope
1	Class A Forest	Downslope >5 to 10 degrees
2	Class A Forest	Downslope >0 to 5 degrees
3	Class A Forest	All upslopes and flat land (0 degrees)
4	Class B Woodland	All upslopes and flat land (0 degrees)
5	Class D Scrub	All upslopes and flat land (0 degrees)
6	Class G Grassland	All upslopes and flat land (0 degrees)
7	Excluded - clause 2.2.3.2 (e)	-
8	Excluded - clause 2.2.3.2 (f)	-

Photographs relating to each area and vegetation type are included in Appendix A.

2.1.3 Post Development Assumptions

Figure 5 illustrates the post-development vegetation plots following the proposed lots and road reserves being cleared of vegetation, the foreshore being revegetated to Class A Forest and the POS reserves and ROS reserve being modified to low threat. The assessment outputs in this BMP have been based on the post development scenario.

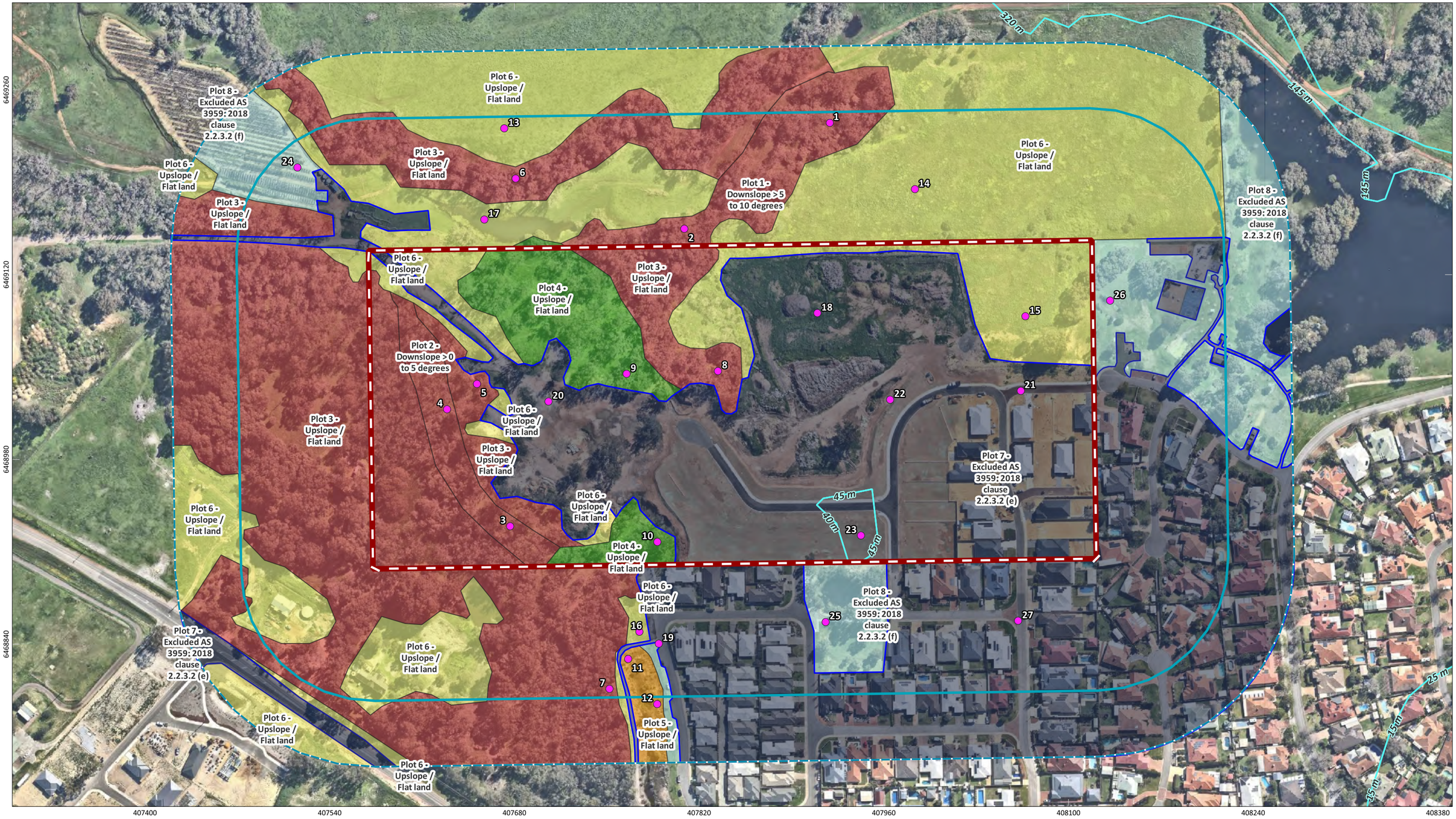


Figure 4: Vegetation Classification (Existing)

N

0 40 80 120 160 m

PROJECT/REPORT NAME	Bushfire Management Plan- Local Structure Plan and Subdivision Application Lots 2, 3 and 6 Midland Road, Helena Valley
SCALE: 1:2,803	SHEET SIZE: A3 COLOUR
CLIENT: Cityplaza Pty Ltd	
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50	PROJECT NUMBER: A24.202 / VERSION: 0
DATA SOURCE: Nearmap Imagery (02 September 2024)	DRAWN BY / REVIEWED BY: JP/DW / DATE: 14/10/2024

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Photos
- 2m Contours (DPIRD-072)
- 10m

Vegetation Classification

- Class A - Forest
- Class B - Woodland
- Class D - Scrub
- Class G - Grassland
- Excluded AS 3959: 2018 2.2.3.2 (e)
- Excluded AS 3959: 2018 2.2.3.2 (f)

No	Description	Drawn	Approved	Date
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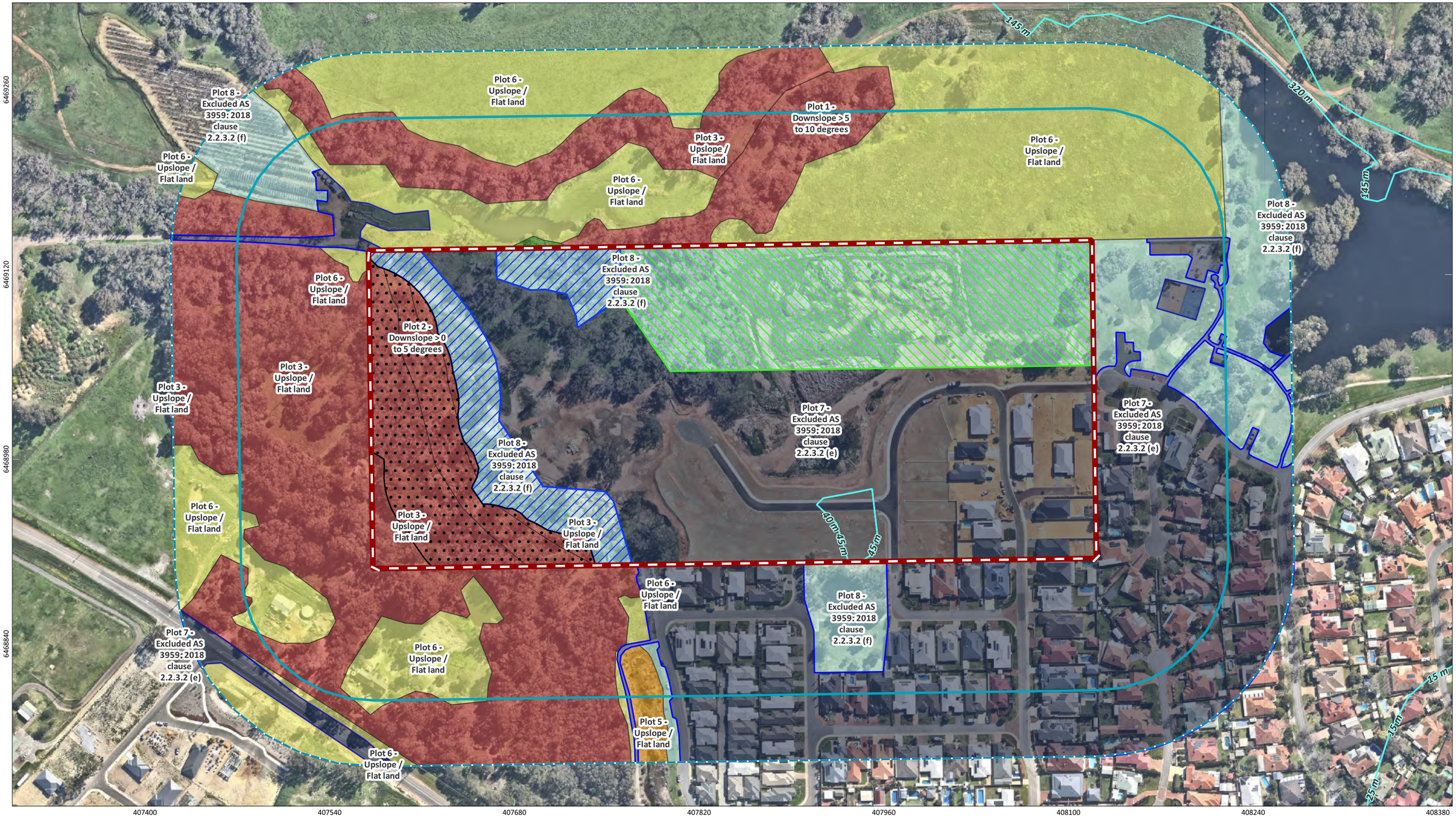


Figure 5: Vegetation Classification (Post Development)

N 0 40 80 120 160 m		PROJECT/REPORT NAME: Bushfire Management Plan- Local Structure Plan and Subdivision Application Lots 2, 3 and 6 Midland Road, Helena Valley	
SCALE: 1:2,803	SHEET SIZE: A3 COLOUR	CLIENT: Cityplaza Pty Ltd	
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50		PROJECT NUMBER: A24.202	VERSION: 0
DATA SOURCE: Nearmap Imagery (02 September 2024)		DRAWN BY / REVIEWED BY: JP/DW	DATE: 10/10/2024

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Revegetation
- POS
- ROS

2m Contours (DPIRD-072)
- 10m

Vegetation Classification
- Class A - Forest
- Class B - Woodland
- Class D - Scrub
- Class G - Grassland
- Excluded AS 3959: 2018 2.2.3.2 (e)
- Excluded AS 3959: 2018 2.2.3.2 (f)

No	Description	Drawn	Approved	Date
A	Original issue	JP	DW	10/10/2024

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2.2 Bushfire Assessment Outputs

A Bushfire Attack Level (BAL) assessment has been undertaken in accordance with SPP 3.7, the Guidelines, AS 3959: 2018 and the bushfire assessment inputs in Section 2.1.

2.2.1 BAL Assessment

All land located within 100 m of the classified vegetation depicted in Figure 4 is considered bushfire prone and is subject to a BAL assessment in accordance with AS 3959: 2018.

A Method 1 BAL assessment (as outlined in AS 3959: 2018) has been completed for the proposed development and incorporates the following factors:

- Fire Danger Index (FDI) rating.
- Vegetation class.
- Slope under classified vegetation.
- Distance between proposed lots and the classified vegetation.

Based on the identified BAL, construction requirements for relevant buildings/structures can then be assigned. The BAL rating gives an indication of the expected level of bushfire attack (i.e. radiant heat flux, flame contact and ember penetration) that may be received by proposed buildings and subsequently informs the standard of construction required to increase building survivability.

2.2.2 Method 1 BAL Assessment

Table 2 and Figure 6 display the Method 1 BAL assessment (in the form of BAL contours) that has been completed for the proposed LSP and subdivision in accordance with AS 3959: 2018 methodology.

Table 2: Method 1 BAL Calculation (BAL Contours)

Plot	Vegetation classification	Effective slope	Separation distances required (m)				
			BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5
1	Class A Forest	Downslope >5 to 10 degrees	<26	26-<33	33-<46	46-<61	61-<100
2	Class A Forest	Downslope >0 to 5 degrees	<20	20-<27	27-<37	37-<50	50-<100
3	Class A Forest	All upslopes and flat land (0 degrees)	<16	16-<21	21-<31	31-<42	42-<100
4	Class B Woodland	All upslopes and flat land (0 degrees)	<10	10 - <14	14 - <20	20 - <29	29 - <100

Plot	Vegetation classification	Effective slope	Separation distances required (m)				
			BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5
5	Class D Scrub	All upslopes and flat land (0 degrees)	<10	10 - <13	13 - <19	19 - <27	27 - <100
6	Class G Grassland	All upslopes and flat land (0 degrees)	<6	6 - <8	8 - <12	12 - <17	17 - <50
7	Excluded - clause 2.2.3.2 (e)	-	No separation distances required - BAL-LOW				
8	Excluded - clause 2.2.3.2 (f)	-	No separation distances required - BAL-LOW				

2.3 Identification of Issues Arising from the BAL Assessment

Post-development, all lots contain sufficient development sites that can achieve a radiant heat impact not exceeding 29 kW/m^2 (BAL-29). The worst-case BAL rating that impacts the proposed lots is summarised as follows:

- Two lots (Lots 98 and 99) will be subject to BAL-FZ however provide sufficient development sites that will achieve ≤BAL-29;
- Five lots (Lots 79, 86 - 89) will be subject to ≤BAL-29;
- Two lots (Lots 80 and 85) will be subject to ≤BAL-19;
- 23 lots (Lots 81 - 84, 90 - 96, 100 - 102, 109 - 121) will be subject to ≤BAL-12.5; and
- All remaining lots will be subject to BAL-LOW.

A reassessment of BAL ratings, through either a BMP addendum or revised BMP will be undertaken if changes to subdivision design, classified vegetation or the ability to manage the POS and ROS reserves within the assessment area which require a modified bushfire management response occur.

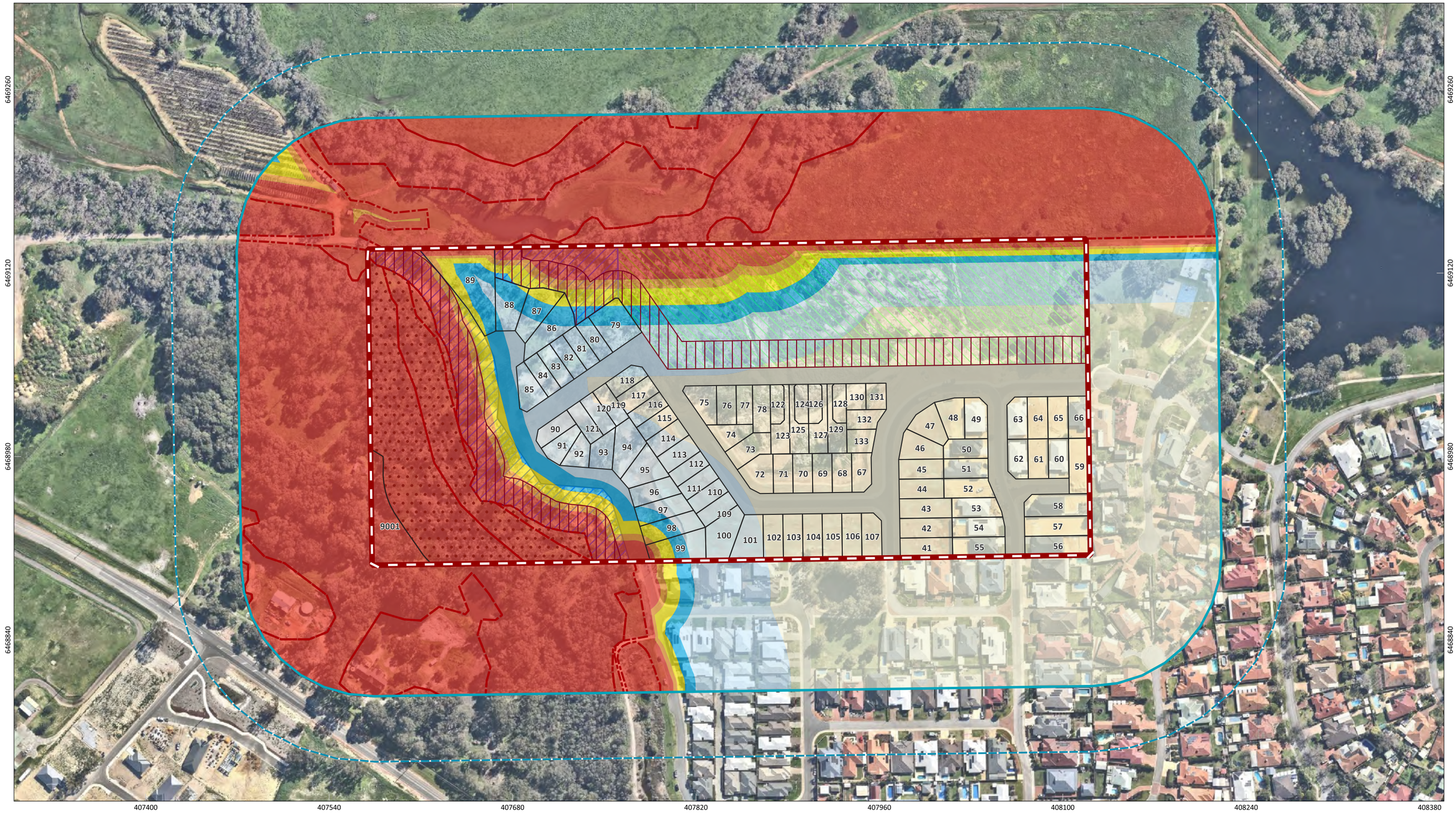


Figure 6: Bushfire Attack Level (BAL) Contours

N

0 40 80 120 160 m

SCALE	1:2,803
SHEET SIZE	A3 COLOUR
COORDINATE REFERENCE SYSTEM	GDA2020 / MGA zone 50
DATA SOURCE	Nearmap Imagery (02 September 2024)

PROJECT/REPORT NAME
Bushfire Management Plan- Local Structure Plan and Subdivision Application
Lots 2, 3 and 6 Midland Road, Helena Valley

CLIENT
Cityplaza Pty Ltd

PROJECT NUMBER	VERSION
A24.202	0

DRAWN BY / REVIEWED BY	DATE
JP/DW	14/10/2024

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Asset Protection Zone (APZ)
- Bushfire hazard Interface
- Lots
- POS
- ROS
- Road
- Foreshore Reserve

Bushfire Attack Level (BAL)

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

No	Description	Drawn	Approved	Date
A	Original issue	JP	DW	14/10/2024

NOTES:

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3. Assessment Against the Bushfire Protection Criteria

3.1 Compliance

The proposed LSP and subdivision is required to comply with Policy Measure 7.1 of SPP 3.7 and Bushfire Protection Criteria 5 of the Guidelines.

Table 3 outlines the Acceptable Solutions (AS) that are relevant to the proposal and summarises how the intent of each Bushfire Protection Criteria has been achieved through the application of bushfire risk management measures. No Performance Solutions (PS) have been proposed for this subdivision. These management measures are depicted in Figure 7 where relevant.

Implementation of this BMP is expected to meet Policy Outcomes 6.1 to 6.4 of SPP 3.7.

Table 3: Assessment Against the Bushfire Protection Criteria

Bushfire Protection Criteria	AS	PS	N/A
Element 1: Location	☐	☐	✓
Not applicable - The current LSP and subdivision has been previously assessed against SPP 3.7 (2015) and the Guidelines. Section 1.3.1 of the Guidelines require any modifications to be assessed against SPP 3.7 (2024) and the Guidelines (2024), with the exception of the new methodology for Element 1: Location.			
Element 2: Siting and design of development **A2.1 Siting and design**	✓	☐	☐
All lots contain a sufficient development site that will achieve a radiant heat impact of 29 kW/m^2 (BAL-29) or below, as detailed on **Figure 6** and **Figure 7.** Two lots (Lots 98 and 99) will be subject to BAL-FZ however provide sufficient development sites that will achieve ≤BAL-29. The LSP and subdivision is considered to be compliant with A2.1.			
A2.2 Asset Protection Zone (APZ)	✓	☐	☐
APZs will be established to provide separation between the proposed lots and permanent bushfire hazards. The APZs will comprise of public roads and managed vegetation on the POS and ROS reserves. The APZs will be established during the subdivisional works to ensure the radiant heat impact on future habitable buildings does not exceed 29 kW/m^2 (BAL-29). The APZs shall meet the technical requirements in Appendix D. The LSP and subdivision is considered to be compliant with A2.2			
A2.3 Clearing of native vegetation	✓	☐	☐
The LSP and subdivision seeks to retain native vegetation along Kadina Brook through the provision of a foreshore reserve which will be revegetated. Native vegetation on private lots, the POS and ROS reserves will be modified to low threat with the aim of avoiding unnecessary clearing where possible. The LSP and subdivision is considered to be compliant with A2.3.			

Bushfire Protection Criteria	AS	PS	N/A
Element 3: Vehicular Access **A3.1 Public Roads**	✓	☐	☐
The subject site is accessed via existing public roads. WEPL assumes the existing public road network meets the technical specification under the IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Austroad Standards and/or any applicable standard in the local government area. The proposed public roads within the subject site will be designed according to Liveable Neighbourhoods and the technical requirements in Appendix D. The existing and proposed public access arrangements will provide suitable access and egress for the community and emergency services personnel in the event of a bushfire. The proposed LSP and subdivision is considered to be compliant with A3.1.			
A3.2 Access routes	✓	☐	☐
Multiple access routes from the subject site to more than two suitable destinations are available via the existing public network (**Figure 7**). Access to the site is available via two different access points. The proposed LSP and subdivision is considered to be compliant with A3.2.			
A3.3a No-through roads	✓	☐	☐
One of the proposed public roads within the subject site will be a no-through road which provides access to four proposed lots. The no-through road is less than 200 m in length and will be comply with the requirements under A3.3b below. The proposed LSP and subdivision is considered to be compliant with A3.3a.			
A3.3b No-through road requirements	✓	☐	☐
The no-through road will comply with the public road specifications in Appendix D and include a cul-de-sac to enable a fire appliance vehicle to turnaround. The proposed LSP and subdivision is considered to be compliant with A3.3b.			
A3.4 Emergency access way	☐	☐	✓
Not applicable - no emergency access ways are required or proposed as part of this LSP and subdivision.			
A3.5a Perimeter roads	✓	☐	☐
The proposed public road network provides perimeter access and separation between all but five of the proposed lots and permanent bushfire hazards. The four lots accessed via the no-through road do not require perimeter roads given they are zoned Rural Residential (rural living equivalent) and Lot 79 will abut areas of low threat vegetation, removing the need for hazard separation via a perimeter road. The proposed subdivision is considered to be compliant with A3.5a.			
A3.5b Fire service access routes	☐	☐	✓
Not applicable - fire service access routes are not required given the four lots which do not have perimeter roads adjoin areas of Class G Grassland and low threat POS reserves.			
A3.6 Battle-axe access legs	☐	☐	✓
Not applicable - four battle-axe lots are proposed, all of which have an access leg less than 50 m in length from a public road in a reticulated water area.			

Bushfire Protection Criteria	AS	PS	N/A
Element 4: Water Supply **A4.1 Water supply for structure plans**	✓	☐	☐
Existing reticulated water is present within the area and the subject site will be connected to this water supply. The nearest existing hydrants are located on Tuckeroo Parade, Carabeen Avenue and Allamanda Gate (**Figure 7**). WEPL assumes the surrounding network of hydrants meet Water Corporation specifications given they are established and within the Perth metropolitan area. The proposed LSP is considered to be compliant with A4.1.			
A4.2 Water supply for subdivision applications	✓	☐	☐
The proposed subdivision will be serviced by reticulated water with hydrants installed in accordance with Water Corporation specifications. The proposed subdivision is considered to be compliant with A4.2.			
A4.3 Water supply for existing habitable building(s)	☐	☐	✓
Not applicable - no existing habitable buildings are being retained.			

Note: AS - Acceptable solution, PS - Performance solution, N/A - Not applicable.

3.2 Additional Bushfire Management Requirements

3.2.1 Vegetation Management

As previously identified, all lots contain sufficient development sites that can achieve a radiant heat impact not exceeding 29 kW/m^2 (BAL-29) on the basis that:

- Classified vegetation in the POS reserves can be modified to low threat, in accordance with the Foreshore and Public Open Space Plan (Appendix A); and
- Classified vegetation ROS reserve can be modified to low threat.

However, it is acknowledged that the future use of the ROS is currently unknown and subject to further discussions with the Shire of Mundaring. If the developer wants to reduce the extent of ROS reserve that needs to be managed, an APZ could be established until a decision has been made on the ultimate use of the ROS reserve. The APZ would need to be maintained along the boundary of the ROS reserve where it is adjacent to the proposed lots to a distance of 21m (Figure 7). This will result in a slight change to the BAL ratings across the subject site however will still ensure that all lots contain sufficient development sites that can achieve a radiant heat impact not exceeding 29 kW/m^2 (BAL-29). The BAL ratings will be certified following completion of the subdivision works which is a requirement of this BMP.

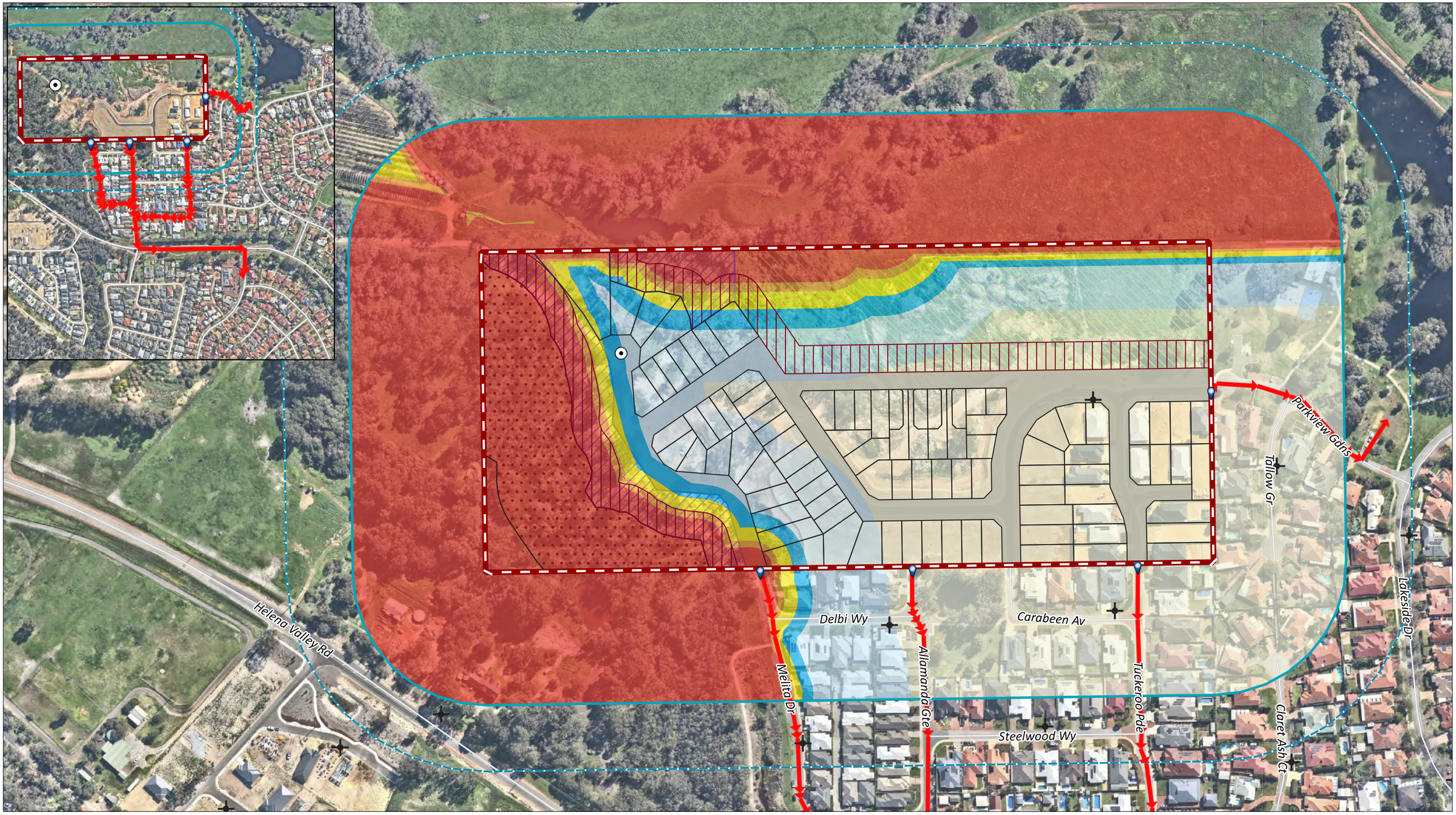


Figure 7: Spatial representation of the bushfire management strategies

N

0 40 80 120 160 m

SCALE: 1:2,803	SHEET SIZE: A3 COLOUR	PROJECT/REPORT NAME: Bushfire Management Plan- Local Structure Plan and Subdivision Application Lots 2, 3 and 6 Midland Road, Helena Valley	
		CLIENT: Cityplaza Pty Ltd	
COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 50		PROJECT NUMBER: A24.202	VERSION: 0
DATA SOURCE: Nearmap Imagery (02 September 2024)		DRAWN BY / REVIEWED BY: JP/DW	DATE: 14/10/2024

Legend

- Subject Site
- Buffer 100m
- Buffer 150m
- Asset Protection Zone (APZ)
- Lots
- POS
- ROS
- Road
- Foreshore Reserve
- Access / egress route
- Access point
- Cul-de-sac
- Water Hydrant (WCORP-070)

Bushfire Attack Level (BAL)

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

No	Description	Drawn	Approved	Date
A	Original issue	JP	DW	14/10/2024

NOTES:

Cadastral boundary from LANDGATE 2022. Label corresponds to the vegetation association number.

WESTERN ENVIRONMENTAL
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08 6244 2310 | enquiries@westenv.com.au
Level 3/25 Prowse St, West Perth WA 6005
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4. Responsibilities for Implementation and Management of Bushfire Management Measures

Responsibility for implementation of the bushfire risk management measures outlined in Section 3 of this BMP applies to the developer, future owners/builders within the subject site and the local government. Table 4 provides a works program detailing these measures, timing of implementation and responsibility.

Table 4: Proposed Works Program

No.	Bushfire management measure
Developer responsibilities - Prior to issue of Titles	
1	Ensure APZs are established and maintained as per Figure 7.
2	Ensure vegetation within the POS reserves is modified to low threat.
3	Ensure vegetation within the ROS reserve is modified to low threat or establish a 21m wide low threat buffer along the boundary adjacent to the proposed lots.
4	Construct public road network (including cul-de-sac) to the technical requirements in Appendix D.
5	Provide reticulated water supply and hydrants in accordance with relevant technical requirements.
6	Certify the BAL ratings for all lots following completion of the subdivision works for each stage.
Developer / Landowner responsibilities - Ongoing	
7	Maintain APZs to the standards in Appendix C.
8	Maintain the POS reserves and ROS reserve in a low threat state.
Future landowners / Builder responsibilities - Ongoing	
9	Construct dwellings to relevant construction standard in AS 3959: 2018.

5. Conclusion

In the professional opinion of the author, the proposed LSP and subdivision satisfies the intent, aim and objectives of SPP 3.7 and the Guidelines and is recommended for approval.

6. References

Department of Fire and Emergency Services (DFES). (2024). *Map of Bush Fire Prone Areas*. Retrieved on 2 October 2024 from: http://www.dfes.wa.gov.au/regulationandcompliance/bushfireproneareas/Pages/default.aspx.

Emerge Associates (2021). Lots 2, 3 & 6 Midland Road, Helena Valley - Foreshore & Public Open Space Plan.

Standards Australia (SA). (2018). *Construction of buildings in bushfire-prone areas* (AS 3959: 2018).

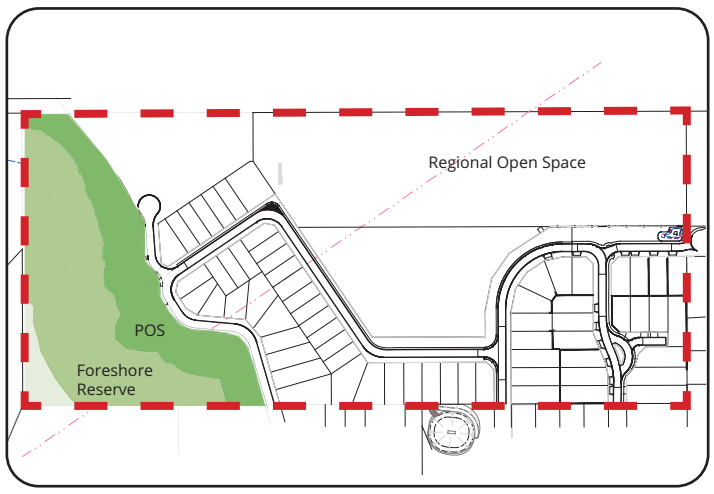
Western Australian Planning Commission (WAPC). (2024a). *State Planning Policy 3.7 Bushfire*. Government of Western Australia.

Western Australian Planning Commission (WAPC). (2024b). *Planning for Bushfire Guidelines*. Government of Western Australia.

Appendix A: Foreshore and Public Open Space Plan

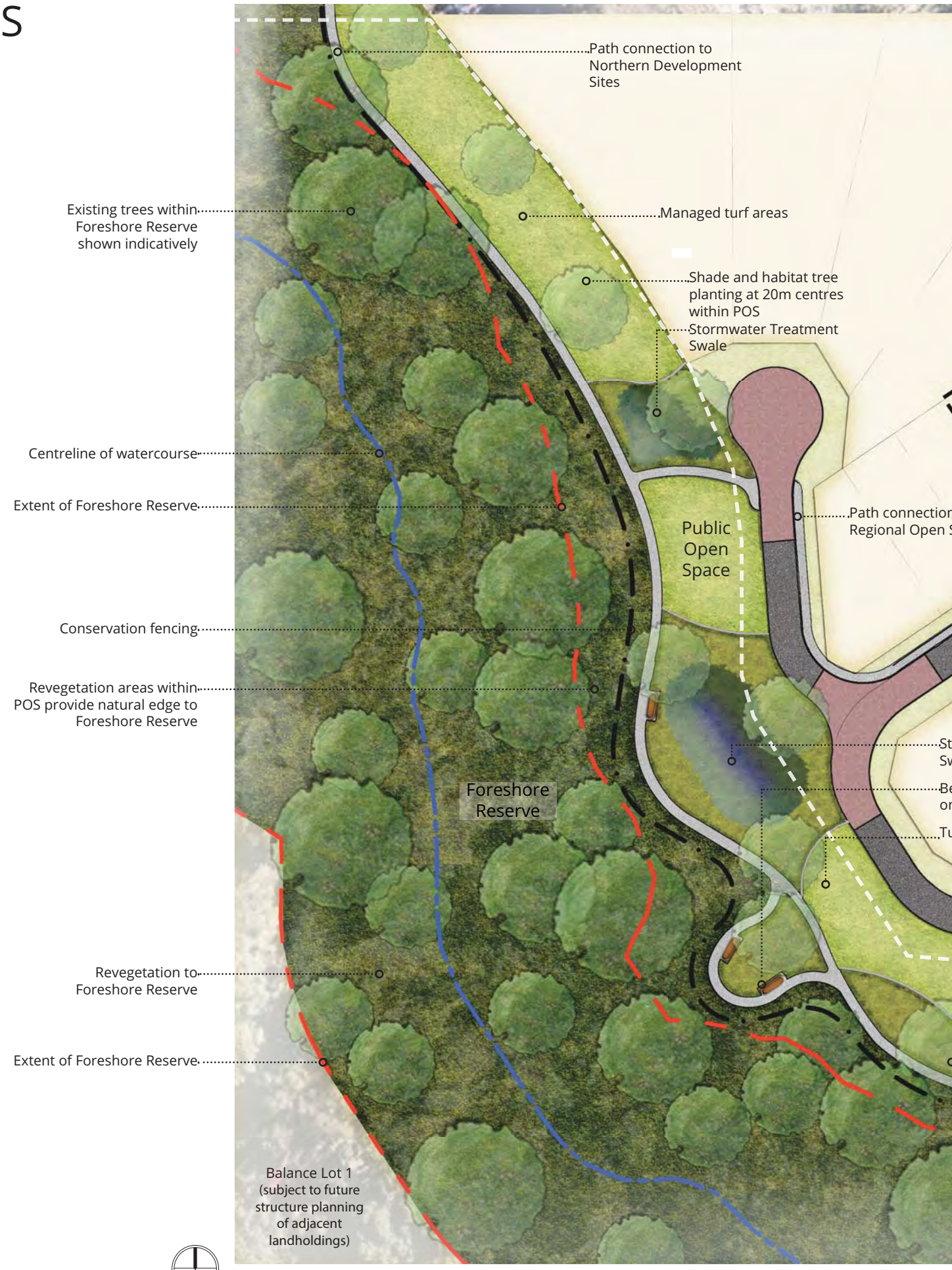
Foreshore Reserve & POS

LOCATION PLAN



LEGEND

- Foreshore Reserve Boundary
- Centreline of Watercourse
- POS Lot Boundary
- Conservation Fencing
- Existing Native Tree Planting
- Shade and Habitat Tree at 20m spacings
- Native Low fire Threat Shrub Planting Areas
- Revegetation Planting
- 2.1m Wide Concrete Path
- Informal / Bench Seating
- Turf areas
- Concrete Mowing/ Maintenance edge
- Road Treatments
- Stormwater Treatment Swale



CONCEPT PLAN

DWG · **ENV-HV-FMP**
REV · **C**
DATE · **Oct 2021**
SCALE · **1:1000 at A3**

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LOTS 2, 3 & 6 MIDLAND ROAD, HELENA VALLEY

FORESHORE & PUBLIC OPEN SPACE PLAN

Appendix B:
Classified Vegetation Photos

Plot 1	Class A Forest
Photo 1 Trees to 30 m in height to the north of the subject site. The overstorey is dominated by Eucalypt species with canopy cover greater than 30% and the vegetation structure within the plot is multi-tiered. The slope under this vegetation was assessed to be downslope 5 - 10 degrees. Note: Drone imagery was used due to access restrictions.	
Plot 1	**Class A Forest**
Photo 2 Trees to 30 m in height to the north of the subject site. The overstorey is dominated by Eucalypt species with canopy cover greater than 30% and the vegetation structure within the plot is multi-tiered. The slope under this vegetation was assessed to be downslope 5 - 10 degrees. Note: Drone imagery was used due to access restrictions.	
Plot 2	**Class A Forest**
Photo 3 Trees to 30 m in height within the subject site along Kadina Brook. The overstorey is dominated by Eucalypt species with canopy cover greater than 30% and the vegetation structure within the plot is multi-tiered. The slope under this vegetation was assessed to be downslope 0 - 5 degrees.	

Plot 2	Class A Forest
Photo 4 Trees to 30 m in height within the subject site along Kadina Brook. The overstorey is dominated by Eucalypt species with canopy cover greater than 30% and the vegetation structure within the plot is multi-tiered. The slope under this vegetation was assessed to be downslope 0 - 5 degrees.	
Plot 3	**Class A Forest**
Photo 5 Trees to 30 m in height within the subject site along Kadina Brook. The overstorey is dominated by Eucalypt species with canopy cover greater than 30% and the vegetation structure within the plot is multi-tiered. The slope under this vegetation was assessed to be flat/upslope.	
Plot 3	**Class A Forest**
Photo 6 Trees to 30 m in height to the north of the subject site. The overstorey is dominated by Eucalypt species with canopy cover greater than 30% and the vegetation structure within the plot is multi-tiered. The slope under this vegetation was assessed to be flat/upslope. Note: Drone imagery was used due to access restrictions.	

Plot 3	Class A Forest
Photo 7 Trees to 30 m in height to the south of the subject site. The overstorey is dominated by Eucalypt species with canopy cover greater than 30% and the vegetation structure within the plot is multi-tiered. The slope under this vegetation was assessed to be flat/upslope.	
Plot 3	**Class A Forest**
Photo 8 Trees to 30 m in height within the subject site. The overstorey canopy cover is greater than 30% and the vegetation structure within this plot is multi-tiered. The slope under this vegetation was assessed to be flat/upslope.	
Plot 4	**Class B Woodland**
Photo 9 Trees to 30 m in height with the overstorey dominated by Eucalypt species. The overstorey canopy cover is less than 30% with predominantly grassy understorey. The slope under this vegetation was assessed to be flat/upslope.	

Plot 4	Class B Woodland
Photo 10 Trees to 30 m in height with the overstorey dominated by Eucalypt species. The overstorey canopy cover is less than 30% with predominantly grassy understorey. The slope under this vegetation was assessed to be flat/upslope.	
Plot 5	**Class D Scrub**
Photo 11 Shrubs greater than 2m in height along Gray Road. The structure is multi-tiered and overall foliage cover is greater than 30%. The slope under this vegetation was assessed to be flat/upslope.	
Plot 5	**Class D Scrub**
Photo 12 Shrubs greater than 2m in height along Gray Road. The structure is multi-tiered and overall foliage cover is greater than 30%. The slope under this vegetation was assessed to be flat/upslope.	

Plot 6	Class G Grassland
Photo 13 Open paddocks to the north of the subject site with grasses greater than 100mm in height and isolated trees less than 10% foliage cover. The slope under this vegetation was assessed to be flat/upslope. Note: Drone imagery was used due to access restrictions.	
Plot 6	**Class G Grassland**
Photo 14 Open paddocks to the north of the subject site with grasses greater than 100mm in height and isolated trees less than 10% foliage cover. The slope under this vegetation was assessed to be flat/upslope. Note: Drone imagery was used due to access restrictions.	
Plot 6	**Class G Grassland**
Photo 15 Open paddocks to the north of the subject site with grasses greater than 100mm in height and isolated trees less than 10% foliage cover. The slope under this vegetation was assessed to be flat/upslope.	

Plot 6	Class G Grassland
Photo 16 Area of grassy regrowth greater than 100mm in height. The slope under this vegetation was assessed to be flat/upslope.	
Plot 6	**Class G Grassland**
Photo 17 Grassy areas currently flooded assumed to be unmanaged and greater than 100mm in height during the bushfire season. The slope under this vegetation was assessed to be flat/upslope.	
Plot 7	**Excluded - clause 2.2.3.2 (e)**
Photo 18 Stages 1 and 2 of the subdivision which have been cleared of vegetation.	

Plot 7	Excluded - clause 2.2.3.2 (e)
Photo 19 Existing residential street devoid of vegetation and low threat public open space.	
Plot 7	**Excluded - clause 2.2.3.2 (e)**
Photo 20 Existing cleared areas throughout the subject site.	
Plot 6	**Excluded - clause 2.2.3.2 (e)**
Photo 21 Existing streets and residential buildings devoid of vegetation.	

Plot 7	Excluded - clause 2.2.3.2 (e)
Photo 22 Stages 1 and 2 of the subdivision which have been cleared of vegetation.	
Plot 7	**Excluded - clause 2.2.3.2 (e)**
Photo 23 Stages 1 and 2 of the subdivision which have been cleared of vegetation.	
Plot 8	**Excluded - clause 2.2.3.2 (f)**
Photo 24 (background) Fruit orchard which contains low threat vegetation. Note: Drone imagery was used due to access restrictions.	

Plot 8	Excluded - clause 2.2.3.2 (f)
Photo 25 Public parkland containing low threat vegetation.	
Plot 8	**Excluded - clause 2.2.3.2 (f)**
Photo 26 (Background) Public parkland containing low threat vegetation.	
Plot 8	**Excluded - clause 2.2.3.2 (f)**
Photo 27 Low threat landscaping on residential properties.	

Appendix C:
APZ Technical Requirements

The following standards have been extracted from the Planning for Bushfire Guidelines (WAPC, 2024b).

Every habitable building is to be surrounded by, and every proposed lot can achieve, an APZ depicted on submitted plans, which meets the following requirements:

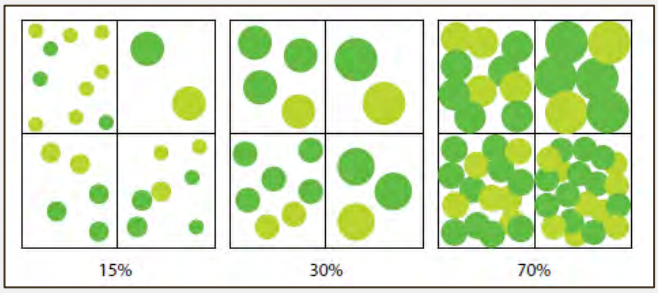
a. Width: the APZ is measured from the development site, and of sufficient size to ensure the radiant heat impact of a bushfire does not exceed 29kW/m² (BAL-29) in all circumstances.

b. Location: the APZ should be contained solely within the boundaries of the lot, except in instances where:

   - the vegetation on the adjoining lot(s) is, and will continue to be, low threat as per Clause 2.2.3.2 of AS 3959 or the APZ technical requirements, or an alternative standard on a local planning scheme, on an ongoing basis in perpetuity; or
   - the adjoining land is and will remain in perpetuity, non-vegetated.

c. Management: the APZ is managed in accordance with the APZ technical requirements (below), or an alternative standard in a gazetted local planning scheme.

APZ Technical Requirements

Object	Requirement
Fences within the APZ	Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).
Fine fuel load (Combustible, dead vegetation matter less than 6 mm in thickness)	• Should be managed and removed on a regular basis to be maintained as a low threat vegetation. • Should be maintained at less than two tonnes per hectare (on average). • Mulches should be non-combustible such as stone, gravel, shells, rock or crushed mineral earth or wood mulch more than five millimetres in thickness.
Trees* (more than 6 m in height)	• Trunks at maturity should be a minimum distance of six metres from all elevations of the building. • Branches at maturity should not touch or overhang a building or powerline. • Lower branches and loose bark should be removed to a height of two metres above the ground and/or surface vegetation. • Canopy cover within the APZ should be less than 15 per cent of the total APZ area. • Tree canopies at maturity should be at least 5 m apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided the total canopy cover within the APZ does not exceed 15 per cent and is not connected to the tree canopy outside the APZ.  *Tree canopy cover – ranging from 15 to 70 per cent at maturity*

Object	Requirement
Shrub* and scrub* (0.5 m to 6 m in height). Shrub and scrub more than 6 m in height are to be treated as trees.	• Should not be located under trees or within three metres of buildings. • Should not be planted in clumps more than five square metres in area. • Clumps should be separated from each other and any exposed window or door by at least 10 metres.
Ground cover*(less than 0.5 m in height. Ground cover more than 0.5 m in height is to be treated as shrub)	• Can be planted under trees but must be maintained to remove dead plant material, as prescribed in 'Fine fuel load' above • Can be located within two metres of a structure but three metres from windows or doors if more than 100 mm in height.
Grass	• Grass should be maintained at a height of 100 mm or less, at all times • Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation.
Defendable space	Within three metres of each wall or supporting post of a habitable building; the area is kept free from vegetation but can include ground cover, grass and non- combustible mulches as prescribed above.
Liquid petroleum gas cylinders	• Should be located on the side of a building farthest from the likely direction of a bushfire or on the side of a building where surrounding classified vegetation is upslope, at least one metre from vulnerable parts of a building. • The pressure relief valve should point away from the house. • No flammable material within six metres from the front of the valve. • Must sit on a firm, level and non-combustible base and be secured to a solid structure.
** Plant flammability, landscaping design and maintenance should be considered - refer to explanatory notes in the Guidelines.*	

Additional Notes:

An Asset Protection Zone (APZ) is a low fuel area, maintained around a building to increase the likelihood a building will survive a bushfire, by reducing the potential for direct flame contact, radiant heat exposure and ember attack. The APZ allows emergency services access and provides an area for firefighters and home-owners to defend their property.

An APZ should be contained within the boundaries of the lot on which the building is situated, except in instances where it is demonstrated the vegetation on the adjoining land is, and will continue to be, low threat as per cl. 2.2.3.2 of AS 3959, or the vegetation on the adjoining lot is, and will remain in perpetuity, non-vegetated. However, it should be noted there is no requirement for a neighbouring landowner or land manager (public or private) to be party to a legal agreement to undertake ongoing management of vegetation as low threat, in perpetuity.

Appendix D:
Vehicular Access Technical Requirements

Technical requirements	Perimeter Roads		Public Roads		Emergency Access Way3		Fire Service Access Route3		Battle-Axe and Private Driveways1	
Map of Bush Fire Prone Areas Designation	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1	Area 2	Area 1
Minimum horizontal clearance (m)	12	8	See note 5		10	6	10	6	6	
Minimum vertical clearance (m)	4.5									
Minimum weight capacity (t)	15									
Maximum grade unsealed road2	See note 5		See note 5		1:10 (10% or 6 degrees)					
Maximum grade sealed road2, 4					1:7 (14.3% or 8 degrees)					
Maximum average grade sealed road					1:10 (10% or 6 degrees)					
Minimum inner radius of road curves (m)					8.5					

Notes:

1. Driveways and battle-axe legs to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision where not required to comply with the widths in this Appendix or the Guidelines.

2. Dips must have no more than a 1 in 8 (12.5% - 7.1 degrees) entry and exit angle.

3. To have crossfalls between 3 per cent and 6 per cent.

4. For sealed roads only the maximum grade of no more than 1 in 5 (20 per cent) (11.3 degrees) for no more than 50 metres is permissible, except for short constrictions to 3.5 metres for no more than 30 metres in length where an obstruction cannot be reasonably avoided or removed.

5. As outlined in the Institute of Public Works Engineering Australasia (IPWEA) subdivision guidelines, Liveable Neighbourhoods, Austroads Standards Main Roads standard, supplement, policy or guideline and/or any applicable or relevant local government standard or policy.

element. | PART OF SLR

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