Structure Plan

Northwater Carnarvon
Stages 4 and 5

Prepared for DevelopmentWA

Prepared by Taylor Burrell Barnett

March 2024

Taylor Burrell Barnett

Document Information

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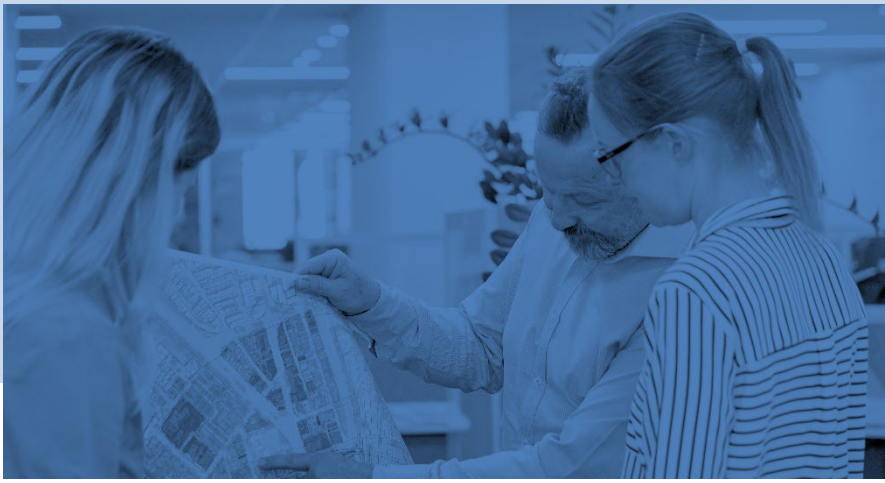

Doc ID: 10~036 RPT Carnarvon Structure Plan 1.0

Revision	Status	Author	Approved by	Date Issue
1.0	Draft	F Farrag E McElwee	M Willcock	1/03/24
1.0	Final	F Farrag E McElwee	M Willcock	5/03/24

ENDORSEMENT

This Structure Plan is prepared under the provisions of the **Shire of Carnarvon Local Planning Scheme No. 13**

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

…….. Date

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

…….. Date

…….. Date of Expiry

TABLE OF AMENDMENTS

Amendment No.	Summary of the Amendment	Amendment Type	Date Approved by WAPC

TABLE OF DENSITY PLANS

Density Plan No.	Area of Density Plan Application	Date Endorsed by WAPC

EXECUTIVE SUMMARY

This Northwater Carnarvon structure plan is prepared to guide the subdivision and development of land fronting the Carnarvon Fascine, situated between Jaaga Cove and Babbage Island Road.

Specifically, the structure plan applies to part of Lot 9001 on Deposited Plan 402324 (the subject land), within the locality of Brockman in the Shire of Carnarvon. The structure plan area is approximately 750 metres north-west of the Carnarvon Town Centre, 1.5 kilometres north-west of the Carnarvon Airport and 1.3km north-west of the Carnarvon Hospital. The structure plan is proposed to provide a road connection from Babbage Island Road at its northern extent through to Parnaa View at its southern extent.

The subject land has previously been cleared of remnant vegetation due to the construction of a levee system to protect urban areas from flooding of the Gascoyne River, and the land has partly been filled as a result of depositing dredge spoil associated with the Northwater estate and canal system which is located to the immediate south. Lot 9001 is owned by the Western Australian Land Authority t/a DevelopmentWA. DevelopmentWA will be responsible for the future subdivision and development of the subject land.

The structure plan is prepared in a manner and form approved by the Western Australian Planning Commission (WAPC) and comprises of:

- Executive Summary;
- Part One – Implementation including the Structure Plan; and
- Part Two – Explanatory Section including the technical appendices.

Technical reports and studies have been prepared and are appended to the Structure Plan:

Appendix A	Public Open Space Schedule (TBB Plan: 10/036/044B) and Landscape Masterplan, Rev B (Emerge, 2023);
Appendix B	Local Water Management Strategy, Rev D (GHD, 2024);
Appendix C	Carnarvon Inundation Modelling Summary Report, R1789 Rev 0 (M P Rogers & Associates, 2023);
Appendix D	Servicing Report (GHD, 2023);
Appendix E	Traffic Impact Statement (TBB, 2024); and
Appendix F	Bushfire Management Plan, R64444 R01 Rev 0 (JBS&G, 2023).

The following **Table 1** is a summary of the key statistics and information as it applies to the structure plan area.

Table 1 Structure Plan Summary Table

Item	Data	Structure Plan reference (section no.)
Total area covered by the Structure Plan	8.3917 hectares (ha)	Plan 1 – Structure Plan
Approximate area of each land use proposed: • Residential • Public Open Space • Road Reserves	 4.5595 ha 2.1277 ha 1.7045 ha	Plan 1 – Structure Plan
Estimated Lot Yield	53 lots	Part 1, Section 2.2.1
Estimated No. of Dwellings	53 dwellings	Part 1, Section 2.2.1
Estimated Residential Site Density	6.3 dwellings per site/ha	Part 1, Section 2.2
Estimated Population	Approximately 122 persons	
No. of High Schools	0 (Structure Plan area)	Part 2, Section 3.3.1
No. of Primary Schools	0 (Structure Plan area)	Part 2, Section 3.3.1
Estimated Commercial Space	0m^2 net lettable area	Part 2, Section 3.3.3
Estimated area and percentage of Public Open Space given over to Local Parks	2.1277 ha	Plan 1 – Structure Plan Part 1, Section 2.1.3
Estimated percentage of natural area	25.4%	Plan 1 – Structure Plan Part 1, Section 2.1.3

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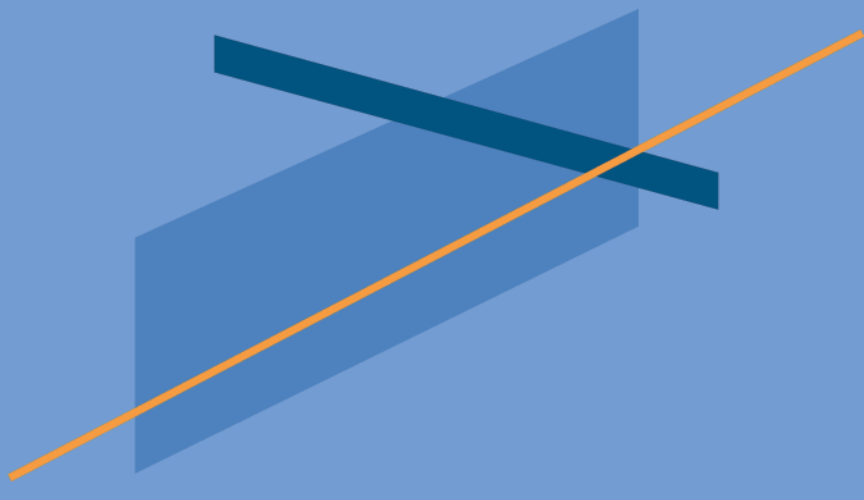
Part 1

IMPLEMENTATION



1.0 Implementation

1.1 Structure plan area and operation

This Structure Plan applies to the land contained within the inner edge of the line denoting the structure plan boundary on the structure plan map (**Plan 1**), comprising part of Lot 9001 on Deposited Plan 402324. Details of land within the structure plan area is contained in **Part 2**, **section 1.2.3**, **Table 5**.

The plan is in effect from the date it is approved by the Western Australian Planning Commission (WAPC) pursuant to section 16 of the *Planning and Development Act 2005* and for a period of 10 years.

The Shire of Carnarvon Local Planning Scheme No. 13 (LPS 13) informs the structure plan's implementation.

1.2 Purpose of the structure plan

The purpose of the structure plan is to guide subdivision and development of the land to coordinate with the existing urban area within Brockman. The structure plan aims to coordinate subdivision and development with extensions of existing roads and utilities. The structure plan will provide quality residential land in proximity to amenity. The structure plan is considered to meet short and medium term demands for housing.

The structure plan is strategically located within Brockman in close proximity to the Carnarvon townsite and with views over the Carnarvon Fascine. The delivery of residential land will assist with additional land supply to ensure that growth of the townsite can be facilitated into the medium and long-term. The structure plan seeks to provide for a range of housing choice and densities to meet the needs of the existing and future community.

The structure plan is partly constrained by the Special Control Area 1 that seeks to protect the existing Waste Water Treatment Plant (WWTP) from encroachment of sensitive land uses. Infrastructure investment and government coordination for the relocation of the WWTP will further assist in de-constraining development within the Brockman locality.

The objectives for the structure plan area have been prepared as follows:

- Provide a sensitive and appropriate design interface between the Carnarvon Fascine and residential development, ensuring public land is provided alongside the waterway consistent with coastal planning principles;
- Design for a mix of development overlooking the waterway, providing a range of experiences, surveillance and equity;
- Deliver nodes of landscape areas for community gathering and social focal points for recreation and views;
- Provide a coordinated and managed landscape interface that ensures low maintenance outcomes for the local government and providing a suitable landscape design that is consistent with bushfire protection objectives; and
- Implement a suitable staged approach having regard to the future requirement for the relocation of the WWTP.

1.3 Staging of implementation

Stages 1 and 2 related to the residential and canal development that have since been developed to the south-east of the structure plan area. Stage 3 relates to an area of the parent lot that was granted subdivision approval in May 2023 for new residential lots.

The structure plan area is separated into Stages 4 and 5 as indicated in **Figure 1**. Stages 4 and 5 relate to the balance of the parent lot and includes land between Parnaa View and Babbage Island Road, fronting the Carnarvon Fascine. The structure plan area is anticipated to facilitate the development of 53 lots.

Stage 4 will be the next stage of subdivision and will facilitate development adjacent to the existing residential area. The subdivision and development of Stage 4 would be subject to subdivision in accordance with this structure plan. Subdivision would require the extension of Parnaa View and Yaburru Loop, with a temporary cul-de-sac head for the extension of Parnaa View (unless a road connection through to Babbage Island Road is required). It is anticipated that the estimated lot yield for Stage 4 would be 30 lots.

Stage 5 is located within the generic buffer which is depicted on the scheme maps as Special Control Area 1 – Carnarvon Waste Water Treatment Plant. Stage 5 would deliver the extension of Parnaa View through to Babbage Island Road (unless a road connection is provided as part of Stage 4), which will facilitate front-loaded residential development. The estimated yield for Stage 5 is 23 lots. This would represent the final build-out of residential development in Brockman and in proximity to the Carnarvon town site.

The timing of subdivision and development within Stage 5 would be incumbent on infrastructure decisions associated with the decommissioning and removal of the existing waste water treatment plant. It is anticipated that the process and cost of relocating the WWTP will be borne by the Water Corporation. The timeframe for decommissioning and relocation of the WWTP is unknown. It is understood the Water Corporation considers the capacity of the existing WWTP can cater for projected population growth through until 2040-2045, depending on growth rates and any other infrastructure, servicing and/or environmental variables. Should the WWTP be decommissioned, the SCA 1 would be considered redundant for the existing location, and an amendment to LPS 13 would be required to remove the buffer and therefore facilitate the delivery of Stage 5.

LEGEND

- STRUCTURE PLAN EXTENT
- **SCA1** - SPECIAL CONTROL AREA - INFRASTRUCTURE
- STAGE 4
- STAGE 5

Note. Staging Boundary for residential development, subject to the future relocation of the Water Corporation Waste Water Treatment Plant.

plan:
10/036/050A

scale:
0 35 70m

BABBAGE ISLAND ROAD
TONKIN CRESCENT
FANE CRESCENT
LEWINGTON LANE
PARNAA VIEW
YABURRU LOOP
DAVID BRAND DRIVE
JAAGA COVE
AREA SUBJECT TO SCHEME AMENDMENT 4

INSET - NORTHWATER CARNARVON STAGE 4 AND 5

Figure 1 - Northwater Carnarvon Stageing Plan

LOT 9001 DAVID BRAND DRIVE, CARNARVON

scale:
1:3000@A3 | 1:1500@A1

0 30 60m

plan:
10/036/050A

date:
16/02/2024

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2.0 Subdivision and Development Requirements

This structure plan has been prepared to provide an appropriate level of information to guide future subdivision and development. The following requirements will be implemented through subdivision and development within the structure plan area.

2.1 Land Use Zone and Reserves

The structure plan map (**Plan 1**) outlines the following zones and reserves applicable within the structure plan area:

- Residential zone;
- Local Road reserve; and
- Public Open Space reserve.

2.1.1 Residential Zone

In accordance with the Shire of Carnarvon Local Planning Scheme No. 13, the structure plan categorises land within the 'Residential' zone to facilitate housing diversity and a well-planned and staged land supply for dwellings. The structure plan delivers outcomes consistent with the objectives of the 'Residential' zone are outlined as follows:

- The structure plan provides for a range of housing and a choice of residential densities to meet the needs of the community. The range of density codes provide for suitable diversity of lot sizes to address housing supply and housing affordability;
- The structure plan will facilitate and encourage high quality design, built form and streetscapes throughout the residential areas. Local development plans may be prepared to guide development within specific locations within the structure plan area; and
- Land use permissibility is established by the zoning table for the 'Residential' zone in the local planning scheme. It is anticipated that other uses may be contemplated within the 'Residential' zone, where listed in the zoning table. This will facilitate a range of compatible non-residential uses that can be complementary to the residential development.

2.1.2 Road reserve

Noting the extent of the structure plan area, **Plan 1** identifies the road network which is aimed at facilitating efficient traffic flow, establishing future road and footpath connections, and optimising the layout of front-loaded residential lots. The structure plan proposes a 20m wide road reserve extension of Parnaa View, and a 14-15m wide road reserve providing a connection from Yaburru Loop to the Parnaa View extension. Further details of the movement network are provided in **Part 2**, **section 5.2.2** and the traffic impact statement (**Appendix E**). Future subdivision applications shall have due regard to this indicative road layout, ensuring roads are designed to a suitable standard appropriate for residential development.

2.1.3 Public Open Space reserve

The Brockman suburb has been analysed to confirm the existing supply of POS within the locality, to determine what percentage of the structure plan would be required to ensure a minimum of 10% is provided overall. As per **Figure 2**, the suburb of Brockman covers an area of 103.12 hectares. Of this, 23.64 hectares of the suburb are considered to be deductions from the gross subdivisible area including sewage pumping stations, waterways, pedestrian access ways and a child care centre. The remaining gross subdivisible area is calculated to be approximately 80.47 hectares, 10% of which is calculated to be 8.05 hectares of required POS.

As part of preparing this structure plan, calculations were undertaken and approximately 5.58 hectares of the Brockman suburb is provided as POS, equivalent to 6.9%. To help lift this provision to 10%, the structure plan area would need to provide 2.13 hectares of land as POS. This would contribute towards the overall availability and supply of POS within the Brockman suburb.

An area of Public Open Space (POS) is identified on the structure plan (**Plan 1**) along the western interface of Lot 9001 and the Carnarvon Fascine. This POS is proposed to provide adequate amenity along the Carnarvon Fascine, and to provide a suitable landscaped interface between the waterway and residential development.

A public open space schedule is provided in **Table 2**. Consideration has been given to the provisions of *Liveable Neighbourhoods* (WAPC, 2009) permitting a 5% variation to the provision of POS as a condition of subdivision. Noting this, the POS schedule in **Table 2** below indicates that the structure plan area has sufficient capability to deliver 25.4% of the structure plan area as POS, which would lift the total provision of POS in the Brockman suburb to 10%.

Table 2 Public Open Space Schedule

Northwater Stage 4 – 5 Structure Plan		
	Hectares (ha)	**Hectares (ha)**
Total Structure Plan Area		**8.3917**
Less Deductions		0.0000
N/A	0.0000	
Net Subdivisible Area		**8.3917**
Public open space @ 10%		0.8392
Public Open Space requirements:		
80% Unrestricted Use (Minimum)	0.6713	
20% Restricted Use (Maximum)	0.1678	
Total		**0.8392**
Public Open Space provision:		
Unrestricted Public Open Space		**2.1277**
POS 1	2.1277	
Restricted Public Open Space		**0.0000**
N/A	0.0000	
Total Credited Public Open Space		**2.1277**
Percentage of Credited Public Open Space Provided		**25.4%**

POS shall be developed in accordance with the requirements of the WAPC's operational policy *Liveable Neighbourhoods* and generally in accordance with the landscape concept plan (refer **Appendix A**). It is intended that portions of the POS will interface with residential development and have partial road frontage. Within the structure plan area, the POS will provide a passive function. To address local government preliminary advice, the landscape design of the POS is proposed to be very low maintenance and will represent a low threat landscaping outcome to mitigate any BAL impacts on dwellings. Low threat vegetation will be able to incorporate suitable species of vegetation well-suited to a coastal environment, reflecting the Carnarvon Fascine setting whilst ensuring an appropriate landscape response for adjacent residential development.

Public open space shall be ceded free of cost with management vested to the local government for the purposes of public open space / recreation / foreshore management.

LEGEND

- BROCKMAN LOCALITY BOUNDARY (103.1119ha)
- CROWN RESERVE
- PUBLIC OPEN SPACE - NON RESERVE
- WATERWAYS
- VACANT CROWN LAND
- PROPOSED PUBLIC OPEN SPACE - STRUCTURE PLAN (2.1277ha)
- 2 PUBLIC OPEN SPACE NUMBERS
- D2 DEDUCTION NUMBERS

PUBLIC OPEN SPACE YIELDS

PUBLIC OPEN SPACE	
1 R44093, Lot 1239	0.6432ha
2 Lot 1179	3.4825ha
3 R49812, Lot 838 and R46363, Lot 1348	0.7222ha
4 R49812, Lot 837	0.1678ha
5 R49812, Lot 836	0.0581ha
6 R41680, Lot 1299	0.0978ha
7 R41680, Lot 1313	0.1159ha
8 R41680, Lot 500	0.0903ha
9 Lot 1193 and Lot 1147	0.6859ha
10 R42702	0.0869ha
11 PROPOSED PUBLIC OPEN SPACE - STRUCTURE PLAN	2.1277ha
TOTAL	**8.2783ha**

DEDUCTIONS	
D1 R41681 - Sewage Pumping Station	0.431ha
D2 VCL (cumulatave total)	9.9589ha
D3 Waterways (cumulative total)	8.7903ha
D4 R49811 - Waterway Management	0.7050ha
D5 R40700 - Sewage Pumping Station	0.0544ha
D6 L10 D74601 CT 2694/856	0.0656ha
D7 L9001 DP55249 CT 2006/270	0.7026ha
D8 R30512 and R30513 - child care centre	0.4009ha
D9 L55 P13859 CT 2725/28 - PAW	0.0250ha
D10 L55 P13389 CT 157/801 - PAW	0.0300ha
D11 R6049 - Historical Purposes	1.6753ha
TOTAL	**22.839ha**

BABBAGE ISLAND ROAD
DAVID BRAND DRIVE
JAAGA COVE
Lot 9001

Figure 2 - Public Open Space Plan for the Brockman Suburb

BROCKMAN

scale: 1:5000@A3 | 1:2500@A1

0 50 100m

plan: 10/036/044C

date: 16/02/2024

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2.1.4 Special Control Area 1: Town of Carnarvon Wastewater Treatment Plant (WWTP)

The SCA 1 boundary is delineated on the Scheme Map and is reflected on **Plan 1**. The LPS 13 shall prevail to the extent of any inconsistency with the depiction of the SCA 1 boundary on Plan 1.

The provisions of the SCA 1 do not prevent a structure plan from being prepared within the WWTP buffer. For the purposes of reflecting the objectives of the SCA 1, the staging boundary is placed on the structure plan with a note stating that "*Staging Boundary for residential development, subject to the future relocation of the Water Corporation Waste Water Treatment Plant*". The main outcome of showing the future road and residential development within the land subject to SCA 1 is to demonstrate how road connections and development can be undertaken in the long-term, in a manner that integrates with existing/proposed roads and development. **Section 1.3** refers to the implementation for Stage 5 having regard to the future decommissioning relocation of the WWTP.

2.1.5 Special Control Area 3: Flood Prone Area

The SCA 3 boundary is delineated on the Scheme Map and is reflected on **Plan 1**. The structure plan identifies land within the special control area, and new development shall not detrimentally impact, alter or modify the extent of floor impact, and is informed by recommendations for minimum habitable floor levels.

The structure plan requires development to occur within the scheme's SCA 3 boundary to facilitate new road connections and appropriate residential lot sizes and regular shaped lots.

The responsible authority for determining a subdivision application within an area subject to SCA 3 and potentially impacted by coastal erosion would require the area to be developed above 4.0mAHD. This would allow all roadways and linkages necessary for residents for access. The alternative would be for finished floor levels to be above 4.0mAHD, if all areas including existing roads cannot achieve a level of 4.0mAHD.

Following subdivision and development, a review of the SCA 3 boundary may be required (i.e., as part of a scheme review) to more accurately reflect post-development conditions.

2.2 Density and Development

2.2.1 Density and R-Codes

Plan 1 designates a density code range applicable to subdivision and development in the structure plan area.

An R-Codes plan is to be submitted at the time of subdivision for the entire structure plan area. The plan will allocate R-Codes for proposed street-blocks/lots (as the case requires). Once approved by the WAPC, the R-Codes plan forms part of the structure plan.

2.2.1.1 Dwelling Target

The structure plan seeks to achieve a target of approximately 53 dwellings within the 'Residential' zone.

2.2.1.2 Residential Density

The structure plan area will utilise a density code range of 'R12.5-R25' to provide flexibility of development and diverse housing opportunities. The density code range will facilitate a range of lot sizes to respond to local considerations and are consistent with the densities and forms of residential development expressed in the local area, thereby providing a suitable character and amenity for the structure plan area.

The 'R12.5-R25' residential density code range applies to all future lots in the structure plan area. The proposed density code range facilitates flexibility and opportunity for a mix of dwelling typologies and, due to site constraints, will achieve front-loaded lot product. Noting that future dwelling requirements may change, the density code range will provide flexibility. An R-Codes Plan together with suitable justification can be submitted as part of a subdivision application.

2.2.2 Development Layout

The structure plan is proposed to facilitate residential development. The structure plan also identifies land for public open space and has regard to special control areas that overlay the structure plan area.

This structure plan will facilitate and provide for a wide range of generous lot sizes to encourage an appropriate level of housing product diversity to meet market demands in Carnarvon. Development on lots will be oriented with direct street frontages, to provide opportunities for passive surveillance towards roads and public open space, and presenting as single dwellings having regard to the predominant lot layout and dwelling typology expressed in the immediate locality including Stages 1, 2 and 3 of the Northwater Carnarvon precinct adjacent to the south.

The structure plan area is constrained by the flood prone area special control area (SCA 3), infrastructure special control area (SCA 1), the dimensions of the subject land, the very northern extent being bush fire prone, and the aim to integrate the proposed development outcomes with existing lots and roads.

To mitigate against SCA 1, subdivision and development within Stage 5 (as shown on **Figure 1**) will be undertaken having regard to the future decommissioning and relocation of the waste water treatment plant.

To mitigate against SCA 3, minimum habitable floor levels are recommended having regard to detailed modelling undertaken in the *Carnarvon Inundation Modelling Summary Report* (refer **Appendix C**).

Within the 'Residential' zone, the LPS 13 provisions, R-Codes and relevant local planning policies will apply to dwellings (including outbuildings). Specific development controls can be adopted where it is considered necessary to provide additional planning controls via a local development plan or local planning policy. Land use permissibility and development standards will be consistent with LPS 13.

2.2.2.1 Development Requirements

a) In considering subdivision and development of Lot 9001 on Deposited Plan 402324, the requirements of LPS 13 for the 'Residential' zone and the R-Codes apply, unless otherwise provided for within this structure plan;
b) Minimum habitable floor levels for residential development are to have regard to the recommendations of the *Carnarvon Inundation Modelling Summary Report*, refer **section 2.2.3** and **Appendix C**; and
c) Development in bush fire prone areas shall have regard to the requirements of the bushfire management plan (and any addendum), as approved by the local government, refer **Appendix F**.

2.2.3 Design storm surge inundation levels for the structure plan area

Subdivision and development within the area is potentially subject to impacts by coastal erosion and inundation. Potential coastal inundation levels have been modelled and are provided in **Appendix C**. Table 4.1 of the *Inundation Modelling Summary Report* (M P Rogers & Associates, 2023) recommends new freehold development to be located at or above an elevation of 4.0 m AHD, which is the predicted level of the 500-year ARI event and the 4.0 m AHD includes a 0.98 m allowance for sea level rise.

Where the structure plan area interfaces with existing development, including roads that are existing below 4.0 m AHD, the aim will be to ensure that finished floor levels for freehold development at or above an elevation of 4.0 m AHD.

2.2.4 Local Development Plans

The preparation of a local development plan (LDP), as indicated on **Plan 1**, may be required for this structure plan area to address the following criteria:

- Development to be designed and sited to promote the use, enjoyment and surveillance of public open spaces; and
- LDP(s) may be required to provide guidance to address car parking and access, bin pad locations, dwelling orientation, retaining walls, fencing, and other matters.

2.2.5 Interface with adjoining areas

The structure plan seeks to seamlessly integrate with the existing residential area within Brockman via the extension of previously constructed roads such as Parnaa View and Yaburru Loop. A northern extension of Parnaa View would facilitate a road connection to Babbage Island Road.

There is existing residential development to the east, and the residential densities within the structure plan area are consistent so that new lots would share rear lot boundaries with existing residential lots, providing a sense of privacy and amenity for new and existing residents.

Proposed subdivision and development along the western boundary of the structure plan will have regard to the interface to the proposed public open space and the Carnarvon Fascine.

2.2.6 Heritage

DevelopmentWA (then known as LandCorp) commissioned an ethnographic survey of the Carnarvon Fascine development in 1994, which involved consultation and community meetings. The Aboriginal Site Survey, *Report on a survey for Aboriginal sites and the Carnarvon Fascine Development Project* included the structure plan area, and concluded that there is a very low potential for surface archaeological material but a low-moderate potential for finding subsurface archaeological material including skeletal material (ERM, 2007). The ethnographic survey and archaeological investigation confirmed there were no known sites of Aboriginal significance within the structure plan area. It is considered that development is capable

of being implemented in the structure plan area, and the proponent is aware of their legislative obligations in relation to aboriginal cultural heritage and managing activities that may harm that heritage.

2.3 Other Requirements

2.3.1 Bushfire protection

The northern portion of Lot 9001 is identified within a bushfire prone area, as such, a Bushfire Management Plan (BMP) has been prepared by accredited bushfire practitioners, JBS&G, in support of this structure plan, refer **Appendix F**.

The BMP confirms that although the subject land currently includes Extreme Bushfire Hazard Levels (BHLs) not suitable for habitable development, the post-development BHL assessment demonstrates that on completion of development, all habitable development areas will be located on land with a Low or Moderate BHL.

A BAL contour assessment will need to be prepared at future planning stages (i.e., subdivision) to demonstrate at a more detailed level that all development will be located within areas of BAL-29 or below, and continue to demonstrate compliance with the acceptable solutions of the *Guidelines for Planning in Bushfire Prone Areas* (the *Guidelines*).

2.3.2 Infrastructure arrangements

Servicing within the structure plan area will be dependent on the ability to connect infrastructure from existing networks and services for electricity, water supply, telecommunications and reticulated sewer.

Utility upgrades will be determined in consultation with utility providers, having regard to the extent of staged subdivision and development requirements.

2.3.3 Development contributions

No development contribution arrangements are required for the Structure Plan area.

2.3.4 Protection or management of environmental or landscape features

Public open space will provide for management of environmental and landscape features, in a manner consistent with the local government's maintenance requirements.

2.3.4.1 Levee system

It is understood the existing levee system may provide some protection from oceanic storm surge. Babbage Island Road acts as a levee and protects the structure plan area from flooding of the Gascoyne River.

The levee system will be subject to negotiation with the Shire of Carnarvon whether the existing levee needs to be removed or replaced.

2.3.5 Water resource management

A local water management strategy has been prepared to support the structure plan (refer **Appendix B**). The LWMS proposes a total water cycle approach to sustainably manage water resources within the structure plan area with water management principles, design criteria and development requirements to be considered with regard to existing site conditions and aspects of the redevelopment.

The LWMS identifies the following key water management objectives:

- Optimise potable and non-potable water use efficiencies and maximise water reuse wherever possible;
- Maintain or improve water quality through water sensitive design principles, while maintaining flood protection and conveyance capacity of the drainage system; and
- Implement waterwise garden practices across all open space areas, including sustainable irrigation practices.

3.0 Additional Details

3.1 Information to be submitted with an application

The following **Table 3** lists the information to be submitted with an application, what matters the plan/study will address, and the relevant consultation requirements.

Table 3 Information to be submitted with an application

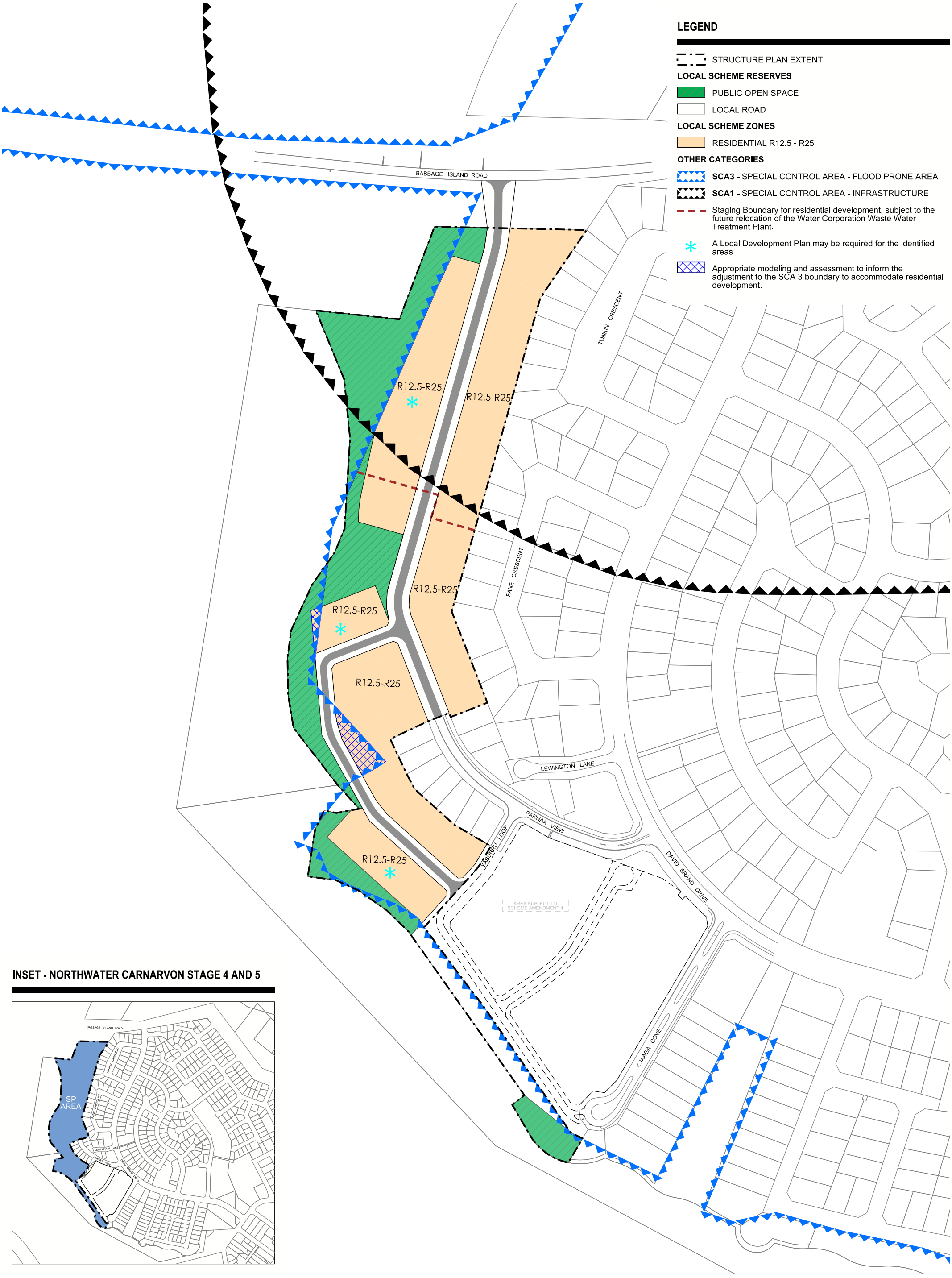
Additional Information / Purpose	Approval Stage	Responsible Agency (consultation required)
Address requirements under SPP 3.7 and *Guidelines* (as amended) only for land that is designated as bushfire prone on the *Map of Bush Fire Prone Areas*.	Subdivision Development	Shire of Carnarvon
As per section 2.2.1 of the structure plan, an R-Codes plan is to be submitted at the time of subdivision for the entire structure plan area. The plan will allocate R-Codes for proposed street-blocks/lots (as the case requires).	Subdivision	Shire of Carnarvon
Public Open Space Plan and Schedule, identifying the size and distribution of public open space.	Subdivision	Shire of Carnarvon

3.2 Studies / Plans required under conditions of approval

The following **Table 4** identifies studies/plan(s), to be required under conditions of subdivision/development approval.

Table 4 Studies to be required under condition of subdivision / development approval

Conditions of Subdivision Approval	Responsible Agency
Urban Water Management Plan	Department of Water and Environmental Regulation
Bushfire Management Plan	Shire of Carnarvon
Local Development Plan	Shire of Carnarvon
Public Open Space Landscape Plan	Shire of Carnarvon



LEGEND

- STRUCTURE PLAN EXTENT

LOCAL SCHEME RESERVES

- PUBLIC OPEN SPACE
- LOCAL ROAD

LOCAL SCHEME ZONES

- RESIDENTIAL R12.5 - R25

OTHER CATEGORIES

- **SCA3** - SPECIAL CONTROL AREA - FLOOD PRONE AREA
- **SCA1** - SPECIAL CONTROL AREA - INFRASTRUCTURE
- Staging Boundary for residential development, subject to the future relocation of the Water Corporation Waste Water Treatment Plant.
- * A Local Development Plan may be required for the identified areas
- Appropriate modeling and assessment to inform the adjustment to the SCA 3 boundary to accommodate residential development.

INSET - NORTHWATER CARNARVON STAGE 4 AND 5

Plan 1 - Structure Plan

LOT 9001 DAVID BRAND DRIVE, CARNARVON

A DevelopmentWA Project

scale: 1:3000@A3 | 1:1500@A1

0 30 60m

plan: 10/036/049D

date: 16/02/2024

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Part 2

EXPLANATORY SECTION

1.0 Introduction and Purpose

1.1 Overview

This structure plan represents a logical staging of appropriate land for residential development that will integrate with existing development in the Brockman suburb. The structure plan has been prepared to address the planning framework and to guide future subdivision and development. The structure plan has been informed by and addresses the requirements of clause 16 of the Deemed Provisions, *Planning and Development (Local Planning Schemes) Regulations 2015*, the *Structure Plan Guidelines* and the provisions of the scheme.

1.2 Land Description

1.2.1 Location

Carnarvon is the main population centre for the Gascoyne region and is the commercial and administrative centre for the local government area. Carnarvon is regarded to be an important regional settlement that provides opportunities for lifestyle living with convenient access to employment, services and recreational activities. The structure plan area is less than one kilometre from the town centre and is an ideal location to cater for residential development adjacent to the Carnarvon Fascine. A diverse range of services and amenities ensures the town is a desirable location for young families, job seekers and people pursuing a lifestyle change.

The structure plan area comprises of portion of Lot 9001 owned by DevelopmentWA. The structure plan area is bound by Babbage Island Road to the north, the Carnarvon Fascine waterway to the west/south-west and existing residential development to the east/south-east. The site has direct road frontage to Jaaga Cove, David Brand Drive, Parnaa View, Yaburru Loop and intends to provide future access to Babbage Island Road.

Lot 9001 has been cleared and filled with dredge spoil, whilst levee systems were built within the northern section of Lot 9001 to protect the Carnarvon town site. The structure plan area has been subject to previous clearing, levee construction and earthworks, and dredge disposal for the purpose of facilitating the Northwater canal development to the south-east.

The structure plan area has the opportunity to capitalise on its proximity to economic and employment opportunities, and its proximity to the town centre which is within a relatively easy walking distance. The site has easy access to the town centre, Babbage Island Road, David Brand Drive, Robinson Street and Olivia Terrace.

1.2.2 Area and Land Use

The structure plan area spans over approximately 8.3917 hectares of vacant land on Lot 9001 which is considered to be suitable and appropriate for residential development. The structure plan area does not contain any existing dwellings or outbuildings. The land will be subject to future subdivision works to facilitate development.

1.2.3 Legal Description and Ownership

The legal description of the subject lot included within the Structure Plan area is outlined in **Table 5** below.

Table 5 Land Ownership Details

Lot	Plan	Volume	Folio	Area	Registered Proprietor
Lot 9001	402324	2854	467	12.1551 hectares	Western Australian Land Authority t/a DevelopmentWA

2.0 Planning Framework

2.1 State Planning Framework

2.1.1 State Planning Strategy 2050

The *State Planning Strategy* highlights the overall strategic plan for the State, informing future framework plans, strategies and policies. The *State Planning Strategy* sets out a vision for sustained growth and prosperity for the State, in which by 2050, Western Australia will have a diverse range of interconnected and vibrant local communities and regional centres. The key strategic goal of the *Strategy* include striving for global competitiveness, strong and resilient regions, sustainable communities, infrastructure planning and coordination and conservation.

The *State Planning Strategy* recognises that as the State's population increases, so will the demand for land for residential, industrial, educational, social, recreational and environmental purposes.

The structure plan presents an opportunity to address the key challenges and goals identified within the *State Planning Strategy* and provides essential residential land for development. The structure plan area has been identified as suitable and appropriate for residential development and the plan's implementation will facilitate future development of housing that can respond to market demands.

2.1.2 Gascoyne Regional Investment Blueprint 2050

The *Gascoyne Regional Investment Blueprint 2050* is an aspirational plan that seeks to map the way forward for the Gascoyne region, identifying opportunities, barriers and strategies to guide investment and development in the region through to 2050. The *Blueprint* recognises the strategic location of the Gascoyne on the central coast of Western Australia; as an internationally recognised tourism destination; as a reliable global provider of quality food products; and as a maritime hub for energy project supply chains.

The *Blueprint* sets out a vision for the Gascoyne region to accommodate a population of 23,000 people by 2050 and to support high value, diverse and future-proofed industries. The Shire of Carnarvon has a significant role to play in supporting the anticipated growth and economic development of the region. Attracting new residents and households will require improvements in housing affordability to be achieved and maintained over time, through effective land and housing supply.

The *Blueprint* noted an undersupply of housing in the market, with demand growing at a faster rate than supply. The *Blueprint* had noted that the Shire of Carnarvon that 13% of dwellings were unoccupied in 2011. In the 2021 Census, 21% of dwellings were recorded to be unoccupied (ABS, 2022). This was consistent with the Gascoyne region 2021 census data at 20.5%, whilst the State average was 10.9% (ABS, 2022).

The state government launched the *WA Renewable Hydrogen Strategy* in July 2019, seeking to harness WA's competitive advantages, including world-class renewable energy resources and vast land mass to drive WA's position as a major producer and exporter of renewable hydrogen. In May 2021, in a media statement released by the State Government, it was announced that the construction of a Hydrogen Demonstration Plant had begun in the nearby town of Denham in the Shire of Shark Bay, south of Carnarvon. More recently, the state government released another media statement in November 2021 advertising a commitment to continue to support and facilitate industry efforts to develop a renewable hydrogen industry in WA, an initiative that will inevitably result in population growth in the Gascoyne and increase demand for housing.

This structure plan will facilitate future residential land supply. It provides an opportunity to ensure there is capacity and ability to respond to population growth and economic growth. The structure plan aims to facilitate the provision of housing and it demonstrates that this can be undertaken to ensure a seamless integration with adjacent residential lots to the east, and proposed residential development to the south.

2.1.3 Gascoyne Coast Sub-Regional Strategy

The *Gascoyne Coast Sub-Regional Strategy* (WAPC, 2018) was prepared to articulate a strategic direction for land use planning, to analyse the capacity of Gascoyne settlements to accommodate growth, and to guide local planning processes. The coastal portion of the Shire of Carnarvon, including the structure plan area, is located within the *Sub-regional Strategy*.

The *Sub-regional Strategy* notes that in 2017, the Shire of Carnarvon accounted for 60% of the population within the Gascoyne Coast sub-region. Further to this, the *Sub-regional Strategy* identifies a range of population forecasts and aspirational population scenarios for the Gascoyne Coast sub-region at 2026 and 2051. The population growth scenario for the Shire of Carnarvon ranges from an Annual Average Growth Rate (AAGR) from 2016 to 2026 of 0.8% to an aspirational 7.4% AARG.

To support the expected population growth, the strategy identified 728 hectares of residential zoned land in the Shire of Carnarvon, of which 479 hectares was considered to be capable of substantial further development. The analysis in the *Sub-regional Strategy* noted that residential land surrounding the town centre has been developed; however, there were considerable undeveloped centrally located parcels of land fronting the Fascine at Brockman. The land in this structure plan is included in that assessment of available undeveloped land.

The Carnarvon Settlement Land Use Plan is contained within the *Sub-regional Strategy*. It provides information regarding current and future land uses for the Carnarvon area. The Carnarvon Settlement Land Use Plan (refer **Figure 3**) identifies the structure plan area as current 'residential' land and depicts the road extension from Parnaa View to Babbage Island Road, with a direct interface to the Carnarvon Fascine. The *Sub-regional Strategy* considered the structure plan area to be capable of substantial residential development.

The proposed structure plan is consistent with the actions and direction of the *Sub-Regional Strategy* as it will facilitate subdivision and deliver additional residential development in close vicinity to the Carnarvon Fascine and the Carnarvon town centre.

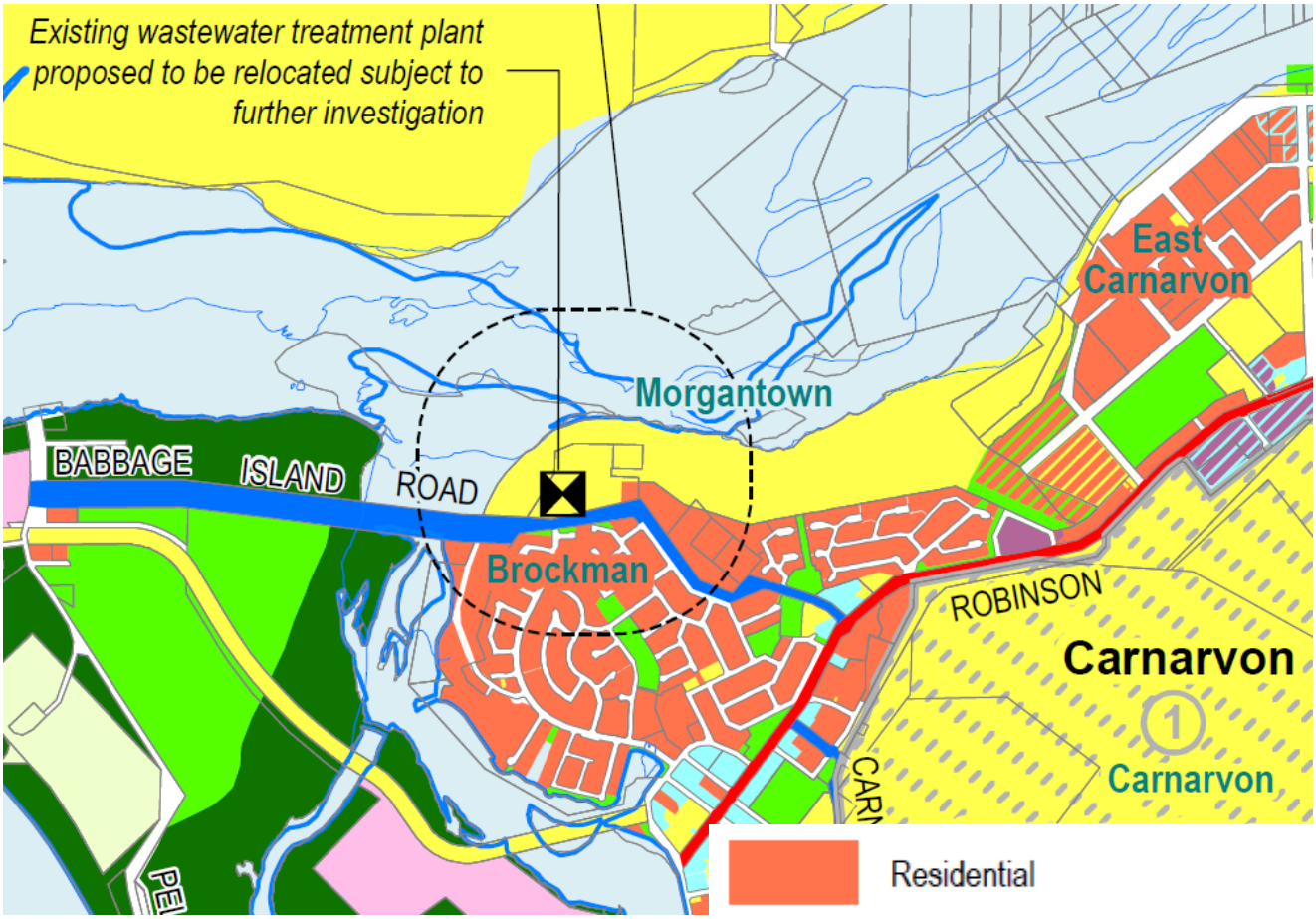


Figure 3 Extract of Carnarvon Settlement Land Use Plan (WAPC 2018)

2.1.4 Ningaloo Coast Regional Strategy Carnarvon to Exmouth

The *Ningaloo Coast Regional Strategy* (NCRS) was released by the WAPC in 2004. The NCRS is a strategic land use plan that sets a planning framework for sustainable tourism and land use within the Ningaloo Coast strategy area via the provision of planning objectives and actions. Part 1 of the NCRS included a regional land use plan that referred to a Carnarvon Structure Plan. The Carnarvon Structure Plan was included in Part 2 of the NCRS and an excerpt is provided, refer **Figure 4**.

The NCRS included the *Carnarvon Structure Plan* which identified the key land uses for areas within the Carnarvon townsite. The structure plan area was identified for 'Residential' purposes and is designed in a manner consistent with the following planning objectives that are contained in the NCRS:

- *Encourage appropriate residential infill in existing residential areas to accommodate growth within flood levee banks.*
- *Encourage medium-density development in close proximity to the town centre to accommodate aged and dependent persons' accommodation.*
- *Encourage subdivision and development within the townsite that incorporates the philosophy of Liveable Neighbourhoods.*

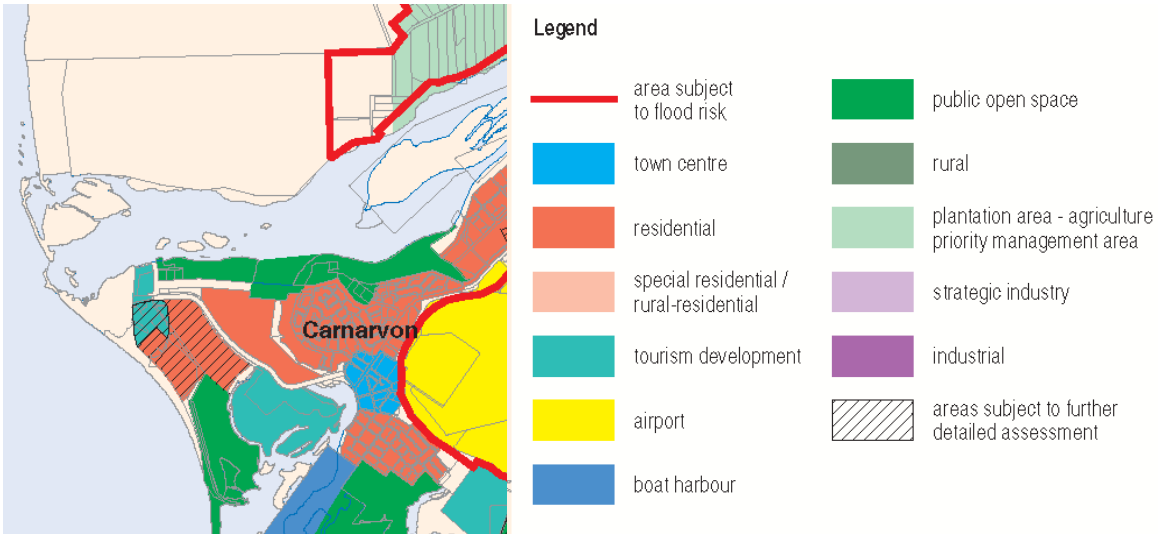


Figure 4 Extract of Carnarvon Structure Plan (WAPC, 2004)

2.1.5 State Planning Policies

State Planning Policies (SPP) that apply within the structure plan area are outlined below.

2.1.5.1 SPP 2.6 State Coastal Planning

This policy recognises the pressures on coastal zones for land use and development. The policy provides guidance for decision making within coastal zones including the management of development and land use change, establishment of coastal foreshore reserves and to protect, conserve and enhance coastal values.

The objectives of the policy are to:

- *Ensure that development and the location of coastal facilities takes into account coastal processes, landform stability, coastal hazards, climate change and biophysical criteria;*
- *Ensure the identification of appropriate areas for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities;*
- *Provide for public coastal foreshore reserves and access to them on the coast; and*
- *Protect, conserve and enhance coastal zone values, particularly in areas of landscape, biodiversity and ecosystem integrity, indigenous and cultural significance.*

The structure plan is consistent with policy objectives and will facilitate residential development located in the existing Carnarvon settlement, close to established infrastructure and services. The existing levee system and proposed habitable levels will provide essential protection and retention of the Fascine for public open space will ensure an appropriate and sustainable use of the coastline. The structure plan has had regard to the provisions and objectives contained within SPP

2.6 and to accord with the requirements of SPP 2.6, the *Carnarvon Inundation Modelling Summary Report* recommends new freehold development at the site would need to be developed at or above a level of 4.0 m AHD.

2.1.5.2 SPP 2.9 Water Resources

This policy provides clarification and additional guidance to planning decision-makers for consideration of water resources.

The objectives of this policy are to:

- *Protect, conserve and enhance water resources that are identified as having significant economic, social, cultural and/or environmental values;*
- *Assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources;*
- *Promote and assist in the management and sustainable use of water resources.*

It is considered the structure plan is consistent and has had due regard to the objectives of SPP 2.9 as the development of the site will continue to facilitate the protection of the highly valued Carnarvon Fascine and surrounding water resources. A Local Water Management Strategy (refer **Appendix B** and **section 2.1.5.3**) has been prepared in support of the structure plan.

2.1.5.3 Draft SPP 2.9 Planning for Water

The intent of draft SPP 2.9 and *Guidelines* is to deliver greater clarity around how water-related provisions are implemented. The draft SPP 2.9 and *Guidelines* incorporate improvements that will lead to better planning decision-making through consideration of appropriate management measures to achieve optimal water resource and development outcomes.

The objectives of the policy are to:

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

In support of the structure plan:

- The Local Water Management Strategy (LWMS) identifies further water management principles, design criteria and development requirements to meet objectives with regard to existing site conditions, and key aspects of the redevelopment; and
- The *Carnarvon Inundation Modelling Summary Report* (refer **Appendix C**) provides recommendations for addressing SPP 2.6 and will be complementary to the LWMS.

2.1.5.4 SPP 3.0 Urban Growth and Settlement

This policy guides the planning of urban settlements to promote sustainable and well-planned settlement patterns across the state, build on existing communities to concentrate services and infrastructure, manage growth and development of urban areas, promote sustainable and liveable neighbourhood forms, and to coordinate new development.

The structure plan integrates the objectives of the policy by seeking to utilise readily available services and infrastructure, build on the existing Brockman community and facilitate residential development in a manner that is compatible with the immediate locality.

2.1.5.5 SPP 3.4 Natural Hazards and Disasters

The purpose of this policy is to inform and guide the WAPC in the undertaking of its planning responsibilities, and integrating and coordinating the activities of State agencies that influence the use and development of land that may be affected.

The objectives of the policy are to:

- *Include planning for natural disasters as a fundamental element in the preparation of all statutory and non-statutory planning documents, specifically town planning schemes and amendments, and local planning strategies;*
- *Through the use of these planning instruments, to minimise the adverse impact of natural disasters on communities, the economy and the environment.*

The preparation of the *Carnarvon Inundation Modelling Summary Report*, the LWMS and the BMP have had regard to natural hazards including impacts of bush fire risk and storm surge inundation risk on the future residential development. The structure plan will ensure that subsequent subdivision and development will suitably address these relevant matters.

2.1.5.6 SPP 3.7 Planning in Bushfire Prone Areas

This policy applies to bushfire prone areas in Western Australia and seeks to guide the implementation of risk-based land use planning and development to preserve life and reduce the impact of bushfires on properties and infrastructure.

The very northern portion of the structure plan area is within a Bushfire Prone Area. A Bushfire Management Plan (BMP) has been prepared by JBS&G in accordance with the requirements of SPP 3.7 *Planning in Bushfire Prone Areas* and the *Guidelines* to support the structure plan (refer **Appendix F**).

The BMP provides an assessment of the proposed development, bushfire risk context, and required bushfire mitigation measures and includes:

- A review of existing pre-development and anticipated post-development vegetation classifications and effective slope within the project area and surrounds;
- Results of a pre- and post-development Bushfire Hazard Level (BHL) assessment to determine the applicable BHLs across the project area and adjoining land;
- Details of any bushfire hazard issues relevant to the site and proposed development; and
- A compliance assessment to demonstrate the proposed development can comply with the bushfire protection criteria of the Guidelines at subsequent planning stages.

Post-development bushfire hazard level (BHL) results demonstrate that all proposed development areas will be located on land with either a low or moderate BHL.

Having regard to the staging of subdivision (refer Part 1 **sections 1.3** and **3.1**), the preparation of a further BMP will not be required for subsequent applications for subdivision and development, except where the application area is designated as bushfire prone as per the State Government's *Map of Bushfire Prone Areas*.

2.1.5.7 SPP 6.3 Ningaloo Coast

SPP 6.3 Ningaloo Coast supports residential development in Carnarvon, and the subject land is identified as Residential in the Carnarvon Structure Plan contained in the *Ningaloo Coast Regional Strategy – Carnarvon to Exmouth* (WAPC, 2004). Furthermore, the *Future Directions for the Ningaloo Coast Regional Strategy* (WAPC, 2019) discussed the implementation of SPP 6.3 in line with the directions of the *Gascoyne Regional Planning and Infrastructure Framework* (WAPC, 2015) and *Gascoyne Coast Sub-Regional Strategy* (WAPC, 2018).

Noting the NCRS and the *Gascoyne Coast Sub-Regional Strategy* (WAPC, 2018) both inform SPP 6.3, the structure plan area has been consistently identified for residential development in these plans and strategies. It is considered that the structure plan is consistent with the relevant planning instruments.

2.2 Local Planning Framework

2.2.1 Local Planning Strategy

The Shire of Carnarvon *Local Planning Strategy* was endorsed by the WAPC in March 2017 to inform land use and decision-making for the upcoming 10 to 15 years. The operational part of the *Local Planning Strategy* outlines the major characteristics and issues relevant to future planning and development of the Shire of Carnarvon, with specific actions, approaches, asks and exercises that should be undertaken over the life of the document to fulfill its vision to:

> *"Remain a wonderful place of endless opportunity, with a pristine environment, where the desert meets the sea."*

The structure plan aims to address several of the key issues and opportunities, including:

- Accommodating future population growth;

- Ensuring that housing meets the needs of the local community; and
- Managing coastal areas.

It is considered that the structure plan is consistent with the *Local Planning Strategy* as:

- The structure plan area is identified for 'Residential' and 'Public Purposes', shown below in **Figure 5**;
- Under Part 4.1 Population Growth and Part 4.3 Settlements, the *Local Planning Strategy* identified five structure plan areas (Babbage Whitlock Island, Coral Bay Settlement, East Carnarvon, Kingsford, and Carnarvon Food Bowl structure plans) and a structure plan may be required for the Brown Range investigation area;
- Planning Action 10 of the Local Planning Strategy states 'Retain existing residential densities and zoning for Brockman, Morgantown & South Carnarvon";
- Under Part 4.3 Settlements, action 2(c) seeks to maintain the existing residential density coding and zoning, and to provide opportunities for increased density at the Fascine. The structure plan will facilitate residential subdivision and development within proximity to Carnarvon town centre, addressing the housing supply within a constrained housing market. Consistent with the *Strategy*, the structure plan will consolidate residential growth within the town and applying a suitable density code range that would facilitate residential development that is consistent with the existing residential densities; and
- The land is capable of being serviced and is located in close proximity to essential services and amenities.

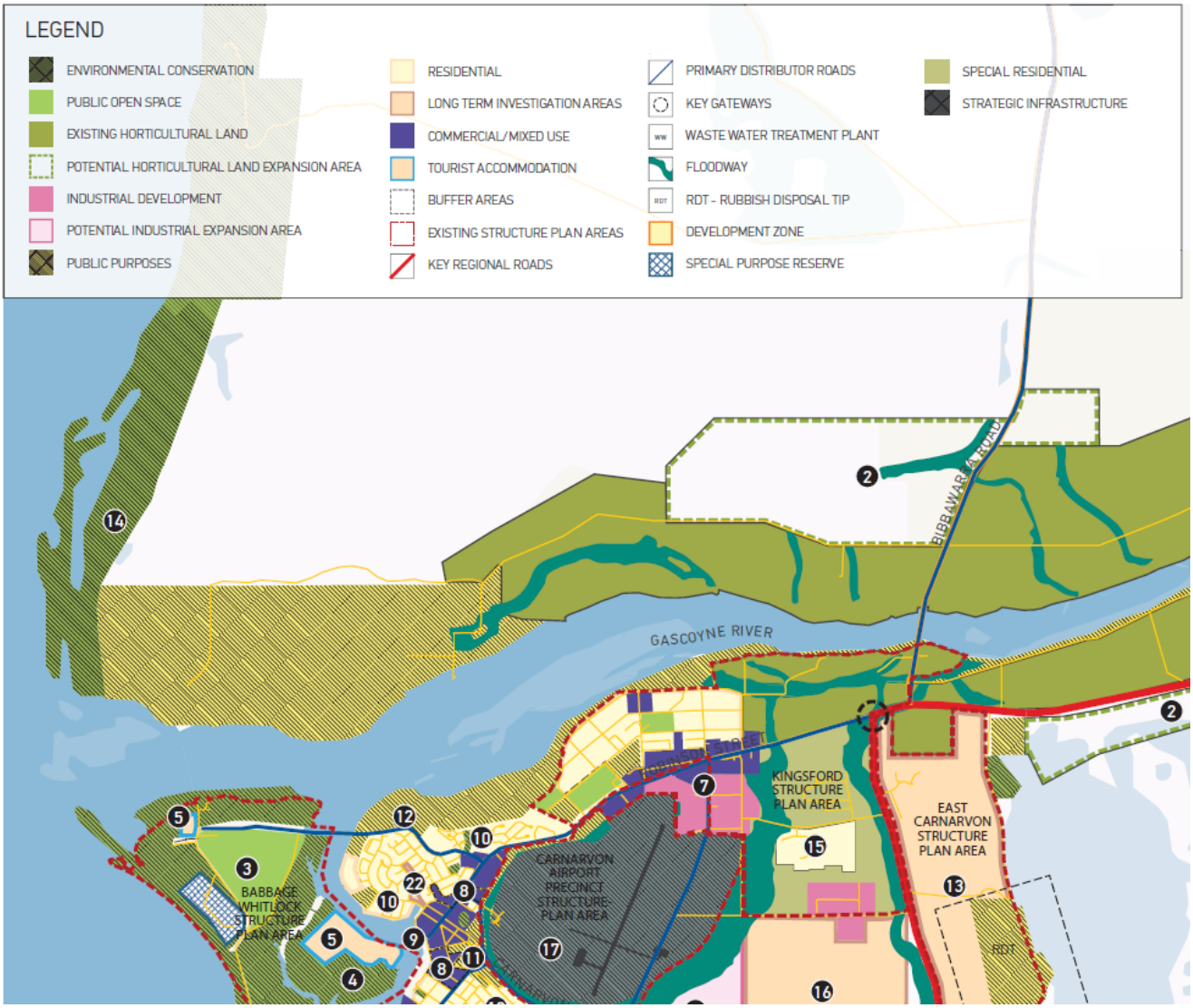


Figure 5 Local Planning Strategy Map (Extract)

2.2.2 Local Planning Scheme No.13

The Shire of Carnarvon Local Planning Scheme No.13 (LPS13) was gazetted on 3 November 2020 and an extract of the scheme map is provided in **Figure 6**. Within the structure plan area, the land is zoned 'Residential R20', 'Urban Development', with portions of the structure plan reserved as 'Local Road', 'Drainage/Waterway', and 'Public Open Space'. Parts of the structure plan area are overlaid by SCA 1 and SCA 3.

The 'Urban Development' zone objectives are as follows:

- *To provide an intention of future land use and a basis for more detailed structure planning in accordance with the provisions of this Scheme.*
- *To provide for a range of residential densities to encourage a variety of residential accommodation.*
- *To provide for the progressive and planned development of future urban areas for residential purposes and for commercial and other uses normally associated with residential development.*

Based on pre-lodgement discussions with the Shire of Carnarvon and the DPLH, the preference was for a structure plan to be prepared, to guide development over the balance of Lot 9001 David Brand Drive in accordance with clause 15 of the *Planning and Development (Local Planning Schemes) Regulations 2015*.

The land adjacent to the southern and eastern boundaries of the structure plan area is zoned 'Residential R20'. Land west of the subject area is identified as 'Public Open Space' reserve, whilst the northern boundary of the site is Babbage Island Road which is designated as a 'Local Distributor Road' scheme reserve.

The southern portion of Lot 9001 David Brand Drive was the subject of Scheme Amendment 4, a basic scheme amendment to rezone the relevant land from 'Urban Development' to 'Residential R20'. The amendment was initiated by the Council at its Ordinary Council Meeting held on 25 October 2022 and was published in the *Government Gazette* on 19 May 2023.

The structure plan aims to guide development in a coordinated and staged manner to facilitate future residential land use and development with complementary public open space alongside the Carnarvon Fascine and a well-connected local road network. The proposed uses and development outcomes within the structure plan will ensure a coordinated and integrated development outcome having regard to adjacent uses and development.

The structure plan was analysed for possible yield and a concept considered the land was capable of delivering approximately 53 residential lots ranging in lot size from 589m^2 to 1718m^2.

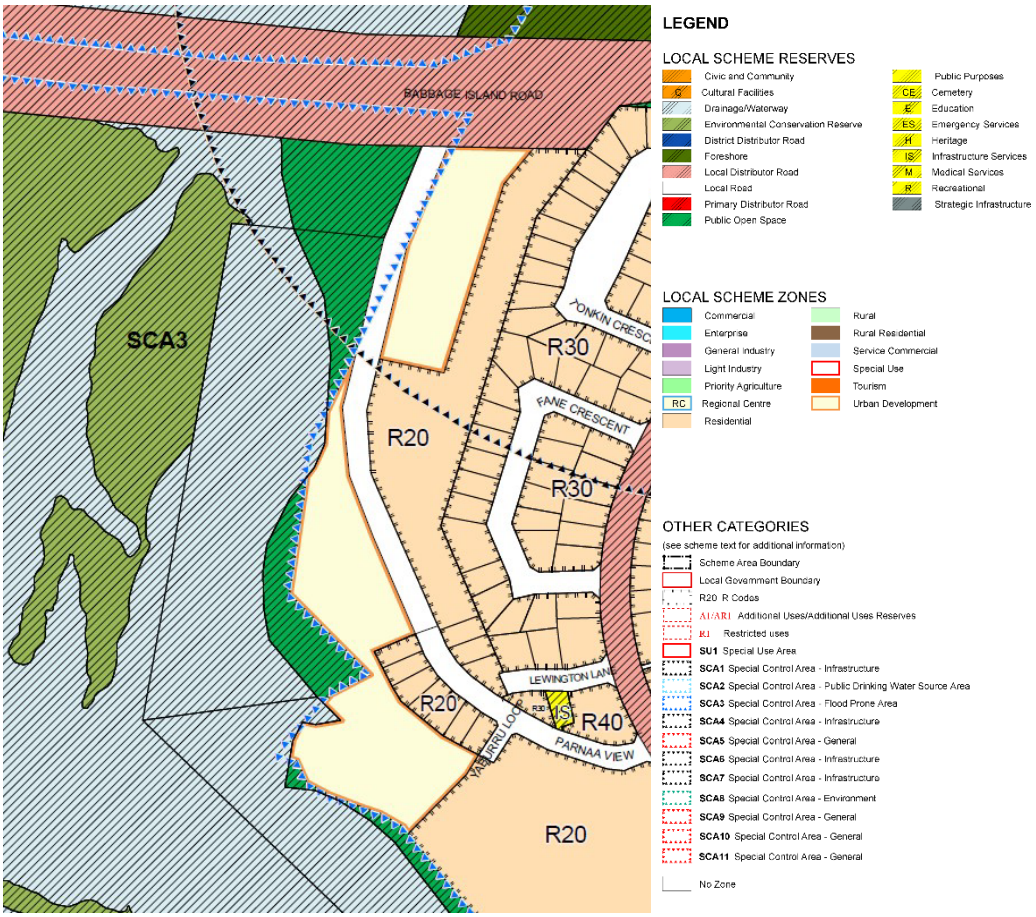


Figure 6 Extract of Local Planning Scheme No. 13 (source: DPLH, 2023)

Lot 9001 is located within proximity to the Town of Carnarvon Wastewater Treatment Plant which is located to the north; and the Carnarvon Fascine to the south and west. The structure plan area is partly contained within Special Control Area 1 – Carnarvon Wastewater Treatment Plant (SCA 1) and Special Control Area 3 – Flood Prone Area (SCA 3).

In relation to SCA 1, it is considered that staging will facilitate new subdivision and development outside of the buffer area. It is anticipated that the process of relocating the WWTP will be borne by Water Corporation. The timeframe for decommissioning and relocation of the WWTP is unknown. It is understood the Water Corporations considers the capacity of the existing WWTP is expected to provide for population growth and effluent rates through until 2040-2045, depending on growth rates and any other infrastructure, servicing and/or environmental variables. Should the WWTP be decommissioned, the SCA 1 would be considered redundant for the existing location, and an amendment to LPS 13 would be encouraged to remove the buffer constraining future stages of urban development. With no SCA 1 in place, the balance of the structure plan area could be subject to subdivision applications and development for new housing.

Relevant to SCA 3, the *Carnarvon Inundation Modelling Summary Report* recommends levels for freehold development, refer to **Appendix B**. The *Report* notes that filling of development areas at or above 4.0m AHD should be considered as a means of managing potential predicted inundation risks from modelled storm surge caused by the passage of tropical cyclones (and allowance for sea level rise).

2.2.3 Local planning policies

There are no local planning policies applicable to the subject land.

2.2.4 Previous structure plans

Over the last 35 years structure planning and works have occurred in the broader Carnarvon Fascine, including land contained within the structure plan area. In January 1987, the southern arm of the Gascoyne River was closed by the construction of the Babbage Island Road causeway and levee. The improved access to Babbage Island also resulted in a significantly reduced risk of flooding.

The Carnarvon Fascine Structure Plan (1994) (refer **Figure 7**) once applied over the land and provided the broader basis for rezoning, subdivision and development that is around the Carnarvon Fascine. The Fascine Structure Plan was revised

in 2006. The revised Fascine Structure Plan continued to identify the land for residential development. The Carnarvon Fascine Structure Plan is no longer in effect.

As outlined in the Carnarvon Settlement Land Use Plan (refer **Figure 3** in **section 2.1.3**), the land has long been contemplated for residential development.

In this context, the structure plan proposes standard residential lot development with an interconnected road network, reflecting contemporary town planning and urban design principles.

Figure 7 Previous Structure Plans that have applied at the Carnarvon Fascine

3.0 Site and Context Analysis

3.1 Physical Context

3.1.1 Climate

The Shire of Carnarvon local government area experiences an arid to semi-arid climate with hot and dry conditions in the summer months and cooler and wet conditions in the winter months. There are occasions where tropical cyclones may bring rainfall and winds during the summer months, when the cyclone season typically occurs.

3.1.2 Topography

The structure plan area is described as low lying (<RL 5m AHD), and is generally level as a result of previous reclamation and engineering works associated with the dredging and reshaping of the adjoining Fascine waterway. Some of the land is elevated from natural ground level due to the construction of the levee system and the approved deposition of dredge spoil on the land. Recent surveys have indicated that spot heights range between 3.46m AHD and 3.89m AHD along the frontage to David Brand Drive. The land gently slopes at the Fascine.

Within the southern portion of the site, a drainage line is dug into the ground to an elevation nominally 2m AHD, extending from Parnaa View through to the Fascine. The drainage line is proposed to be decommissioned and replaced with pit and pipe infrastructure within a future road reserve that would be a continuation of Yaburru Loop.

3.1.3 Place Description

Lot 9001 is vacant land owned by DevelopmentWA with frontage to existing residential development and Yaburru Loop, within the suburb of Brockman. Lot 9001 has a land area of 12.1551 hectares and the structure plan area relates to approximately 8.3917 hectares; the balance is subject to existing subdivision approvals and is zoned 'Residential R20'.

Lot 9001 extends north to Babbage Island Road and is bound by the Carnarvon Fascine to the west/south-west and existing residential development to the east. Lot 9001 has been cleared and filled with dredge spoil. Levee systems were built within the northern section of Lot 9001 to protect the existing development within the Brockman suburb.

3.1.4 Environmental Factors

Lot 9001 comprises of vacant land with regrowth vegetation sparsely spread throughout the site. The lot has been previously cleared for development and filled with dredge spoil.

The Carnarvon Fascine is an enclosed waterway due to the construction of Babbage Island Road causeway and levee system that disconnected the Fascine from the Gascoyne River. In January 1987, the south arm of the Gascoyne River was closed by the construction of Babbage Island Road causeway (Wells & Oma, 1987). This improved access to Babbage Island and significantly reduced the risk of flooding. Due to this, the Fascine is less susceptible to periodic river flows, with water levels largely influenced and driven by the tide. Previous flood modelling of the Gascoyne River was carried out by GHD for Main Road in 2014 and inundation risk was modelled for the structure plan area to address SCA 3 and to provide recommended floor levels for development.

The structure plan recommends levels of 4.0m AHD for development, which is based on modelling for predicted storm surge risk (and factoring in sea level rise). In addition, the interconnected road network and proximity to the town centre provides opportunities for residents to leave the area if required in the event of a natural hazard or required in the interests of public safety.

3.1.5 Existing land uses, built form and infrastructure

Over the last 35 years, proposals have been contemplated over the subject land and for the structure plan area. A summary of proposals is provided as follows:

- In June 1990, the Shire of Carnarvon referred its proposal to develop the Fascine Area to the EPA. The Shire's proposal involved dredging the Fascine and eight stages of development for a canal estate, tourist accommodation and a yacht club. The EPA determined that the proposal was environmentally acceptable and the Minister's decision was

published on 16 May 1994 that the proposal may be implemented. Stage 1 of the canal development was developed by LandCorp (now DevelopmentWA) in 2001. This proposed structure plan area was contained within that area that was subject to the Minister's decision.

- The original 1994 Carnarvon Fascine Structure Plan provided the basis for rezoning, subdivision and development oriented around the Fascine, to meet medium and long-term requirements for residential development. The structure plan area was subject to a Public Environmental Review (EPA, 1993) and determined to be environmentally acceptable (Minister for the Environment, 1994). Development in the Northwater area was guided by that structure plan. This structure plan area was contained within that structure plan area and was identified for residential development.
- The Fascine Structure Plan was revised in 2006. A revised Environmental Management Plan (ERM, 2007) was prepared for staged development over the subject land. The EMP was supported by a Water Quality Management Plan, Acid Sulfate Soil Management Plan, Roadworks and Stormwater Drainage Plan. The EMP addressed the environmental objectives described in the 1994 Ministerial Statement. The revised Fascine Structure Plan continued to identify the land for residential development.

During the years 2006-2022, subdivision approvals have been granted for Stages 2 and 3 of the Northwater precinct. These subdivision approvals have facilitated development of standard residential lots and canal waterfront lots. Development has occurred in the form of single dwellings, extension of roads and services.

Services are located within proximity to the structure plan area which can be extended to service the structure plan area and future residential development. These necessary services include the existing:

- telecommunication network;
- reticulated power;
- Water Corporation water reticulation network;
- DN150 gravity sewer mains; and
- stormwater assets in the area are owned and maintained by the Shire of Carnarvon. A stormwater pit and pipe network is present within all surrounding roads.

3.1.6 Connections with surrounding areas

The structure plan area has seamless connections to the surrounding residential area and Carnarvon town centre via David Brand Drive, Parnaa View, Yaburru Loop and Babbage Island Road.

3.2 Biodiversity and Natural Area Assets

3.2.1 Flora and Vegetation

The structure plan area has been cleared of native vegetation in accordance with previously approved activities, and fill material has been brought in to raise the overall general level of the site. It is understood the upper 3.0m of the soil profile is imported fill material, most likely sourced from the Gascoyne River (ERM, 2007). Any flora on-site is acknowledged to be regrowth. The vegetation on-site was assessed for the BMP, refer **Part 2**, **section 3.2.6**.

3.2.2 Fauna

No fauna surveys were undertaken in support of this structure plan, acknowledging that the structure plan has been cleared of native vegetation and deposition of dredge spoil on-site. As outlined in **Part 2**, **section 3.1.5**, the structure plan area was subject to a Public Environmental Review by the EPA and determined to be environmentally acceptable for residential development.

3.2.3 Landform and Soils

The LWMS prepared by GHD (refer **Appendix B**) summarises the subsurface profile and key soil types with the subject land according to geotechnical investigations previously undertaken, as follows:

- Excavation across the site indicates that the soil conditions comprise sand fill, up to 3.0 m in thickness where intersected, overlying alluvial deposits comprising natural sand, with clay and silt (in variable proportions) to the full depth of investigation.
- Localised areas of clayey sand fill were encountered at near surface (up to 1.5 m depth) and were observed to generally comprise pale brown low plasticity clayey sand.

- Beyond a depth of 3 m, soils generally comprise medium dense sand, with localised firm to stiff clay / silt layers (variably sandy) up to 6.7 m below ground surface level, overlying stiff to hard clay to full depth of investigation (i.e., up to 8.2 m).
- A layer of firm to soft, medium to high plasticity clay was encountered within the eastern portion of the site and typically ranged between 0.4 m and 0.8 m in thickness. The top of the clay layer was found to occur at a depth range of between 2.4 m and 3.2 m below ground surface level.

3.2.4 Groundwater and Surface Water

The LWMS prepared by GHD (refer **Appendix B**) includes an investigation of ground water levels and surface water quality for the structure plan area. The site does not contain surface water.

The structure plan has regard to the SCA 3 regarding flood control of the Carnarvon Fascine, refer **Part 1**, **section 2.1.5**.

3.2.5 Heritage

The structure plan area was reviewed using the Aboriginal Cultural Heritage Inquiry System (ACHIS). Several places overlay the structure plan are including:

- Aboriginal Cultural Heritage Register Place 39200 – Gascoyne and Lyons River;
- Aboriginal Cultural Heritage Register Place 874 – Carnarvon Fascine; and
- Aboriginal Cultural Heritage Register Place 7132 – Breakwater No. 2.

LandCorp (now DevelopmentWA) commissioned an ethnographic survey of the Carnarvon Fascine development in 1994, which involved consultation and community meetings. The Aboriginal Site Survey, Report on a survey for Aboriginal sites at the Carnarvon Fascine Development Project included the structure plan area, concluding that that there is a very low potential for surface archaeological material but a low-moderate potential for finding sub-surface archaeological material including skeletal material (ERM, 2007). In 2006, a desktop search of ID 874 and 7132 was undertaken (ERM, 2007), the ethnographic survey and archaeological investigation confirmed there was no known sites of Aboriginal significant within Lot 9001.

3.2.6 Bushfire Hazard

The northern portion of the structure plan area is designated as a bushfire prone area. In support of this structure plan, JBS&G have prepared a Bushfire Management Plan (BMP) to ensure the protection and management of bushfire hazards within the structure plan boundaries.

The BMP provides an assessment of pre-development Bushfire Hazard Levels (BHLs) within the structure plan area on the basis of the pre-development vegetation being as follows:

- Class D scrub containing shrubs 2–6 m in height with a continuous horizontal fuel profile within the southern portion of the project area and adjacent land to the north, west and southeast;
- Class C shrubland containing shrubs less than 2 m in height with a continuous horizontal fuel profile within the northern and central portions of the project area and adjacent land to the northwest, west and south; and
- Class G grassland containing understorey grasses and weeds greater than 100 mm in height at maturity within the northeast corner of the project area and adjacent land to the northeast.

Based on the pre-development vegetation described above, the pre-development BHL assessment demonstrates that existing land within the assessment area comprises a predominant Moderate BHL, with smaller pockets of Extreme BHL throughout areas of Class D scrub vegetation. However, post-development BHLs have been mapped within the assessment area and demonstrates that all proposed development areas will achieve compliance with Element 1 of the *Guidelines* and will be located on land with either a Low or Moderate BHL, with the assumption that on-site classified vegetation will be modified to a non-vegetated/low threat managed state. The structure plan provides a design response to the bushfire hazards to ensure no development occurs within Extreme BHL areas.

The proposed road and low threat POS interfaces proposed between areas of habitable development and external classified vegetation are considered sufficient to ensure that all future habitable development can achieve BAL-29 or lower. This is to be confirmed through detailed BAL contour analysis at the subdivision stage.

The BMP concludes that bushfire risks are readily manageable through standard bushfire management responses outlined in the *Guidelines*, Australian Standard 3959 and the management strategies in the BMP.

3.3 Community context

3.3.1 Human, social and economic characteristics

Local services, amenities and businesses within the Carnarvon town centre ensures the structure plan area will become a desirable location for young families, job seekers, and people seeking a lifestyle change or waterfront location. The convenient walkable location provides for social interaction and benefits ensuring the site is a desirable and appropriate location for residential development.

The structure plan area is located within 2km of the following educational, retail, community services and civic uses:

- St Mary Star of the Sea Catholic School;
- Carnarvon Christian School;
- Carnarvon Community College;
- Carnarvon Library and Galle;
- Granny Glasgow Day Care Centre;
- Carnarvon Hospital;
- Carnarvon Airport;
- Retail and food and beverage; and
- Tourism services including the Port Hotel-Motel, Carnarvon Sea Change Apartments, Backpackers Inns, and the Carnarvon Central Apartments.

In August 2020, the State Government announced the Gascoyne Recovery Plan as part of the overall WA Recovery Plan. Components of the Recovery Plan were considered relevant to Carnarvon. The construction of residential development will enable Carnarvon to capitalise upon the level of government investment in Carnarvon as part of the WA Recovery Plan.

3.3.2 Demographics

The urban centre of Carnarvon is home to approximately 5,251 people comprising of 1,117 family households. With population within the Carnarvon town anticipated to rise, there will be demand for additional housing mix and choice. The existing Carnarvon housing supply provides 2,567 private dwellings with the occupied dwellings comprising of 1,320 separate houses, 215 semi-detached houses and 48 flat/apartments. Key demographic and housing statistics relevant to Carnarvon are outlined in **Table 6** below.

Table 6 Carnarvon Demographics and Housing Status - ABS Data 2021

Census Data 2021 (Categories)		Census Data 2021
People	Male	2,732 (52.0%)
	Female	2,520 (48.0%)
Indigenous Status	Aboriginal and/or Torres Strait Islander	857 (16.3%)
	Non-Indigenous	3,514 (66.9%)
	Indigenous status not stated	882 (16.8%)
Housing Composition	Family households	1.117 (63.1%)
	Single (or lone) person households	589 (33.3%)
	Group households	63 (3.6%)
Tenure Type	Owned outright	544 (30.7%)
	Owned with a mortgage	373 (21.1%)
	Rented	739 (41.7%)
	Other tenure type	65 (3.7%)
	Tenure type not stated	40 (2.3%)

Census Data 2021 (Categories)		Census Data 2021
Dwelling Characteristics	Average number of people per household	2.8
	Average number of people per bedroom	1
	Median weekly household income	$943

3.3.3 Employment and Business Activity

The structure plan area's proximity to North West Coast Highway (5km) provides future residents with access to Carnarvon's horticultural industry and future general and light industrial precincts throughout the Gascoyne region. The location of the structure plan area presents the opportunity for the development to capitalise on increasing the local and regional economic and employment precincts.

In recent years, the State Government has supported major green hydrogen projects within the Gascoyne and Mid West regions, more specifically, Geraldton and Carnarvon were identified by the Federal Government as sites for two of three new 'hydrogen clusters'. It is anticipated that there will be significant investment as a result of the hydrogen and ammonia projects within the Gascoyne region in the medium- and long-term future. It is expected that these projects will provide large scale employment opportunities, driving the economic and employment precincts within the Gascoyne region.

3.4 Initial concept layouts

Taylor Burrell Barnett in collaboration with the developer, DevelopmentWA, have undertaken investigations into potential structure plan concepts and layouts that would facilitate the efficient land use allocation and planning within the structure plan area.

The development of the Carnarvon Fascine has been subject to ongoing revision and refinement, with early concepts utilising the natural curvature of the Fascine to create habitable canals and development along the water edge. Examples are provided at **section 2.2.4** and **Figure 7**. Over time, the vision for an extensive canal development around the Fascine has been reviewed and reduced, with the option for typical residential dry lots being contemplated as a more appropriate and cost-effective alternative to more expensive canal lots and construction of artificial waterways.

Due to the staged subdivision and development of land fronting the Carnarvon Fascine, the structure plan area has an irregular boundary that follows the boundaries of Lot 9001. The previous concepts ensured a road connection between David Brand Drive through to Babbage Island Road. This connection is proposed to be retained through this structure plan.

The structure plan design has since evolved to respond to requirements from the Shire of Carnarvon to incorporate POS along the Carnarvon Fascine and to respond to the SCA 3 – Flood Prone Area under LPS 13. The irregular nature of the site provides limited flexibility in the overall lot layout and road design that can be contemplated. The long thin stretch of available land results in traditional lots having direct road frontage to a north-south road connection between Parnaa View and Babbage Island Road.

A level of public interface has been considered within the structure plan, to aim to deliver a mix of road edges and residential lot edges to the public open space network. This ensures that views through the structure plan to the Carnarvon Fascine are available to provide context and the opportunity for aspect to the waterways. The structure plan aims to provide for residential development to directly interface to adjacent public open space, noting the constrained nature and dimensions of the available land, the interface to the Carnarvon Fascine, and the amenity uplift associated with passive surveillance of public open space and views over the Carnarvon Fascine.

4.0 Stakeholder and community engagement

4.1 Community consultation

This structure plan has been prepared in accordance with the state, regional and local strategic planning framework, through which extensive community consultation will have been undertaken. Further community consultation was therefore not considered necessary to guide the development of Stages 4 and 5 of Northwater Carnarvon.

4.2 Pre-lodgement consultation

The developer, DevelopmentWA, has been in ongoing discussions with the Shire of Carnarvon and the Department of Planning, Lands and Heritage regarding the preparation, delivery and planning of the North Carnarvon Structure Plan. The following consultation was undertaken prior to lodging the structure plan.

Stakeholder	Purpose and Outcome	Date
Water Corporation	Taylor Burrell Barnett met with the Water Corporation to discuss the likely timeframe for the relocation of their wastewater treatment plant (WWTP) which is located north of the Lot 9001 David Brand Drive, to the north of Babbage Island Road. Water Corporation advised the following: • There is no timeframe for the decommissioning of the wastewater treatment plant and relocating it to a new site (land at Oyster Creek Road); • Based on their calculations of current inflows (approximately 650kL/d or 50% of the WWTP capacity = 1330kL/d), the WWTP should have sufficient capacity for the next 30 years. Water Corporation would not be doing any modelling to support future development; • Water Corporation would not agree to any buffer reduction to accommodate new residential development; and • Water Corporation does not have odour control on the plant and there are no plans to install it.	March – September 2022
Department of Water, Environment and Regulations	GHD was commissioned by DevelopmentWA to prepare an LWMS for Lot 9001 David Brand Drive. The LWMS was forwarded to the DWER Carnarvon Office for feedback and comments. DWER advised the following: • The levee no longer provides any Gascoyne River flood protection and is redundant in that respect. • Various modifications are required to be made to the LWMS to provide additional information and clarity regarding data and technical inputs.	August – October 2023
Department of Planning, Lands and Heritage	The draft structure plan was provided to the DPLH for preliminary feedback and no comments were received.	November 2023
Shire of Carnarvon	The draft structure plan was provided to the Shire of Carnarvon and minor modifications were recommended to the POS areas along the Carnarvon Fascine.	November – December 2023

5.0 Design Response

5.1 Vision and Objectives

This structure plan seeks to deliver housing in proximity to the Carnarvon townsite, connecting to existing communities and providing an alternate lifestyle opportunity for residents. The structure plan seeks to facilitate a high amenity urban environment with the appropriate provision footpaths, road networks and areas of public open space. The objectives the structure plan are set out below:

- Provide a sensitive and appropriate design interface between the Carnarvon Fascine and residential development, ensuring public land is provided alongside the waterway consistent with coastal planning principles;
- Design for a mix of development overlooking the waterway, providing a range of experiences, surveillance and equity;
- Deliver nodes of landscape areas for community gathering and social focal points for recreation and views;
- Provide a coordinated and managed landscape interface that ensures low maintenance outcomes for the local government and providing a suitable landscape design that is consistent with bushfire protection objectives; and
- Implement a suitable staged approach having regard to the future requirement for the relocation of the WWTP.

5.2 Design response and outcomes

5.2.1 Community design

Preliminary design concepts have demonstrated that dwellings will be able to address the Carnarvon Fascine, road networks and public open space, facilitating activation of these spaces, opportunities for passive surveillance, and cohesive streetscape outcomes.

The structure plan area presents a significant locational advantage for residential development noting the close proximity to essential health and education facilities and services, an existing road and public transport network, and adjacent residential areas. This structure plan represents one of the few remaining areas of land available in proximity to the Carnarvon townsite for residential development.

5.2.2 Movement network

The structure plan will facilitate the extension of existing road network including Parnaa View and Yaburru Loop, to provide internal connections to and through the structure plan area. Access to the subject land is provided from Parnaa View, and a future road connection northwards to Babbage Island Road, providing the structure plan area with two access routes ensuring compliance against *State Planning Policy 3.7 – Planning in Bushfire Prone Areas*. The site is well located boasting strong road linkages, public transport networks and accessibility.

Parnaa View will extend north towards Babbage Island Road with residential lots to gain direct frontage along the entire eastern interface and portion of the western interface. The proposed extension of Yaburru Loop to the west will intersect with a 15-metre road reserve providing the extension of residential lots north, parallel with Parnaa View, and providing a partial road interface to the Fascine.

The internal roads seek to provide a high level of connectivity and where appropriate have a road design that moderates vehicle speeds. Footpaths will be provided to one side of all residential streets to further support walking and cycling within the Structure Plan area. The road network within the structure plan area is logical and interconnected to create a regular layout which focusses on a sense of arrival by converging the network towards the Public Open Space adjacent the Fascine. All roads extend either north-south or east-west, promoting good solar access opportunities and ventilation in housing construction. Parnaa View will retain the 20-metre-wide road reserve to maintain consistency with existing development, whilst the new internal connector is designed with a 15-metre-wide road reserve. The road grid is supportive of emergency service movement. The road network along Parnaa View would be capable of supporting school bus services.

A description of the transport networks internal to the structure plan area is summarised in **Table 7** below.

Table 7 TIS matters to be addressed

Transport Matter	Proposal
Proposed subdivision	Anticipated yield of 53 lots and 53 dwellings (1 per lot) across both Stages 4 and 5 of the Structure Plan.
Vehicle Access and Parking	Access will be via new subdivisional roads that connect to Yaburru Loop and an extension of Parnaa View towards Babbage Island Road. It is anticipated parking of vehicles will be capable of being contained on-site, including in garages and outbuildings. All lots will be front-loading and driveways would interface with roads.
Provision for service vehicles	Road network widths would facilitate service vehicles such as for house construction, waste collection, and emergency services.
Daily traffic volumes and vehicle types	The proposed road network will ensure sufficient capacity for daily traffic volumes. Likely vehicle types would be cars and service vehicles.
Traffic management on frontage streets	Traffic management would be undertaken as required for new road connections. Road reserve widths provide suitable sightlines for residential crossovers.
Public transport access	The 803 bus route travels east of the structure plan area, along David Brand Drive. Bus stops are within walkable distance of the structure plan area.
Pedestrian access	A 15m wide road reserve is proposed to connect to Yaburru Loop and travel north, connecting to the Parnaa View extension. A 20m wide road reserve is proposed to be maintained for the Parnaa View extension. Consistent with Liveable Neighbourhoods these roads would provide footpaths to facilitate walking.
Cycle access	15m – 20m road reserves provide sufficient verge width to facilitate cycling on footpaths or on the street pavement.
Site specific issues	None identified.
Safety issues	None identified. The land is relatively clear of vegetation and road reserve widths will offer sightlines for vehicles entering/existing lots.

5.2.3 Lot layout

The structure plan proposes residential densities that are consistent with those applicable within the suburb of Brockman. The structure plan seeks to deliver future lots with a R12.5-25 density code range. The density code range could facilitate minimum lot sizes of 300m^2, with the average lot size anticipated to be fairly generous and more in keeping with larger R20 lots (i.e. average lot sizes 700-800 square metres) across the structure plan area.

The structure plan provides an indicative road network and street lot configuration where lots will be in a north-south or east-west configuration. Lots within the structure plan area will receive lot frontage to the extension of Parnaa View and new subdivisional roads, with some lots backing onto public open space. Typical lots within the structure plan area will have frontages ranging between 21 and 24 metres in width, all lots will be consistent with the minimum frontage requirements of the R-Codes Volume 1 for the respective densities. The depths of typical lots will also range from 35 to 45 metres. These lot dimensions offer dwellings sufficient developable opportunities that reflect the lifestyle and character of the surrounding area; sufficient land for outbuildings, vehicles and suitable for gardens and landscaping opportunities.

The north-south and east-east configured lots provide opportunities for dwellings to take advantage of solar passive house design principles and sustainability objectives. Landowners will have the opportunity to take advantage of considerations such as:

- Designing dwellings for a warm climate with consideration to be given to the impact of strong south to south-easterly winds which predominate over much of the year. Cross ventilation through habitable rooms together with the locations of openings to maximise air movement and prevailing winds through the home in the warmer months;
- The use of eaves, pergolas, verandahs and other shading together with the considered location of thermal massing and glazing to assist with passive solar design and energy efficiency in the house. Consideration of the extent of roof cover to habitable rooms and outdoor living areas will help residents to take advantage of the outdoor lifestyle associated with Carnarvon's warm climate;
- Consideriation of the use of materials, ceiling heights and fans, and other elements to help regulate home temperatures without relying solely on air conditioning;
- Construction of dwellings will be required to address cyclonic conditions as per relevant standards and the BCA; and
- Opportunities to install energy efficient and water efficient appliances, rooftop solar, solar hot water systems, and rainwater harvesting from roofs and storage / re-use. Such outcomes would provide lower household operation costs for landowners, and a reduced carbon footprint.

5.2.4 Public parkland

During the preparation of this structure plan, the local government advised of the preference to minimise maintenance costs associated with managing significant areas of public open space. The design of public open space aims to provide low maintenance landscape outcomes that also address the requirements of the bushfire management plan.

A Landscaping Plan has been prepared by Emerge Associates in support of the structure plan to ensure the future management of the Public Open Space reserve is low maintenance, whilst providing an appropriate level of amenity for future residents.

The Landscape Masterplan proposes the following features for Stages 4 and 5 of the structure plan area:

- Open grassed area with feature coloured concrete hardstand to seating and off the shelf cantilever shelter and picnic setting;
- A 2.1m wide dual use path providing a continuous connection along the coastal interface from the open grassed area south of Yaburru Loop towards Babbage Island Road; and
- Shade trees and coastal planting proposed along lot boundaries to provide screening to adjacent dual use paths.

Note that for areas proposed to be landscaped with 'shade trees & coastal planting to lot boundary', landscaping will need to achieve a 'low threat vegetation' outcome as per clause 2.2.3.2 of A3959 and/or the asset protection zone (APZ) requirements outlined under Element 2: Siting and Design of Development of the Guidelines for Planning in Bushfire Prone Areas (2021).

5.2.5 Urban water management

The LWMS prepared by GHD demonstrates that the structure plan area is capable of being developed for the intended residential land use by adhering to the recommended approach to water management summarised below:

- Manage runoff for serviceability in the minor (20% AEP) storm, and flood protection in the major (1% AEP) storm;
- Retain and treat the first 15 mm of runoff as close to the source as practicable using measures appropriate for lots and roads; and
- Water conservation practices both within the home and in public open spaces.

The preparation of an Urban Water Management Plan (UWMP) will be required based on the Western Australian Planning Commission conditions. The UWMP will detail site characteristics, water use sustainability initiatives to be implemented, stormwater and groundwater management plan, outline the plan for management of subdivision works and develop the implementation plan.

5.2.6 Utilities

Matters related to servicing will be dealt with during the subdivision design and application stage, however the proposed servicing approach is summarised below, as detailed in the Servicing Report prepared by GHD (refer **Appendix D**).

5.2.6.1 Town of Carnarvon Wastewater Treatment Plant

The Water Corporation's WWTP and effluent storage ponds are located within:

- Crown Lot 1321 on DP193061, Reserve 32027 vested to the Water Corporation for purposes 'Sewage Treatment Plant Site';
- Lot 98 on DP417472, owned in freehold by the Water Corporation;
- Crown Lot 1320 on DP193061, Reserve 45070 vested to the Shire of Carnarvon for purposes 'Effluent Storage Ponds'; and
- Crown Lot 1205 on DP240108, Reserve 32169 vested to the Shire of Carnarvon for purposes 'Protection of Levee Banks'.

5.2.6.2 Sewer reticulation

Gravity sewer mains are located east of the structure plan area, with an existing DN225 gravity sewer main located at the rear of existing development on Tonkin Crescent and Fane Crescent, and an existing DN150 main within the Parnaa View western verge.

The southern section of Stage 4 is proposed to connect at Parnaa View, via extension of a DN150 gravity sewer main. Further detailed design is required to inform sewer main connections for the northern portion of the structure plan area. All proposed sewerage will be designed in accordance with Water Corporation design standard DS50.

5.2.6.3 Water reticulation

Stages 4 and 5 are located within an existing Water Corporation water reticulation network. A DN150 water main exists within Parnaa View on the standard 2.1m alignment from existing boundaries, and a DN375 water main is located within the northern verge of Babbage Island Road.

The proposed water reticulation network is designed to service the structure plan area in accordance with the Water Corporation design standard DS63. Network planning proposes an extension of the DN150 water main within Parnaa View through to the DN375 water main within Babbage Island Road.

5.2.6.4 Stormwater drainage

Existing stormwater assets in the area are owned and maintained by the Shire of Carnarvon. Infrastructure including grated stormwater pits are present in the surrounding roads, including on David Brand Drive and Parnaa View.

The LWMS prepared by GHD (refer **Appendix B**) proposes stormwater is captured via an underground drainage pipe system for up to the 20% AEP Minor Storm event, and discharged to the Gascoyne River. Gross pollutant traps (GPT) will be incorporated into the drainage system as required.

Lot drainage will be directed into the road reserves and ultimately into the Fascine. For larger events, it is proposed that stormwater is conveyed via the road network to adjoining waterways using current best management practices.

Two outlets are proposed for the drainage catchments within Stage 5. Indicative locations and further assumptions are represented in the LWMS, with exact locations to be confirmed during detailed design and discussion with the Shire of Carnarvon.

5.2.6.5 Underground power

In accordance with the local government's lighting compliance requirements, street lighting is required and will be provided during the subdivision and implementation of Stages 4 and 5 of Northwater Carnarvon. An existing transformer located on David Brand Drive has multiple Low Voltage (LV) feeders that currently supply power to residential lots and street lighting surrounding the structure plan area.

Noting Horizon Power's Distribution Design Rules assigns a DADMD (capable maximum demand) of 6kVA per residential lot for this area, this would equate to 318kVA for the additional 53 lots proposed under Stages 4 and 5 of this development. The nominated DADMD would only be confirmed by Horizon Power when the Design Information Package (DIP) is requested.

On this basis, it is possible that either new high voltage infrastructure may be required or alternatively the existing Modular Packaged Substation (MPS) in the area could be converted to a non-MPS arrangement to allow a larger 1MVA transformer to be installed. Once the DIP is received, a detailed design will be completed to confirm the final requirements for the additional lots proposed within this structure plan.

5.2.6.6 Telecommunications

The southern portion of the structure plan area is located within an existing Telstra network. The existing network can be extended to service the lots within Stage 5. Provision of a telecommunications pit and pipe network will be required, including a service agreement with Telstra to provide cabling/fibre to the proposed lots.

5.2.7 Activity Centres and Employment

No activity centres or significant employment generators are proposed within the structure plan area.

The structure plan area is within close proximity to the Carnarvon Town Centre, with local public transport services along David Brand Drive allowing future residents to easily access necessary shopping, community, civic facilities and services.

Some small-scale incidental land uses to the residential uses may be contemplated in the Residential zone. Pursuant to the zoning table, 'Home Business' is 'D' discretionary use, and 'Home Office' is an 'P' permitted use. Other small-scale opportunities include 'Consulting Rooms' and 'Convenience Store' as 'A' discretionary uses under the scheme.

5.2.8 Schools

Education facilities in proximity to the structure plan area include the Granny Glasgow Day Care Centre (within one kilometre) and St Mary Star of the Sea Catholic School, Carnarvon Christian School and Carnarvon Community College (within two kilometres).

No schools or day-cares are proposed within the structure plan area. However, it is noted that 'Child Care Premises' and 'Family Day Care' are 'A' discretionary uses within the Residential zone. Such land uses could potentially be provided if there was sufficient demand and relevant approvals were obtained.

5.3 Rationale for R-Code designation

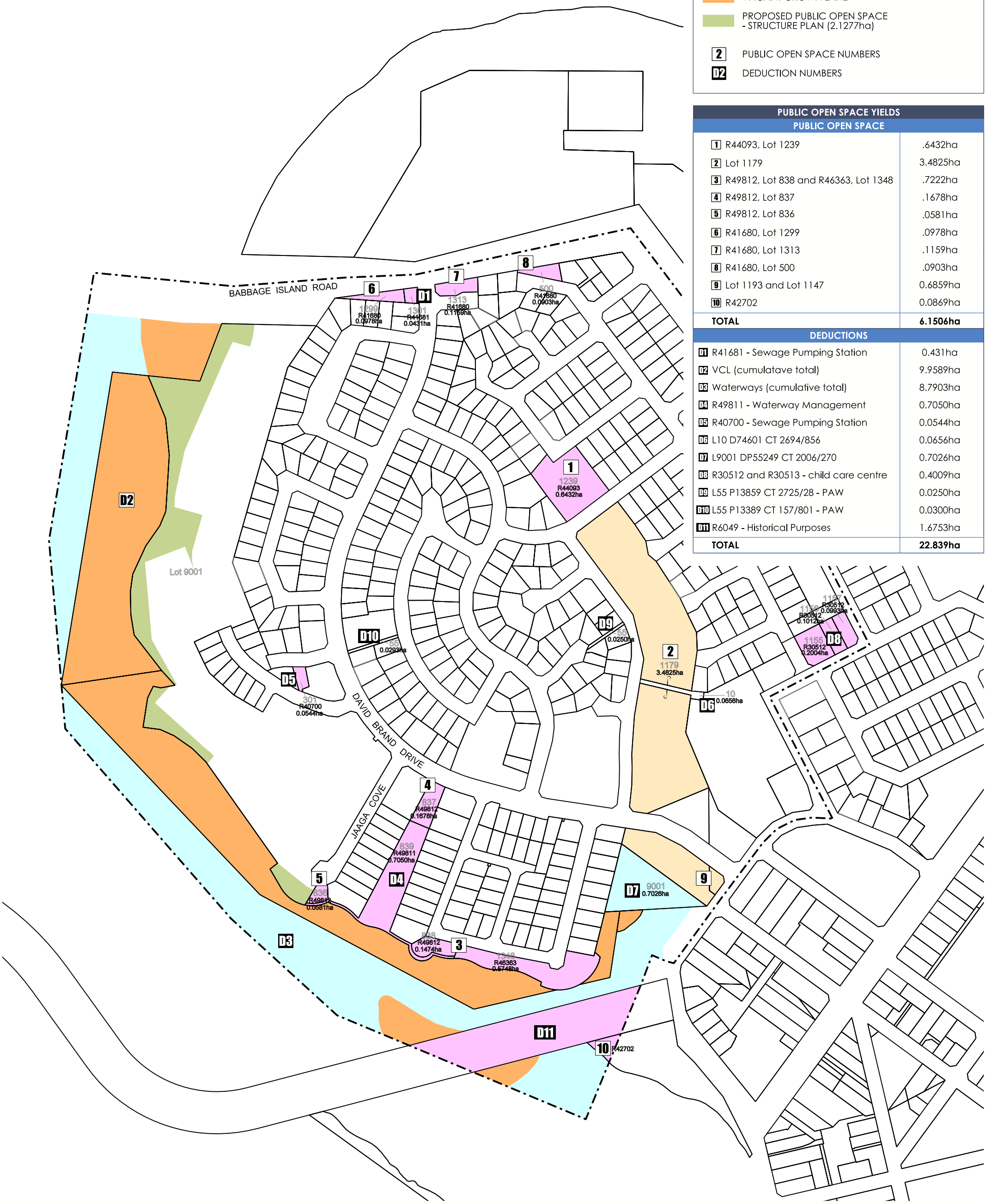
The density code range designation (R12.5-R25) has been identified based on guidance in the *Structure Plan Guidelines*. The R-Code range of R12.5-R5 has been identified due to an evolving appreciation of the market demand in the Shire for low-density living. Areas of higher amenity may influence the frontages of lots and the balanced need to deliver sites that will be capable of development for single houses and associated outbuildings, together with other vehicles, campers, boats, caravans and other lifestyle items.

The structure plan has been designed based on lot sizes that could range from 580m^2 up to 1,700m^2, and an overall average lot size of 860m^2. This range responds to the dimensions of the site, and the depth of lots to interface with public open space on the western extend of the structure plan and the interface to existing residential development on the eastern boundary of the structure plan. The R-Code range therefore is intended to be robust to enable development of smaller and larger lots in response to market demands. The intention will be to maintain a 'single house' outcomes for individual sites, without duplex or infill potential which may result in unintended or undesirable built form outcomes. A density code range can help to facilitate the ability to deliver larger lots to suit lifestyle requirements of residents.

The future subdivisions the overall lot mix will facilitate the delivery of diverse product whilst meeting the current market in Carnarvon. The future staging of subdivision will consider the appropriate range of lot products capable of accommodating a diversity of dwelling options.

Appendix A

Public Open Space Schedule and Landscape Masterplan



LEGEND

- BROCKMAN LOCALITY BOUNDARY (103.1119ha)
- CROWN RESERVE
- PUBLIC OPEN SPACE - NON RESERVE
- WATERWAYS
- VACANT CROWN LAND
- PROPOSED PUBLIC OPEN SPACE - STRUCTURE PLAN (2.1277ha)
- 2 PUBLIC OPEN SPACE NUMBERS
- D2 DEDUCTION NUMBERS

PUBLIC OPEN SPACE YIELDS

PUBLIC OPEN SPACE	
1 R44093, Lot 1239	.6432ha
2 Lot 1179	3.4825ha
3 R49812, Lot 838 and R46363, Lot 1348	.7222ha
4 R49812, Lot 837	.1678ha
5 R49812, Lot 836	.0581ha
6 R41680, Lot 1299	.0978ha
7 R41680, Lot 1313	.1159ha
8 R41680, Lot 500	.0903ha
9 Lot 1193 and Lot 1147	0.6859ha
10 R42702	0.0869ha
TOTAL	**6.1506ha**
DEDUCTIONS	
D1 R41681 - Sewage Pumping Station	0.431ha
D2 VCL (cumulatave total)	9.9589ha
D3 Waterways (cumulative total)	8.7903ha
D4 R49811 - Waterway Management	0.7050ha
D5 R40700 - Sewage Pumping Station	0.0544ha
D6 L10 D74601 CT 2694/856	0.0656ha
D7 L9001 DP55249 CT 2006/270	0.7026ha
D8 R30512 and R30513 - child care centre	0.4009ha
D9 L55 P13859 CT 2725/28 - PAW	0.0250ha
D10 L55 P13389 CT 157/801 - PAW	0.0300ha
D11 R6049 - Historical Purposes	1.6753ha
TOTAL	**22.839ha**

Public Open Space Plan

Brockman

scale 1:5,000@A3 | 1:2,500@A1

0 10 20m

plan 10/036/044B

date 9/11/2022

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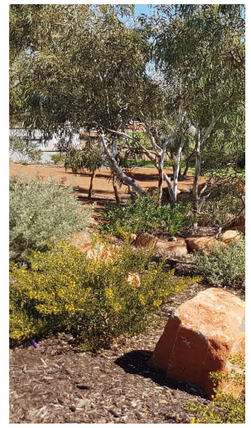
Taylor Burrell Barnett

LEGEND

- EXTENT OF WORKS
- CONCRETE PATH
- SHRUB PLANTING
- TURF
- COLOURED CONCRETE
- STONE PITCHING
- PROPOSED STREET TREES
- PROPOSED TREES
- GRAVEL BANDING



NOTE:
FOR AREAS PROPOSED TO BE LANDSCAPED WITH 'SHADE TREES & COASTAL PLANTING TO LOT BOUNDARY', LANDSCAPING WILL NEED TO ACHIEVE A 'LOW THREAT VEGETATION' OUTCOME AS PER CLAUSE 2.2.3.2 OF AS3959 AND/OR THE ASSET PROTECTION ZONE (APZ) REQUIREMENTS OUTLINED UNDER ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT OF THE GUIDELINES FOR PLANNING IN BUSHFIRE PRONE AREAS (2021).

CARNARVON NORTHWATER
STAGE 4 & 5 MASTERPLAN

DWG **CARN-01-01**
REV **B**
DATE **APRIL 23**

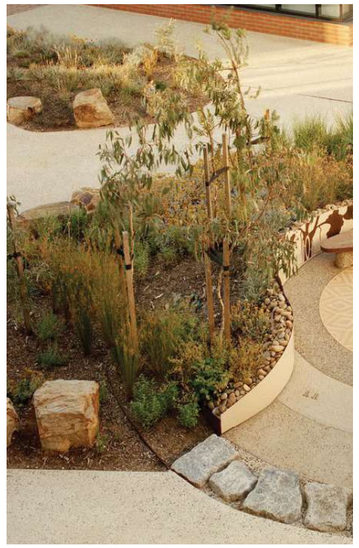
0 10 20 30 40 50 m

SCALE **1 : 1000 @ A1**

emerge ASSOCIATES

LEGEND

- EXTENT OF WORKS
- CONCRETE PATH
- SHRUB PLANTING
- TURF
- COLOURED CONCRETE
- STONE PITCHING
- PROPOSED STREET TREES
- PROPOSED TREES
- GRAVEL BANDING



GROUND COVER SPECIES

Acacia gregorii
Gregory's Wattle

Ptilotus exaltatus
Pink Mula Mula

Eremophila glabra
'Kalbarri Carpet'

Swansonia formosa
Sturt Desert Pea

SHRUB SPECIES

Marsdenia australia
'Silky Pear'

Gomphrena canescens
Batchelors Buttons

Grevillea crithmifolia
'Green Carpet'

Lomandra longifolia
'Tanika'

Senna artemisoides
Silver Cassia

Scaevola crassifolia
Thick Leaved Fan Flower

Triodia pungens
Soft Spinifex

Westringia fruticosa
Coastal Rosemary

TREE SPECIES

Corymbia hamersleyana
'Pilbara bloodwood'

Melaleuca argentea
'Silver-leaved paper-bark'

Eucalyptus victrix
Coolibah

Allocasuarina decaisneana
'Desert Oak'

NOTE:
FOR AREAS PROPOSED TO BE LANDSCAPED WITH 'SHADE TREES & COASTAL PLANTING TO LOT BOUNDARY', LANDSCAPING WILL NEED TO ACHIEVE A 'LOW THREAT VEGETATION' OUTCOME AS PER CLAUSE 2.2.3.2 OF AS3959 AND/OR THE ASSET PROTECTION ZONE (APZ) REQUIREMENTS OUTLINED UNDER ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT OF THE GUIDELINES FOR PLANNING IN BUSHFIRE PRONE AREAS (2021).

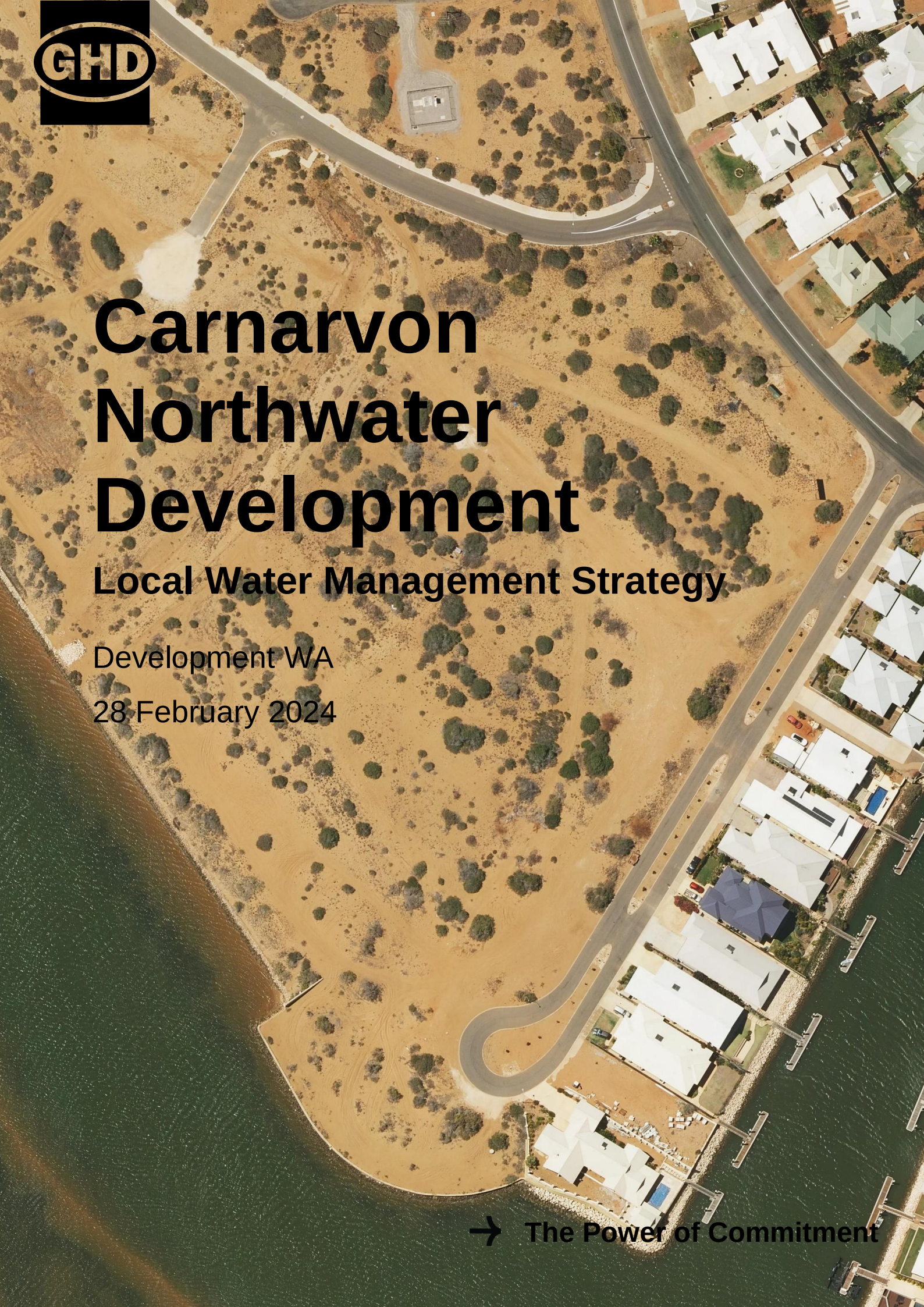
CARNARVON NORTHWATER
STAGE 4 & 5 MASTERPLAN

DWG **CARN-01-02**
REV **B**
DATE **APRIL 23**
SCALE **1 : 1000 @ A1**
0 10 20 30 40 50 m

emerge ASSOCIATES

Appendix B

Local Water Management Strategy



Carnarvon Northwater Development

Local Water Management Strategy

Development WA

28 February 2024

The Power of Commitment

Project name		DWA - Carnarvon Northwater					
Document title		Carnarvon Northwater Development | Local Water Management Strategy					
Project number		12571364					
File name		12571364-REP-Carnarvon Northwater Development LWMS_Final Version.docx					
Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S3	D	K. Chipongo/ M. Nuruzzaman	N. Deeks		G. Hendrie		28 Feb 2024

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Executive Summary

This local water management strategy (LWMS) has been prepared to support the Northwater Estate Development Plan (NE) Stages 3 and 5 areas. The NE was developed to provide modern residential development, and foreshore living surrounded by natural amenities including the south arm of the Gascoyne River (the Fascine) on the Indian Ocean and associated foreshore reserve as well as public.

The NE area is currently undeveloped, with development likely to occur in an incremental manner over time. Planning for the NE aims to ensure that future development supports and builds upon the existing character of the area, while accommodating a diversity of land uses and dwelling typologies throughout the NE area.

The NE LWMS proposes a total water cycle approach to sustainably manage water resources within the proposed development with the following key water management objectives:

– Optimise potable and non-potable water use efficiencies and maximise water reuse wherever possible.
– Maintain or improve water quality through water sensitive design principles, while maintaining flood protection and conveyance capacity of the drainage system.
– Implement waterwise garden practices across all open space areas, including sustainable irrigation practices.

This LWMS identifies further water management principles, design criteria and development requirements to meet the above management objectives with regard to existing site conditions, and key aspects of the redevelopment.

There is no existing stormwater drainage infrastructure, and local runoff discharges into the Fascine. NE is close to the significant waterbodies, including the Indian Ocean and the Fascine. Pipe and pit network along with bioretention swales as water sensitive urban design (WSUD) have been proposed to manage and discharge stormwater runoff.

Key site characteristics that inform water management in the NE include its location on a foreshore bounded by the Gascoyne River, with climate change and resulting sea level rise predicted to result in an increased risk of flooding. Shallow depth to groundwater also occurs across the majority of the NE. These key characteristics will need to be considered during development planning, design, and construction.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and the assumptions and qualifications contained throughout the Report.

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Table index

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Appendices

1. Introduction

NorthWater Estate (NE) is a modern residential development in the seaside town of Carnarvon, on Western Australia's coral coast approx. 900 km north of Perth. This Local Water Management Strategy (LWMS) is prepared in support of a Local Structure Plan (LSP) prepared over Lot 9000 David Brand Drive in Carnarvon (the Site). The Site is controlled by DevelopmentWA who intends to develop the site for residential purposes. The LWMS will describe the structure plan, zoning and landuse, previous landuse, key landscape features and landscape plan for Stages 3 and 5 including the Lewington Drive Road casement.

The Site area predominantly comprises of Lot 9000 which, with a total area of 12.7 ha, represents the largest of the landholdings in the locality. Stage 3 and Stage 5 are located immediately west of Northwater Stage 2 and is generally bounded by Babbage Island Road (north), Parnaa View and Brockman (west), Jaaga Cove (south east) and the Carnarvon Fascine (west and south). Figure 1 indicates the approximate extent of Northwater Estate and the locality of the Site.

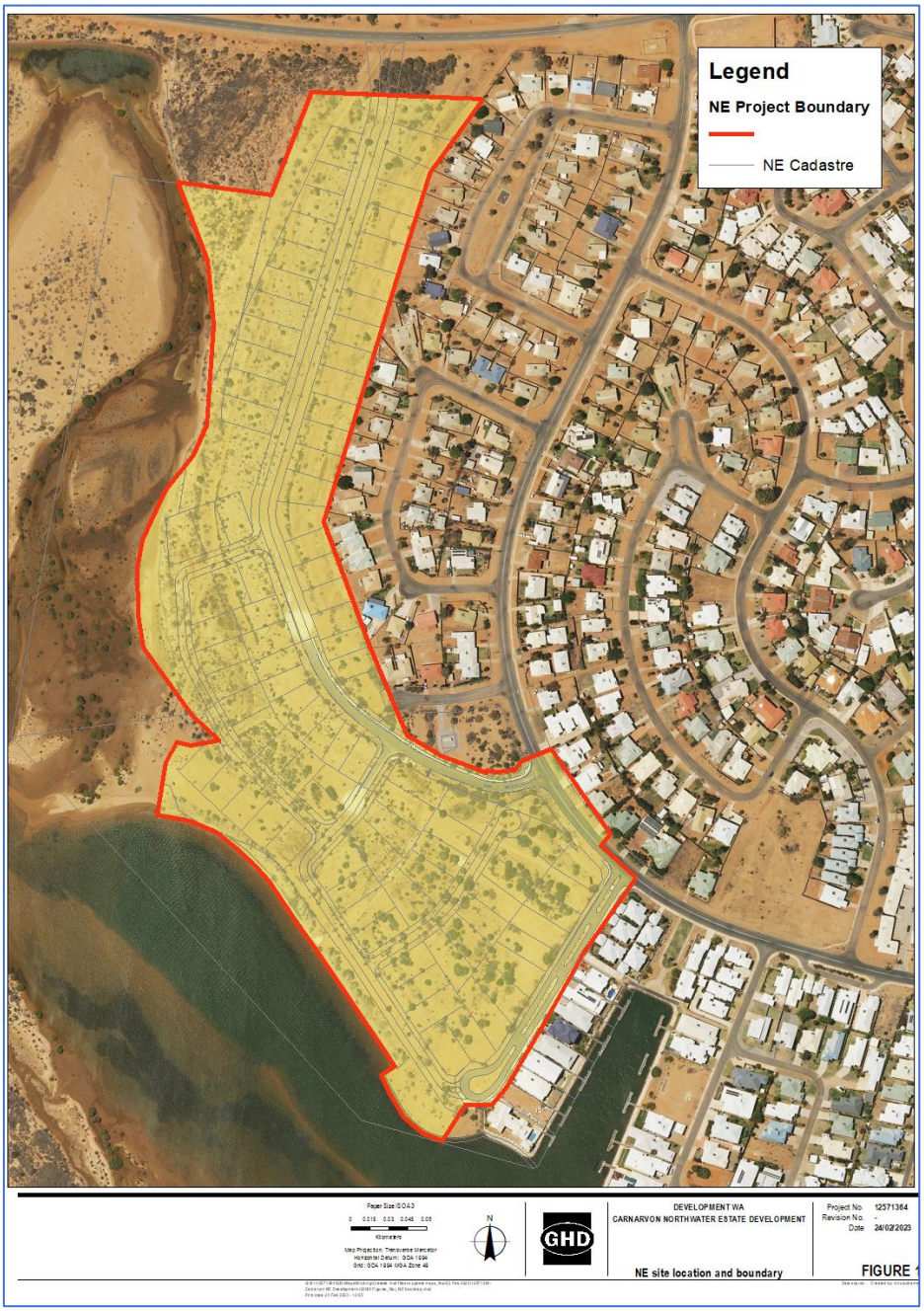

Figure 1 NE Site location and boundary

1.1 Purpose of this report

This local water management strategy (LWMS) has been prepared to support development and revitalisation within the NE. The strategy provides background to the NE, and identifies key principles, design criteria and development requirements, and additional guidance to support the proposed development.

1.2 Scope and limitations

This report: has been prepared by GHD for Development WA and may only be used and relied on by Development WA for the purpose agreed between GHD and Development WA as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Development WA arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report are limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described throughout this report and specifically in section 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Development WA *and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions.*

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

1.3 Assumptions

This LWMS is based on a desktop study only, using available information from a range of existing published and unpublished data sources and reports.

Development within the NE should be completed with regard to site specific investigations.

1.4 Planning background

This LWMS has been prepared in accordance with State Planning Policy 2.9: Water Resources (WAPC, 2006) and Better Urban Water Management (WAPC, 2008). The planning framework for land and water planning is illustrated in Figure 2. Further key state and local guidance documents are summarised in Section 1.4.1 and Section 1.4.2, respectively.

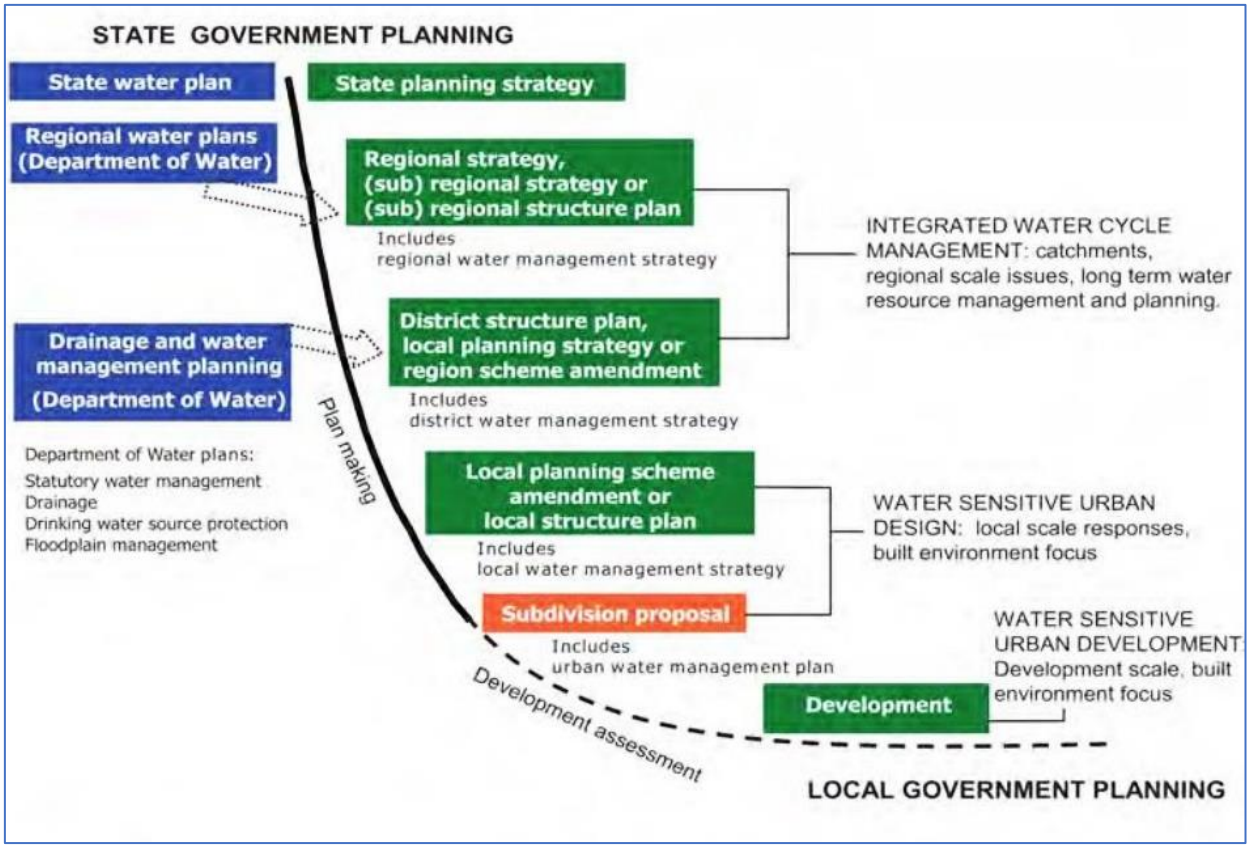

Figure 2 *Framework for integrating water planning with land planning*

1.4.1 State planning and guidance

1.4.1.1 State Planning Policy 2.9 Planning for Water

State Planning Policy 2.9 (SPP 2.9) ensures that planning and development considers water resource management and includes appropriate water management measures to achieve optimal water resource outcomes. Under SPP 2.9 the NE plan must ensure that planning contributes to the conservation of resources, in particular reduced consumption of water, with identification of design guidelines for the application of sustainable development principles to maximise water conservation. The implementation of the policy is detailed in the *State Planning Policy 2.8 Planning for Water Guidelines* document. According to the guidelines, a Local Water Management Report (WMR) must include the components outlined in Table 1:

Table 1 *General requirements (where applicable) for a Local WMR*

Component	Description of requirements
Principles and objectives	1. Recognition of the requirements of SPP 2.9 and other relevant State planning instruments including Regional/ District WMRs. 2. Identification of relevant site-specific water management objectives and outcomes to be achieved.
Planning context	Identification of the current and next planning stage, any existing higher order plans and strategies, as well as existing planning approvals or conditions on or adjacent to the site.
Water resource context	1. Identification, characterisation, and mapping of water resources, including determination of appropriate buffers and foreshore areas if they have not previously been identified, and supported by results and findings of monitoring and site investigations including: a) surface water catchments and associated landform and geotechnical conditions; b) waterways and their estuaries, inlets, floodplains, foreshore areas and reserves, wetlands, their catchments and buffers; c) groundwater systems and associated hydrogeology; d) natural and constructed drainage systems;

Component	Description of requirements
	e) sensitive water resource areas and other important environments; f) PDWSAs and their priority areas and protection zones; and g) catchment flooding and seasonal inundation. 2. Identification of Aboriginal heritage values and other heritage values. These areas should be mapped where appropriate.
Issues identification	Identification of water resource risks and issues relevant to the development of the site, including: a) potential sources of contamination including acid sulfate soils; b) risk of water balance changes resulting from drainage, land clearing and increased or reduced groundwater use; c) impacts to water quantity and quality from proposed land use change; d) risk of flooding or inundation (surface water and/or groundwater); e) water source and system availability and capability (drinking and non-drinking); f) wastewater treatment system availability and capacity; g) drainage system availability and capacity; h) regulatory requirements under water and environmental legislation; i) sensitive water resource areas, PDWSA, other important environments and environmental assets requiring protection; and j) where appropriate, identification of water related issues to be addressed in future stages of the planning process. Notes: Guidance on specific water management requirements is provided in sections 6-11 of the Guidelines.
Water balance modelling	Inclusion of a detailed pre-and post-development site water balance is required to quantify likely changes in response to development. Critical elements of the water balance that should be considered include: a) infiltration and recharge; b) runoff and drainage; c) evapotranspiration; and d) new water brought, if it is sourced from a disconnected surface water catchment or confined aquifer. Notes: The findings of the site water balance must be considered throughout the WMR and applied to inform an integrated water resource management approach to minimise associated risks to and from the environment.
Water demand assessment	Inclusion of a water and wastewater demand assessment for all proposed uses demonstrating application of water conservation and efficiency strategies to achieve relevant targets.
Water and wastewater servicing strategy	1. Confirmation of connection to drinking and fit-for-purpose non-drinking water (including irrigation of public open spaces and schools) and wastewater services with secure water service providers. 2. Inclusion of design information for proposed water distribution systems, and/or wastewater collection systems including pipe layouts. 3. Identification of locations for key infrastructure elements including storage tanks, pumping stations and associated buffers, groundwater bores including wellhead protection zones, and treatment systems and associated buffers. This includes triggers for infrastructure development, to take account of staged development and minimum operating volumes for varying systems. Notes: i. Where an alternative approach to drinking or non-drinking water supply or wastewater servicing is proposed, it is necessary to provide confirmation of service delivery arrangements including ongoing management roles and responsibilities and any interim and/or staging requirements. Guidance is provided in the Guideline for the Approval of Non-Drinking Water Systems in Western Australia (Department of Water, 2013). Refer to section 8.2. ii. Where on-site wastewater disposal is proposed, the WMR should include a site and soil evaluation in accordance with AS/NZS 1547 to demonstrate the site is suitable for long-term on-site wastewater disposal. The level of information required will be commensurate with the scale and nature of the proposal. Refer to section 8.7.6.

Component	Description of requirements
Stormwater and groundwater management design	1. Inclusion of surface water management system design details and modelling results including: a) presentation and justification of modelling parameters; b) demonstration of compliance with inflows and outflows specified in WMR for previous planning stages or defined through catchment scale modelling; c) design of small rainfall event management systems; d) design of minor rainfall event management systems including conveyance system layout, invert levels, hydraulic grade lines and dimensions; e) design of major rainfall event management systems including overland flowpath layouts and dimensions including flow depths and velocities; f) storage system invert levels, high water marks and dimensions; and g) integrated street and landscape designs. 2. Where temporary dewatering is required, outline of the requirements, including how the quality and quantity of the dewatering discharge will be managed. 3. Where groundwater management (permanent dewatering) is required, inclusion of design details and modelling results are required to be provided in the WMR including: a) presentation and justification of modelling parameters; b) definition of an appropriate controlled groundwater level for protection of sensitive water resources and other important environments; c) design of groundwater management system including system layout, critical invert levels, demonstration of a free-draining outlet, integration with stormwater management and a workable earthworks strategy; d) predicted groundwater levels between subsurface drainage lines and relationship to buildings, infrastructure, open spaces and environmental impacts; and e) design of water quality treatment systems (where required) to treat groundwater discharged from subsoil drains and temporary dewatering systems. Notes: i. Stormwater management systems should be designed consistent with the Decision Process for Stormwater Management in Western Australia (DWER, 2017), Stormwater Management Manual for Western Australia (DWER, 2004), Australian Rainfall and Runoff (Commonwealth of Australia (Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I) 2019), the latest version of Local Government Guidelines for Subdivisional Development (IPWEA) and any other site-specific documents. ii. Where a new catchment drainage system is required the WMR must provide details of the proposed implementation strategy to ensure that the service is delivered ahead of staged development. Refer to section 8.6. iii. Flood risk management is required for sites identified in floodplain mapping or on land likely to be impacted by flooding where no floodplain has been defined. Refer to section 7.
Earthworks strategy	Inclusion of preliminary earthworks model that aligns to proposed stormwater sub catchments and demonstration that proposed locations for street-scale design elements are viable. For instance, identification of proposed roadside raingardens or swales should coincide with sag locations. Notes: Where management of a groundwater system is required, design details and modelling results integrating with the proposed earthworks model are required. Refer to section 8.5.
Water quality management strategy	1. Inclusion of water quality modelling to demonstrate compliance with relevant water quality targets. Water quality targets are provided in water quality improvement plans and can be site-specific. 2. Consideration of separation distances from waterways and wetlands required to protect water quality (in addition to waterway foreshore areas and wetland buffers).
Management of works	Confirmation of requirements for protection of the environment and management of construction activities including dewatering, acid sulfate soils, constructed best management practices, and dust, sediment and erosion control, timing and possible staging.
Monitoring program	Inclusion of a sampling and assessment plan that contains duration and arrangements for ongoing actions. Notes:

Component	Description of requirements
	i. Monitoring should be in accordance with Guiding Principles and section 5. ii. For more information and guidance on water monitoring, refer to Water monitoring guidelines for better urban water management strategies and plans (DoW 2012).
Maintenance plan	Confirmation of requirements for maintenance of proposed assets, systems and strategies to inform future asset owners and managers.
Implementation plan	Confirmation of requirements for future planning and development including: a) Is a WMR required to inform future subdivision and/or development? b) Who is responsible for detailed design and construction of the site and water, wastewater and drainage systems? c) What staging is proposed over what timeframe? d) What actions are required by whom and when to address remaining site-specific issues, including restoration of wetlands and their buffers and waterways and their foreshore area?
Other	1. Summation of critical information and design requirements for key disciplines to consider in future stages of planning and development. 2. Inclusion of maps and drawings to present key information. These may include: a) location plan, site context plan and/or subdivision layout plan; b) structure plan; c) site condition plan, geotechnical plan and/or environmental plan; d) surface water context plan, and conceptual design drawings showing modelling results for small, minor and major rainfall events; e) groundwater context plan, typical cross sections and conceptual design drawings; and f) landscape plans and typical cross-sections for water management systems integrated with streetscapes and public open spaces.

1.4.1.2 Ningaloo Coast Statement of Planning Policy 6.3

The development is located within the policy area of Ningaloo coast statement of planning policy 6.3. The policy provides guidance for the preparation or amendment of town planning schemes, strategies and policies, and when providing comment and advice on planning applications that deal with land within the Ningaloo coast policy area. The key objectives of the policy are:

1. *Provide state agencies, local government, community and proponents with clear guidance regarding acceptable and sustainable development on the Ningaloo coast.*
2. *Maintain the Ningaloo coast as an all-seasons recreation and nature-based tourism destination and limit growth with managed staged development, to ensure that the community continues to enjoy a remote and natural experience.*
3. *Preserve and protect the natural environment and enhance and rehabilitate degraded areas within the environment.*
4. *Consolidate future residential, commercial, higher-impact tourism and industrial development in the towns of Carnarvon and Exmouth and provide strategic directions for their future growth*.

1.4.1.3 Relevant State Policies

Other relevant policies to note include:

– State Water Plan (Government of Western Australia, 2007)
– Rural Water Plan (Department of Water and Environmental Regulation, 2007)

1.4.2 Shire of Carnarvon planning, policy, and guidelines

The Shire of Carnarvon does not have stormwater guidelines or design criteria. However, design guidance is provided in the Shire of Carnarvon Local Planning Strategy (2017).

1.4.2.1 Shire of Carnarvon town planning scheme

The framework for water resources consideration at each planning stage is outlined in Better Urban Water Management (WAPC, 2008). Water management strategies and plans are to be prepared for each phase of the planning process to progressively refine development proposals based on the findings of more detailed investigations.

BUWM is considered as the ideal process in a more densely populated setting. An alternative approach has been adopted for the Carnarvon area because detailed flood and groundwater studies have already been undertaken to establish the baseline predevelopment scenario. Figure 3 diagrammatically shows the ideal BUWM process and the alternative for Carnarvon.

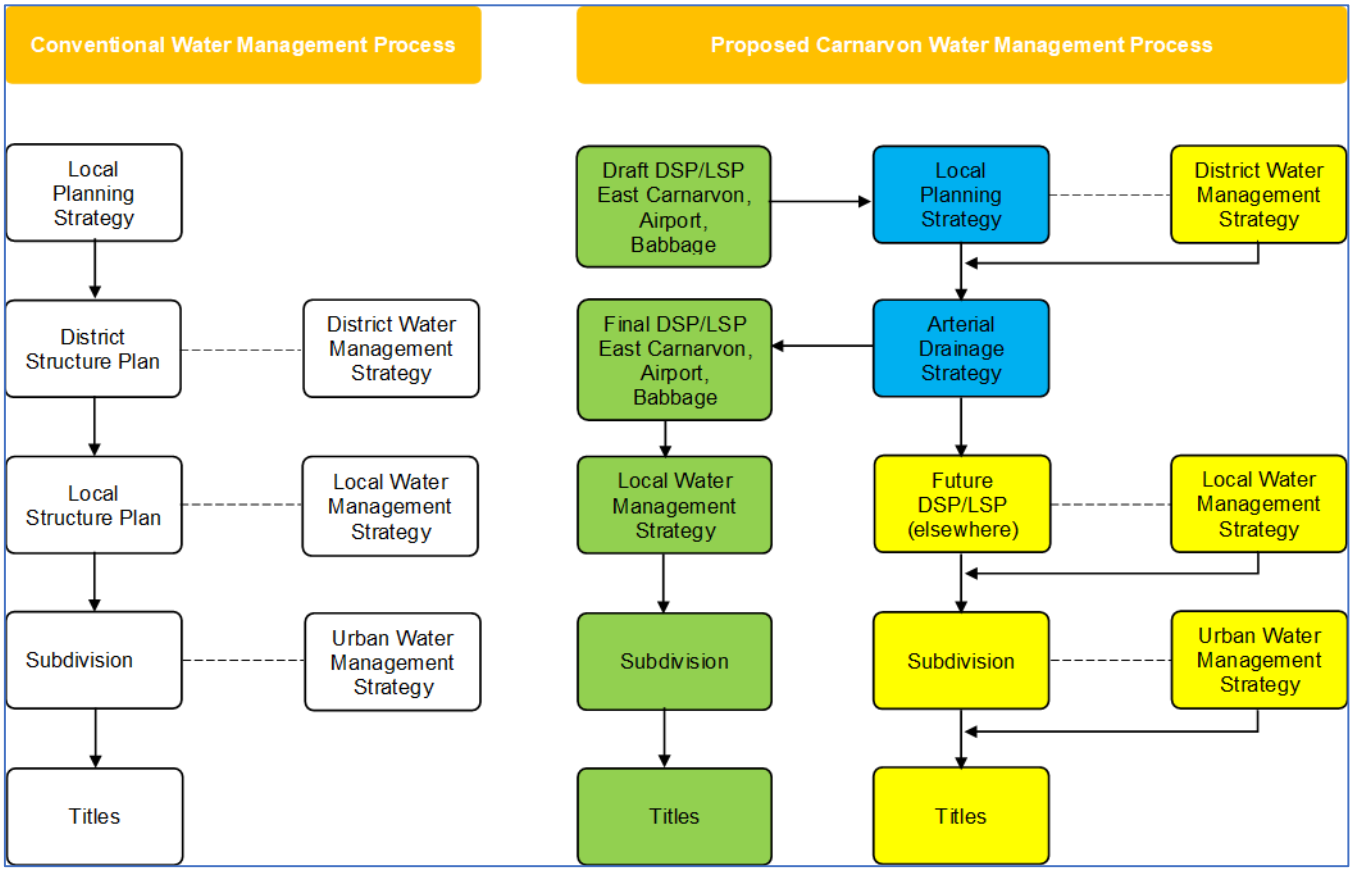

Figure 3 *Conventional and proposed water management framework for Carnarvon*

The following key differences can be noted in the Carnarvon alternative approach and that outlined in BUWM:

– Post-development Arterial Drainage Strategy (ADS)

  The ADS addresses regional flood management issues, i.e., flows and flood levels within the Structure plan to ensure that drainage corridors are sized appropriately.

– Local Water Management Strategy (LWMS)

  The detailed LWMS provides greater degree of detail for the Structure Plan thus making it easier to manage fragmented ownership.

– Urban Water Management Strategy (UWMS)

  A UWMS is not required on the basis that future developments are likely to be small in scale.

1.4.3 Relevant reports and information

The following reports are relevant to the project as described:

– Lower Gascoyne River – Carnarvon Floodplain Management Study (SKM, 2002) and (2010). This report described the floodplain management measures proposed to mitigate flood risk throughout Carnarvon.

– GEMS. (2009). *Cyclonic Inundation and Costal Process Modelling*. Carnarvon, Global Environmental Modelling Systems, June 2009. Final Report. This report describes various coastal hazards to Carnarvon, and proposes a set-back line for development.

– GHD. (2010). *Carnarvon Flood Mitigation Works: 100% Design Report.* Prepared for Main Roads Western Australia. This report described the flood mitigation works and presents final flood risk mapping.

– DPI (2003). *South Carnarvon, Surge Wall, Risk Analysis and Preliminary Design*. Department of Planning and Infrastructure, March 2003. Report No. 421.

2. Proposed development

2.1 NorthWater Estate

The Northwater Estate (NE) area comprises 12.24 ha of land located immediately west of Northwater Stage 2 and is generally bounded by David Brand Drive (north), Lewington Lane (north-west) and the Carnarvon Fascine (west and south). Stages 3 and 5 are depicted in Figure 4.

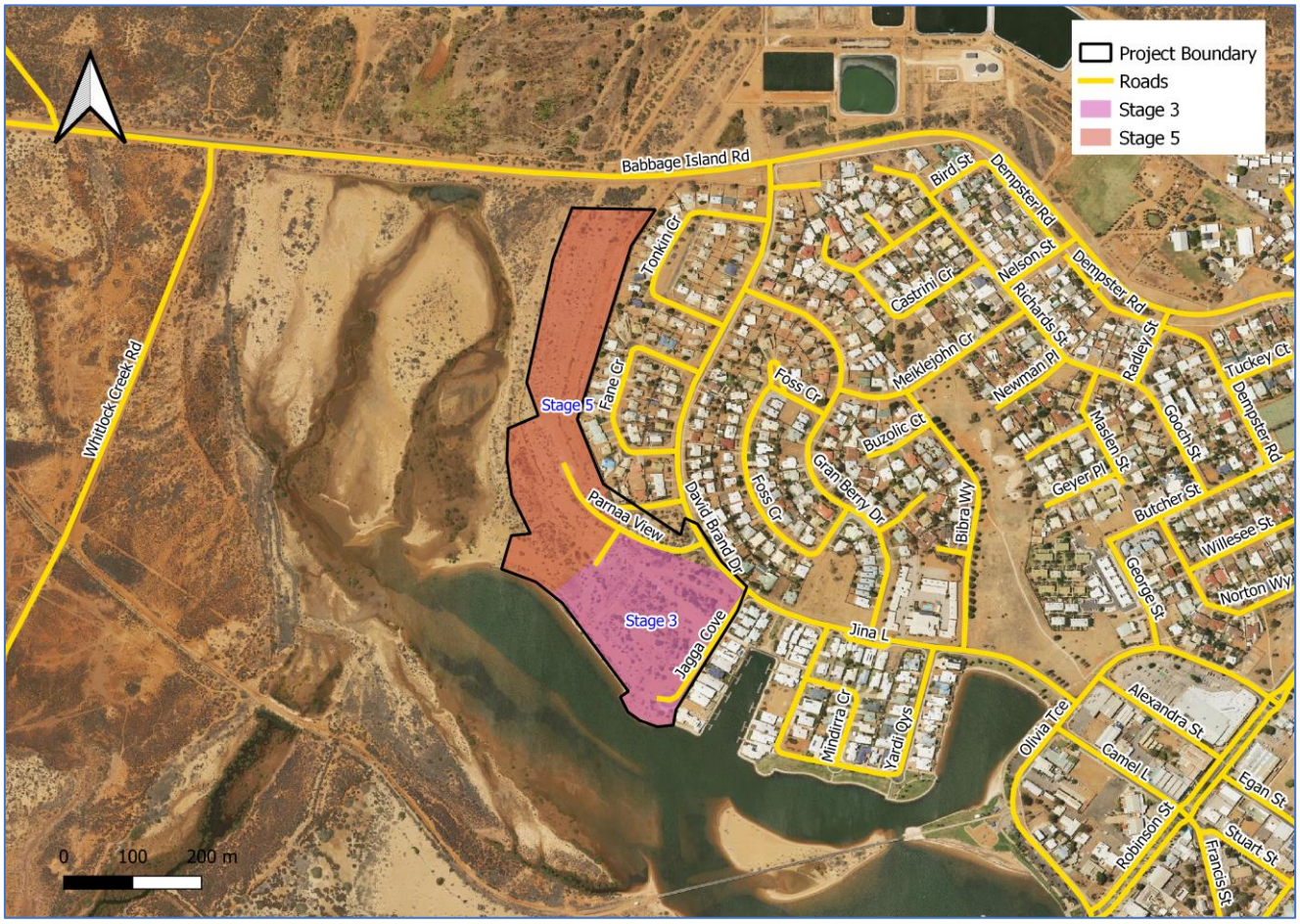

Figure 4 *NorthWater Estate boundary of Stage 3 and Stage 5*

2.1.1 Stage 3

Stage 3 development has a total area of 4.34 ha and consists of 33 residential lots with an average lot size of 887 m^2, and two local roads.

2.1.2 Stage 5

Proposed Stage 5 development covers a total area of 7.904 ha and consist of 53 residential lots with an average lot size of 844 m^2, three public open spaces and five local roads. It also includes the extension of Parnaa View to Babbage Island Road.

2.2 Existing land-use and infrastructure

NE is a modern residential development, surrounded by natural amenities including the south arm of the Gascoyne River on the Indian Ocean and associated foreshore reserve (the Fascine) as well as public open spaces. Existing residential development in NE comprises a mix of low and medium-density housing.

Existing drainage infrastructure throughout NE is owned and managed by the City of Carnarvon. Any proposed modifications to the existing drainage infrastructure will require approval of the City as well as Department of Water and Environmental Regulation (DWER) and Department of Biodiversity Conservation and Attractions (DBCA) for any works that may potentially impact the fascine.

2.3 Planning

Under the Metropolitan Region Scheme the NE has the following zoning:

– Public Open Spaces (Restricted Public Access)
– Environmental Conservation (Reserve)
– Residential – existing residential development areas

Parts of NE lies within the Gascoyne River Special Control Area (SCA3) – Flood Prone Area (Appendix A) and will need to consider the relevant planning and development requirements identified by the DBCA.

2.4 Key elements of the proposed development

NE concept plan is presented in Figure A1 of Appendix A. The plan identifies multiple residential lots as well as three public open spaces within the proposed development plan (Appendix A).

3. Site characteristics

3.1 Climate

The climate at Carnarvon is typically classified by hot, dry summers and mild, wet winters. The nearest Bureau of Meteorology weather station with long term data is located at Carnarvon Airport (Station 006011), approximately 1.5 kilometre away. Rainfall has been recorded at this station since 1945.

The average annual rainfall recorded at the station since 1945 is 222.2 mm, with an average of 41.0 rain days per year. The majority of rainfall falls between May to July, with the monthly distribution of rainfall shown in Table 2.

Table 2 Mean rainfall for Carnarvon Airport (Station 006011)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean rainfall (mm)	11.2	21.0	16.0	15.8	33.1	46.0	42.7	17.1	6.2	5.0	3.8	5.3

Tropical cyclones occasionally occur during the summer months bringing heavy rainfall and strong winds. Despite being located within an identified cyclone Region, the last cyclone to make landfall at Carnarvon was Cyclone Frank (Category 3) in 1995. However, six cyclone impacts were recorded from 1960 to 1970.

Climate change presents a particular challenge in regional areas and therefore has become an important consideration for Australia. The Gascoyne Region, including Carnarvon is expected to be affected by a number climate change factors including:

– Increasing sea levels;
– Changing wind and rainfall patterns;
– Increases in the frequency and severity of tropical cyclone events;
– Increases in average temperature of up to 1°C by 2030;
– Increases in the rate of evaporation of surface water sources; and
– Increase in drought due to the combination of lower rainfall and high evaporation.

Mean temperatures in the rangelands of WA (which includes Kalgoorlie, Pilbara ranges and Carnarvon coasts) have increased by approximately 1°C since 1910. Mean temperatures are projected to rise by 0.6 to 1.4 °C and 1.5 to 2.9 °C by 2030 and 2090, respectively (DWER, 2021). Effects of climate change are expected to impact agricultural activities.

3.2 Topography and geology

3.2.1 Topography

The Site is currently undeveloped and generally clear with some light vegetation and a portion of the site appears to have been filled with river sand as part of the Stage 2 works. As a result of previous reclamation and engineering works associated with the dredging and reshaping of the Fascine, the site is generally level and the topography low-lying at < RL 5.0 mAHD.

Elevations across the Site range of between RL 3.0 mAHD to RL 4.0 m Australian Height Datum (AHD). The western portion of site is variable (hummocky) with elevations ranging between RL 1.0 mAHD and RL 5.0 mAHD. The Site has a central ridge along proposed Road, draining away to the east and west with a declining slope of 0.2%. The site has an approximate dry lot finished surface level of RL 3.5 m AHD corresponding to around 3 m above the mean water level of the Gascoyne River.

The Site is moderately vegetated with isolated locations of dense vegetation generally comprising low lying grass, thick shrubs with an estimated height of up to 2.0 m and localised areas of young trees. An existing sand dump area is located west of Lewington Lane. Assessment of the natural ground surface contours indicates that the southern portion of site and the middle strip (approximately 50 m wide) has been formed by fill earthworks up to 1.8 m in thickness (GHD, 2013). A detailed local feature survey data illustrates the existing topography and is presented in Appendix J.

3.2.2 Regional geology

According to the Geological Survey of Western Australia 1:250,000 series geological map, the site is underlain by alluvial material of Quaternary origin, described as containing clay, silt, sand, and gravel material.

Being an arid zone delta, the Gascoyne River flows briefly only after heavy rain. Alluvial material deposited by the river may be of significant thickness as the flow experienced following rain events is high, depositing large quantities of coarse-grained material. Near the current water level up to a thickness of 1 m, partially indurated layers of alluvial material containing medium to coarse grained quartz sand and shell fragments exist. Additionally, there may be layers of eolian material deposited between alluvial zones, although it is unlikely these layers have been preserved to a level to which they can be visually identified (Johnson, 1982).

3.2.3 Soils

3.2.3.1 Stage 3 and 4 investigations

The soils in the Gascoyne Region have many features common to semi-arid soils elsewhere in Australia, the most obvious being the red colouration of the soil due to soil particles covered by oxides of iron.

Towards the coast, sandy calcareous soils are often lighter in colour due to littoral shell fragments and oxide leaching. Further, the browner calcareous earths differ again due to the high concentrations of carbonates and lower concentrations of iron oxides. Organic matter is low and concentrated within the top few millimetres.

The alluvial soils of the Carnarvon plantation area are loamy fine sands or silty loams. They are well drained and alkaline. Fertility is high and only small amounts of nitrogen fertiliser are required for high yields.

The surface geology comprises Holocene alluvial deposits from the Gascoyne River delta (clay, silt, sand, and gravel). The Gascoyne delta is characterised by a lobate form approximately 9 km wide and is flat. The seaward edge of the delta is a strand plain, characterised by mangrove tidal flats and elongated lagoons.

The Department of Primary Industries and Regional Development (DPIRD) DPIRD-076 dataset attributes WA Soil Groups to each Soil Landscape Mapping Unit as defined by Schoknecht and Pathan (2013). The following criteria is used to differentiate Soil Groups:

– presence of carbonates;
– colour;
– depth to soil horizons;
– pH; and
– soil structure.

This dataset identifies three key soil types within the site. Soils on the site are described as disturbed land (Appendix B).

The following generally summarises subsurface profiles according to geotechnical investigations undertaken for Stage 4 presented in report (GHD, 2013):

– CPT probing and excavation across the site indicates that the soil conditions comprise sand fill, up to 3.0 m in thickness where intersected, overlying alluvial deposits comprising natural sand, with clay and silt (in variable proportions) to the full depth of investigation.
– Localised areas of clayey sand fill were encountered at near surface (up to 1.5 m depth) and were observed to generally comprise pale brown low plasticity clayey sand.
– Beyond a depth of 3 m, soils generally comprise medium dense sand, with localised firm to stiff clay / silt layers (variably sandy) up to 6.7 m below ground surface level, overlying stiff to hard clay to full depth of investigation (i.e., up to 8.2 m).
– A layer of firm to soft, medium to high plasticity clay was encountered within the eastern portion of the site and typically ranged between 0.4 m and 0.8 m in thickness. The top of the clay layer was found to occur at a depth range of between 2.4 m and 3.2 m below ground surface level.

3.2.3.2 Historic investigations

Coffey Partners International Pty Ltd (Coffey) presented report P791/2-AB which contained results of geotechnical testing at DevelopmentWA's Stage 1 and 2 developments (Coffey, 1995).

This report recommended some design approaches to be incorporated for Stage 3 and 4 based on its own geotechnical investigation.

Coffey's report generalised subsurface profiles encountered on Stage 1 and 2 and are summarised below.

– From ground surface to and elevation of RL 3.1m AHD comprises SAND, and silty SAND, with some beds of sandy clayey SILT.
– From RL 3.1m AHD to RL 3.9m AHD had a distinct bed of clayey SILT/silty CLAY.
– A very stiff Clay bed, several metres in thickness, underlies the above distinct bed.

– A geotechnical investigation for the Site should be undertaken to confirm the conditions and any recommendations for the proposed development.

Coffey (1995) presented report P791/1-AC which highlighted discrete pockets of silt or clay causing perching of groundwater following winter rains. Also recommended in this report was the inclusion of subsurface drains located down one side of all internal roads to intersect perching horizons and assist site drainage.

3.2.4 Acid sulphate soils

During acid sulphate soil (ASS) testing north of site, well sorted, light brown/brown sand containing quartz and shell fragments was encountered (ERM, 2007). The potential acid sulphate soil (PASS) conditions of the soil was reported unknown, however alluvial material is often considered a PASS risk. Previous reports have indicated the soil stockpile to have a high PASS risk.

Preliminary ASS investigations by GHD (2013) observed that soils at two of the locations contained the potential to generate acidity at concentrations above the Department of Environment and Conservation (DEC) action criteria once oxidised. Analysis of results indicated that the source of acidity was indicated likely to be represented predominately by organic sources and not inorganic sulfur minerals resulting in a slower rate of acidity release. The results also indicate that the soils contain a significant amount of ANC indicating that the soils have the potential to buffer the slow acidic release following the oxidation of these soils through onsite disturbance.

Overall, it was concluded that little correlation of identifiable ASS/PASS profiles between borehole locations other than the general presence of discrete PASS being below the water table or zone of groundwater fluctuation was present.

3.3 Geotechnical conditions

The surface geology comprises Holocene alluvial deposits from the Gascoyne River delta (clay, silt, sand and gravel). The Gascoyne delta is characterised by a lobate form approximately 9 km wide and is flat. The seaward edge of the delta is a strand plain, characterised by mangrove tidal flats and elongated lagoons. No geotechnical investigations have been undertaken for this current Stage of the works in its entirety, however geotechnical information is available for Stage 1 & 2, and Stages 3 and 4 by GHD (2011) (Ref: 61/26286/107824). These are summarised in section 3.2.3.

3.4 Contaminated sites

A search of the DWER Contaminated Sites Database identifies no contaminated sites within the NE boundary (Appendix C). It is understood that the database does not include reported sites, including those awaiting classification or classified as Potentially contaminated – Investigation required. Where contaminated sites are identified during construction activities these should be managed in accordance with the Contaminated Sites Act 2003 (WA).

3.5 Flora and fauna

The Carnarvon Basin is listed as one of Australia's 15 National Biodiversity Hotspots providing various habitats for a diverse range of terrestrial and marine life (Ecosystem Solutions, 2021). Except for isolated areas within and surrounding residential areas, most of Carnarvon Basin remains uncleared. However, much of the land outside the Carnarvon Town has become degraded due to historical grazing and pastoral activities.

3.5.1 Threatened ecological communities

The Shire of Carnarvon area includes;

– one Threatened Ecological Community, and
– four Priority Ecological Communities.

In addition, there is one species of Declared Rare Flora recorded in the Shire of Carnarvon and 47 listed priority species.

3.5.2 Fauna

The wide variety of both terrestrial and marine environments provides important habitat for diverse range of species. 38 threatened species have been identified within the Carnarvon area comprising:

– 16 species of birdlife,
– 11 species of mammals,
– 8 species of reptile, and
– 3 species of sharks.

Further, the various habitats within the Carnarvon area support 60 migratory species as well as 94 listed marine species.

3.5.3 Flora

The natural vegetation within Carnarvon and the wider Gascoyne Region comprises

– Spinifex,
– Wattle, and
– Poverty Bush varieties

Closer to the coastal and wetter areas of the Shire, the vegetation variety diversifies significantly. Along the rivers and adjacent flood plains, several varieties of eucalypt grow, together with Paperbarks. On the alluvial flats, shrubs present are of the Bluebush and Saltbush species, while on wetter sites, the shrub Halosarcia is present. Around coastal areas there is much growth of mangrove.

3.6 Environmentally sensitive areas

3.6.1 DWER Environmentally sensitive areas

The DWER maintains a dataset of Environmentally Sensitive Areas (ESAs). ESAs are areas of land deemed to support conservation, heritage or ecological value, or an area protected through existing State Policy. A search of the DWER ESA database (DWER-046) identifies the Fascine as an ESA.

3.6.2 Groundwater dependent ecosystems

A search of the online Groundwater Dependent Ecosystems (GDE) Atlas (BoM 2021) identified one high potential GDE within the NE boundary, identified as ‘Active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.

The GDE overlaps with three groundwater management areas (GMA), i.e., the Lower Gascoyne, Carnarvon Artesian Basin, and Gascoyne. The first two GMA are water allocation planning areas and the third, a groundwater area.

3.7 Reserves

The Shire of Carnarvon Local Planning Strategy identifies the NE Site as residential with some public open spaces (Appendix A).

3.8 Heritage

3.8.1 Ningaloo Marine Park and World Heritage Area

The Ningaloo Marine Park is an 'A' Class reserve along the coastal strip of the Shire of Carnarvon. The Park is vested in the Marine Parks and Reserves Authority and managed by Parks and Wildlife. It includes the 40 m of land above high water mark adjacent to pastoral leases North of Amherst Point. An additional 'C' Class terrestrial

reserve adjacent to the Coral Bay settlement is vested in the Conservation Commission of Western Australia and managed by Department of Parks and Wildlife (DPAW).

Ningaloo marine park is noted for its diversity of ecosystems and habitats and conservation significance of Ningaloo Reef and surrounding marine areas has been recognised by State and Commonwealth governments. In June 2011, the Ningaloo Coast World Heritage Area was inscribed on the World Heritage List. This creates an obligation on the Commonwealth and State Governments to ensure the world heritage values of the area are conserved. Accordingly, the *Environment Protection and Biodiversity Conservation Act 1999* (‘*the EPBC Act*’) regulates actions that will, or are likely to, have a significant impact on the world heritage values of a declared world heritage property, including relevant actions that occur outside the boundaries of a world heritage area (Shire of Carnarvon, 2017).

3.8.2 Shark Bay Marine Reserves and World Heritage Area

The Shark Bay coastline is a fragile land system of roughly 1,000km surrounded by 'A' Class reserves the Shark Bay Marine Park and the Hamelin Pool Marine Nature Reserve. Management of these shores is the shared among the government, landholders and lessees. Shark Bay is a relatively undisturbed ecosystem which in its functioning displays significant geological and biological processes. As well as the conservation values, the Shark Bay area is also associated with the following qualities:

– Cultural values (the coastline can contain remnant camp sites associated with early primary
– industry)
– Recreational values (recreational and commercial fishing, camping, day use); and
– Educational and scientific values (the unusual geomorphology and range of fauna, flora and ecosystems provide extensive opportunities for public education and scientific and technical research).

In 1991, the Shark Bay World Heritage Area was added to the World Heritage List. The *EPBC Act* regulates the protection and maintenance of the values of the Shark Bay World Heritage Area.

The Shire of Carnarvon Local Government Area includes several coastal sections of the Shark Bay Marine Park, including:

– The Wooramel Special Purpose Zone (seagrass protection);

  The Wooramel seagrass bank covers about 1,030 square kilometres and is the largest structure of its kind in the world. The bank structure is a major part of the Shark Bay ecosystem and is recognised as an essential nursery area for important fish and invertebrates, as well as an important area for dugongs. The bank contains various habitats for seagrass, molluscan fauna and mangrove and microbial mat communities in the inter-tidal and supra-tidal zones of the coast. The seagrass is vital to the nutrient cycles of Shark Bay.
– Gladstone Special Purpose Zone (dugong protection);

  Significant for the congregation of high numbers of dugong cow/calf groups in the summer months due to its highly nutritious Halodule seagrass.
– Disappointment Reach Sanctuary Zone;
– Around a third of the eastern coastline of the Hamelin Pool Marine Nature Reserve (the only marine nature reserve in the State);

  Stromatolites, microbial communities and other marine features around the tidal zone of Hamelin Pool are extremely fragile and sensitive to disturbance and therefore are described by the World heritage listing to be of major ecological significance.
– Reserve 30885 (an 'A' Class Reserve for the Preservation of Sedimentary Deposits); and
– The Bernier and Dorre Islands Nature Reserve.

  Shallow waters east of Bernier and Dorre Islands provide rich seagrass and coral habitats for many species including turtles and dugongs and many commercially fished species.

3.8.3 Aboriginal heritage

216 registered Aboriginal heritage sites within the Shire of Carnarvon were recorded following an assessment by the Department of Aboriginal Affairs (DAA) and identification on its Aboriginal Heritage Enquiry System in 2014.

Most of the sites were artefacts / scatter, and the remaining sites included engravings, paintings and skeletal material as well as those of a ceremonial and mythological nature.

3.8.3.1 Indigenous Heritage

There are 216 registered indigenous heritage sites as described in section 3.8.3.

3.8.3.2 Mungullah Community

The Mungullah Community, is located 7km from the Carnarvon Townsite. It is not classified as an Aboriginal Settlement under SPP 3.2 (Planning for Aboriginal Communities) but is a significant Aboriginal community.

3.8.4 European heritage

The Shire of Carnarvon is located between two of Western Australia's three World Heritage Sites. In addition, the Shire also includes a significant number of State and locally significant heritage places. A total of 90 heritage places are located within the Shire including Shark Bay and Ningaloo World Heritage Areas, 10 State Heritage listed places and 78 places which are identified as significant by the local community.

Within the Shire, heritage is expressed in several forms in the built or natural environments that has cultural significance ranging from buildings, streets, parks, plazas, trees, gardens, to views. Most heritage places within the Shire are located within the Carnarvon townsite itself and primarily comprise various private dwellings, hotels, infrastructure and civic buildings. Significant local heritage places are recorded in the Local MHI with a limited number of these places also included on the Heritage List as part of TPS 10.

A list of all heritage places within the Carnarvon Local Government area is provided in Shire of Carnarvon Local Planning Strategy (2017).

3.9 Surface water

3.9.1 Regional surface water-groundwater interactions

The National Water Commission (NWC) measured the level of interaction between surface water and groundwater within the Carnarvon region. Based on available data in the period 2004 to 2005, exchange volumes are shown below (NWC, 2005):

– A total GW-SW exchange volume of 18,000 ML (million litres), and
– Total GW-SW exchange volume as percentage (%) of total inflows was greater than 100%

Given the groundwater and surface water exchange volumes common for the Carnarvon area, depth to water on site (varying between RL-0.481 to RL1.4 mAHD from 2006 to 2007), site proximity to the Fascine, and that groundwater levels are subject to tidal influences from the Fascine, it is considered that there is a large level of interaction between groundwater and Fascine surface water at the Site.

3.9.2 Catchments

3.9.2.1 Regional

The NE is located within the larger Gascoyne River catchment (total catchment area is approximately 80,400 km^2), and the Lower Gascoyne River sub-catchment.

The catchment consists of two distinct areas, an inland, etched, granitic plain; and the Carnarvon Basin, consisting of the Kennedy Range plateau and a flat coastal plain. The granitic plain rises to approximately 700 m AHD on isolated peaks, but averages about 400 m AHD and slopes gently to the west to an elevation of about 280 m AHD. The drainage channels are generally broad and ill-defined by large floodways within very wide valleys. The granitic terrain comprises about three-quarters of the total catchment area and is generally of very low relief (lowest difference in height). The Carnarvon Basin lies westwards from the granitic terrain and is divided into three broad physiographic zones: a coastal, a transitional and an inland zone. The coastal zone consists of flat lying, aggrading alluvial to deltaic plains and sand dunes derived from reworked alluvium. The inland zone consists of erosional landforms of dissected duricrust plateaus with greatest relief (greatest difference in height).

Some areas, such as the Kennedy Range, are virtually undissected plateaus above 300 m AHD, protected from erosion by an extensive sandplain. The transitional zone lies between the two and consists of both low-lying constructional and erosional landforms.

3.9.2.2 Local

The NE Site lies in the flat coastal plain of the larger Gascoyne River catchment. It covers a total of 12.24 ha and generally grades south towards the Fascine. The local catchment information is summarized in Table 3 and shown in Appendix D. The below catchment areas represent the area that will contribute flow to the drainage pipes and not the whole site.

Table 3 Northwater Estate catchment summary

Catchment ID	Total area (ha)
1	1.69
2	2.01
3	0.80
4	1.06
5	2.21
6	0.47
7	1.89
8	1.50

3.9.3 Stormwater and drainage

NE does not occur within a Water Corporation main drainage catchment. Stormwater runoff within NE development area and surrounds currently discharges into the Fascine. The stormwater network associated with Fane Crescent, Tonkin Crescent, and David Brand Drive drains eastwards towards Brockman Park, before discharging into the fascine (Appendix D).

An existing swale drains the sag point of Parna View south towards the fascine. It collects surface water runoff from Parna View only. The Shire's stormwater catchment mapping (Appendix D) indicates that runoff from David Brand Drive and adjoining streets drains eastwards towards Brockman Park, not via the existing swale. There is also no culvert or connection to the sewer pump station.

3.9.4 Flood mapping and management area

The Shire of Carnarvon is well protected from floodwaters and comprehensive flood mapping has been conducted:

– DPI (2003). *South Carnarvon, Surge Wall, Risk Analysis and Preliminary Design*. Department of Planning and Infrastructure, March 2003. Report No. 421.
– GEMS (2009). *Cyclonic Inundation and Costal Process Modelling*. Carnarvon, Global Environmental Modelling Systems, June 2009. Final Report
– GHD (2010). *Carnarvon Flood Mitigation Works: 100% Design Report.* Prepared for Main Roads Western Australia.
– GHD (2014). *Carnarvon Flood Mitigation Works: Post Construction Design Report.* Prepared for Main Roads Western Australia

The results are indicated in the Western Australian Flood mapping tool. As shown in Appendix E, the southern edge of the proposed development lies encroaches on the 1% Annual Exceedance Probability (AEP) floodplain. The water management strategy must consider the 1% AEP flood levels, the effects of climate change and tidal influence as discussed in section 4.2.4.

3.9.5 Waterbodies and wetlands

The Carnarvon Fascine is located immediately south of the site (Figure 5). The Fascine was originally a water body which separated Babbage and Whitlock Islands from the mainland and connected to the Gascoyne River which is located to the north of Carnarvon. Due to considerable volumes of sediment being deposited this connection to the Gascoyne River was disconnected with the construction of a levee to the northern end. The Fascine is now an inlet bay which forms a popular recreational area and tourism attraction to the Township. There is an existing levee within the boundaries of Stage 5 development area. This particular levee segment does not retain the same purpose now as it did when it was constructed. The Babbage Island Road levee redirects Gascoyne River floods directly to the ocean, rather than allowing them to enter the fascine adjacent to the development. Therefore, the subject levee within NE boundary no longer provides flood protection from Gascoyne River flooding. However, it may still have a function to protect Carnarvon from oceanic storm surge inundation and sea level rise. The proposed earthworks will lower the levee. The Department of Water and Environment Regulation have confirmed that the Babbage Road levee is the primary protection, and the subject levee only a secondary protection of the Babbage Road levee fails (Appendix K). As an asset owned and maintained by the Shire, any modification of the levee will require approval from the Shire of Carnarvon as part of this LWMS approval process.

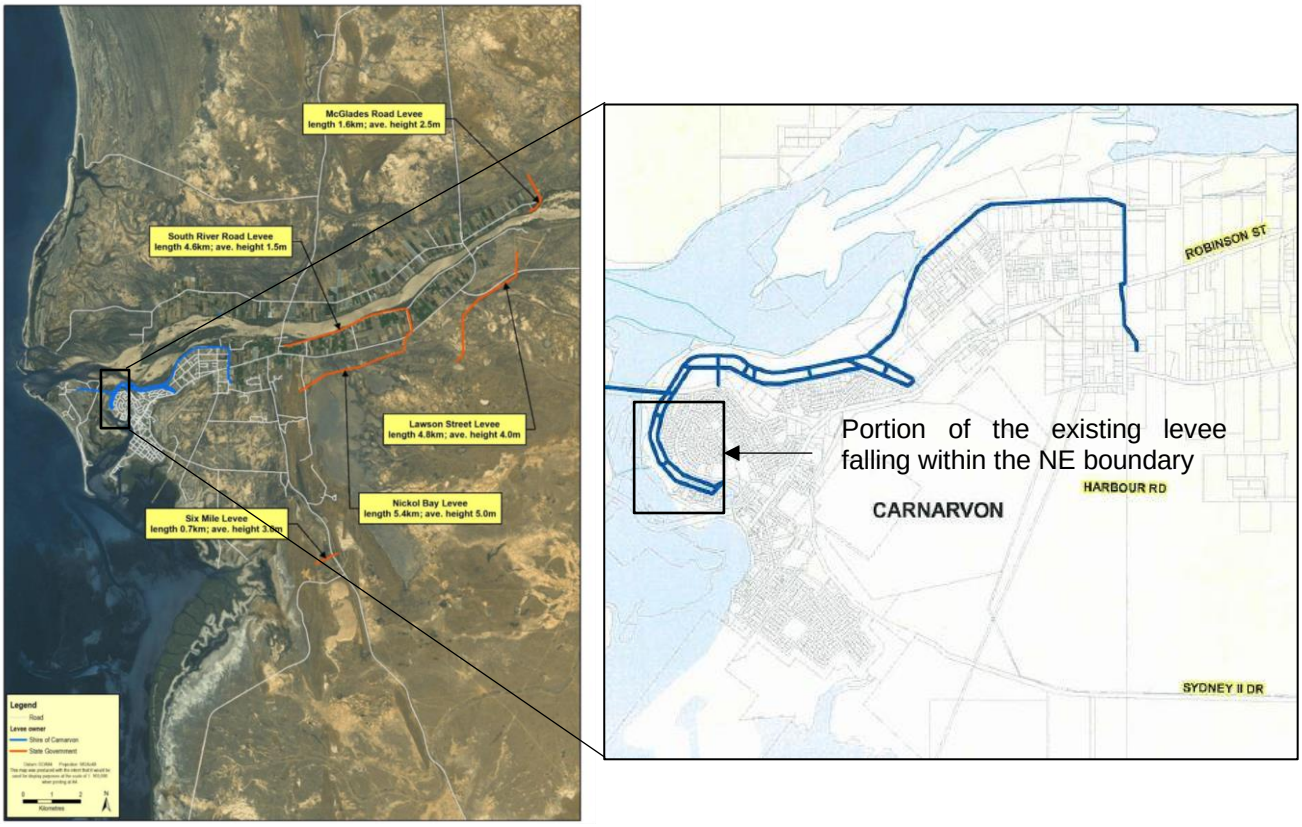

Figure 5 *Existing Levee within the boundary of Northwater Estate*

3.9.6 Surface water quality

3.9.6.1 Surface water monitoring

3.9.6.1.1 Turbidity

The most recent surface water monitoring report available for the Site by Environmental Resources Management (ERM) (2007) found the following during Stage 2 construction phase and post construction phase monitoring period:

– Surface water turbidity readings reached Action Trigger Level (ATL) 1 on 8 occasions however, based on field observations from water quality monitoring personnel, there was no evidence that processes driving increased turbidity levels were directly due to adjacent site construction/excavation activities.
– Field observations suggest that periods of increased turbidity were attributable to natural processes such as tidal variations and seasonal amplification of prevailing Southwest winds (causing an increase in wind driven wave energy within the Fascine). Furthermore, on no occasion did turbidity levels remain at or above ATL 1 for more than 24 hours. As such, in accordance with the Water Quality Management Plan (WQMP), no management actions were required. On no occasion were turbidity levels recorded at ATL 2 at any monitoring locations during the Stage 2 construction phase.
– During the one-month visual observations period (22 March 2007 to 21 April 2007), there were no major incidents which caused an observed increase in turbidity. Although periods of some increased turbidity were evident, they were largely attributable to natural processes outlined above. As such, it is anticipated that turbidity map). The total (unfiltered) phosphorus (TP) and nitrogen (TN) concentrations exceeded the trigger levels at the majority of sites in February 2006 and at most of the development sites in March and April 2006. Concentrations of TN were lowest in May, though the default trigger value for marine systems was exceeded at the ocean sites.
– There was no evidence during the construction period of increased sedimentation associated with construction activities reaching the N2, F1 or T1 monitoring points.
– No management actions were required during the Stage 2 construction period given that there was no evidence of exceedances of water quality action trigger criteria.

It is reasonable to assume that similar conditions and negligible impacts would occur for immediately adjacent Stage 3 and 5 development activities.

3.9.6.1.2 Nutrients

Results of most recent baseline surface water quality data are summarised below :

– Ammonia (NH3) and filterable reactive phosphate (FRP) concentrations were below the relevant trigger levels at each sampling location. Nitrate-plus-nitrite (NOx) concentrations exceeded the trigger levels at the channel and ocean sites during the February 2006 sampling occasion (see Appendix C for sampling location map). The total (unfiltered) phosphorus (TP) and nitrogen (TN) concentrations exceeded the trigger levels at the majority of sites in February 2006 and at most of the development sites in March and April 2006. Concentrations of TN were lowest in May, though the default trigger value for marine systems was exceeded at the ocean sites.
– The data suggests that the high concentrations of nutrients encountered in the Fascine might be from a natural (e.g. adjacent salt marsh) or anthropogenic (e.g. stormwater discharge, groundwater) source.

3.9.6.1.3 Microbial parameters

A baseline study of surface water quality, which monitored the presence of *Enterococci* within the Fascine waters found that (Oceanica, 2006):

– The concentrations of *Enterococci* were low (below guideline for primary contact recreation – swimming, bathing etc) at all sites during each monitoring event except for March 2006.
– Elevated levels at all sites, except site O2, were observed in March 2006, exceeding the guideline for secondary contact recreation (boating, fishing etc) suggesting stormwater contamination within the region prior to the monitoring period.
– Detection of elevated concentrations of *Enterococci* coincided with elevated nutrient levels detected by Oceanica in March 2006, again suggesting a natural (e.g. adjacent salt marsh) or anthropogenic (e.g. stormwater discharge, groundwater) source.

The Shire of Carnarvon also monitored the presence of *Enterococci* within the Fascine throughout 2009 and 2010. The Shire of Carnarvon has indicated that:

– *Enterococci* monitoring yielded similar results over this time span, excluding one sampling event on 23 September 2009. The increased concentrations of *Enterococci* did not coincide with any rainfall events according to rainfall records from the Bureau of Meteorology website.

3.10 Groundwater

3.10.1 Licensed groundwater allocation

The DWER online Water Register identifies that groundwater resources within the Gascoyne Area A, Lower Gascoyne Alluvial. Typical groundwater allocation in Carnarvon comprise 1.8 GL per year for potable uses and 6-7 GL per year for the irrigation industry. 151 existing licenses were identified with a total abstraction allocation of 7.44 GL per year (for both potable and irrigation uses) for government and private holders as listed in Appendix F. Licensed groundwater abstractions in the strategy area are summarised in Table 10.

Currently there is available capacity within the existing allocation limit of 1.8 GL for potable water to accommodate for the town's population growth and an additional 1.8 GL/annum held in reserve. The Department of Water has committed to ensure adequate supply to cater for future growth scenarios by amending license entitlement.

3.10.2 Groundwater levels

Groundwater monitoring was undertaken by ERM in 2006 and 2007 (ERM, 2007). At the time of the investigation, groundwater was visually observed at depths corresponding to an elevation ranging from RL+0.0 mAHD to RL+0.1 mAHD and inferred to lie at depths corresponding to an elevation level ranging from RL-0.4 mAHD to RL+0.3 mAHD (Table 4). In general, the observed levels are generally consistent with the water level of the Gascoyne River (i.e., approximately RL+0.0 mAHD).

It should be noted that the estimated levels may not necessarily represent the highest anticipated groundwater levels, which are influenced by factors such as rainfall recharge, proximity to the Gascoyne River, tidal level and permeability characteristics of the surrounding material.

Table 4 Surveyed groundwater depths 2006 to 2007

Well Number	Gauging Date	Top of Collar (mAHD)	Water Level	
			(mBTOC)	(mAHD)
MW1	28-Nov-06	1.642	1.825	-0.183
	12-Dec-06		2.01	-0.368
	28-Dec-06		1.65	-0.008
	14-Jan-07		2.123	-0.481
	24-Jan-07		1.926	-0.284
	2-Jul-07	2.842	3.058	-0.216
	26-Feb-07		2.987	-0.145
	19-Mar-07		3.094	-0.252
	4-Apr-07		2.49	0.352
	5-Sep-07		NM	NM
	4-Oct-07	new height	1.626	
MW2	28-Nov-06	1.473	1.56	-0.087
	12-Dec-06		1.25	0.223
	28-Dec-06		0.94	0.533
	14-Jan-07		1.26	0.213
	24-Jan-07		1.303	0.17
	7-Feb-07		1.42	0.053
	26-Feb-07		0.989	0.484
	19-Mar-07		1.527	-0.054
	4-Apr-07		1.535	-0.062

Well Number	Gauging Date	Top of Collar (mAHD)	Water Level	
			(mBTOC)	(mAHD)
	4-Oct-07		1.66	-0.187
MW3	28-Nov-06	4.032	~3.935^	0.097
	12-Dec-06		4.015	0.017
	28-Dec-06		3.995	0.037
	14-Jan-07		4.003	0.029
	24-Jan-07		4.02	0.012
	7-Feb-07		4.033	-0.001
	26-Feb-07		3.999	0.033
	19-Mar-07		3.956	0.076
	4-Apr-07		3.769	0.263
	4-Oct-07		3.382	0.65
MW4	28-Nov-06	~5.4*	5.375	0.025
	12-Dec-06		5.46	-0.06
	28-Dec-06		5.43	-0.03
	14-Jan-07		5.473	-0.073
	24-Jan-07		5.726	-0.326
	7-Feb-07		5.77	-0.37
	26-Feb-07		5.279	0.121
	19-Mar-07		5.678	-0.278
	4-Apr-07		4.352	1.048
	5-Sep-07			
	4-Oct-07		3.578	

3.10.3 Groundwater quality

Groundwater quality monitoring was conducted by ERM (2007) including analysis of nutrients during development works for Stage 1 and 2. The results of groundwater monitoring showed no exceedance of adopted nutrient guidelines. It is expected that similar site works during Stage 3 and 5 should also have minimal impact on adjacent surface water.

3.11 Water infrastructure

3.11.1 Potable water supply

3.11.1.1 Existing infrastructure

Potable water for Carnarvon is sourced from groundwater bores located in subarea B-L of the Gascoyne Alluvial Aquifer and stored in the Brickhouse Tanks. Water is then treated with disinfectants and pumped into major storage tanks located at Browne Range. These tanks, both low level and high level tanks, have a capacity of 4,500KL. Potable water from these tanks is conveyed by distribution mains to Carnarvon and a series of reticulation mains are connected to provide service connections to the NE lots. The distribution mains vary between cast iron, lead jointed pipes, asbestos cement and un-plasticised polyvinyl chloride, and of varying age.

Figure 6 illustrates the town's water supply infrastructure (Shire of Carnarvon, 2017).

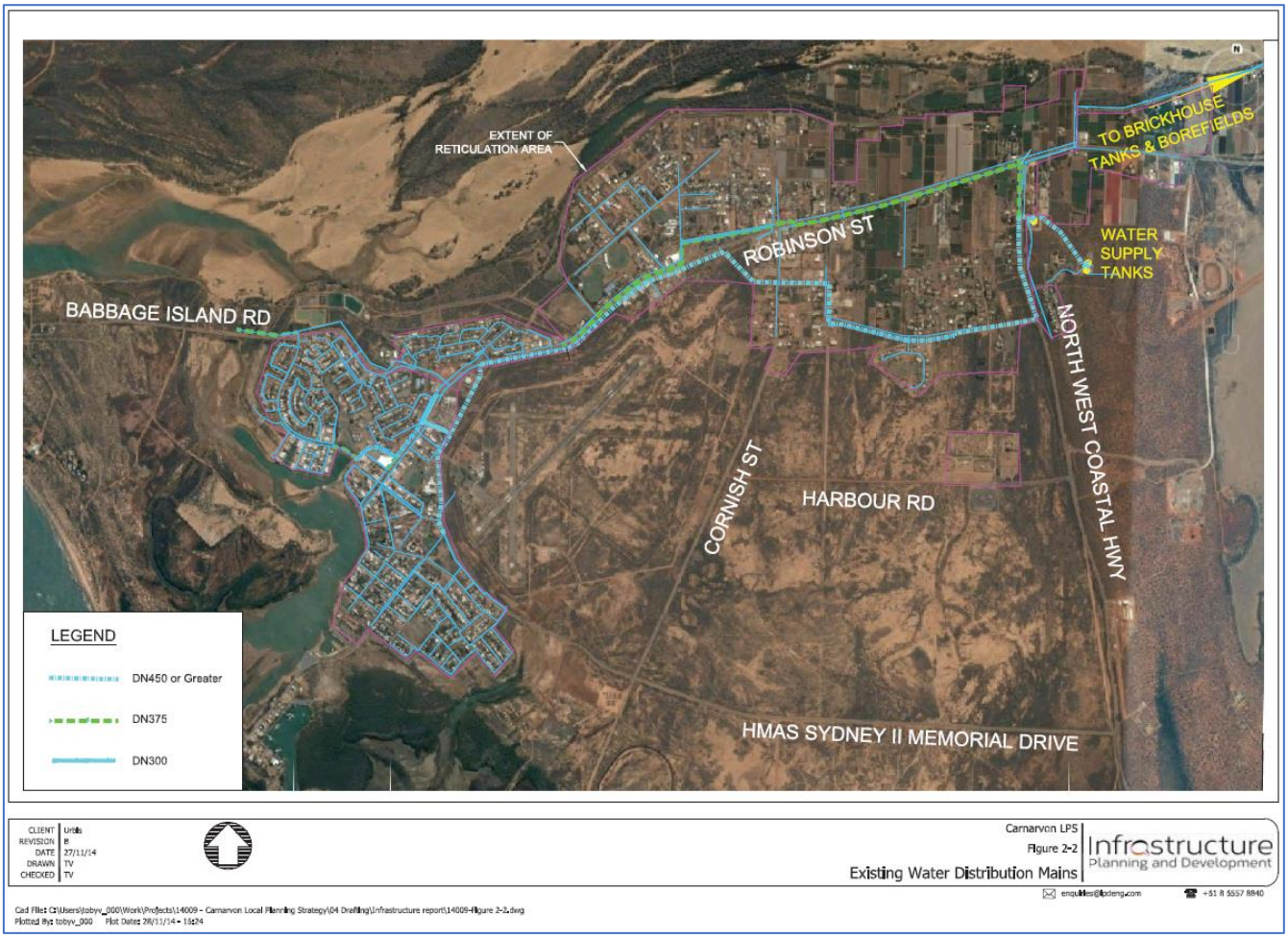

Figure 6 Shire of Carnarvon existing water distribution mains (Shire of Carnarvon, 2017)

3.11.1.2 Proposed Infrastructure

Proposed water infrastructure includes reticulation water pipes (ranging between 100mm and 300mm dia) connecting to the existing Water Corporation reticulation system to be funded and constructed by the developer in order to meet the natural growth demands on the reticulation mains required by development.

The extent of these upgrades should be discussed with and confirmed by the Water Corporation prior to submission for Development Approval (DA) for each development.

3.11.2 Non-potable water supply

There is no existing non-potable third pipe supply servicing the town.

3.11.3 Wastewater services

3.11.3.1 Existing Infrastructure

A large part of the South Carnarvon area is not connected to wastewater system, primarily due to engineering difficulties and high costs associated with high water tables, black swamp (acid sulphate) soils and dewatering problems. The areas connected to the wastewater system are shown in Figure 7. Plans exist to upgrade the Carnarvon Wastewater Treatment Plant when it reaches treatment capacity in 2030.

The development site is directly adjacent to two service areas, each with their own wastewater pump station ie SPS5 (Babbage Island Rd) and SPS6 (Lewington Lane).

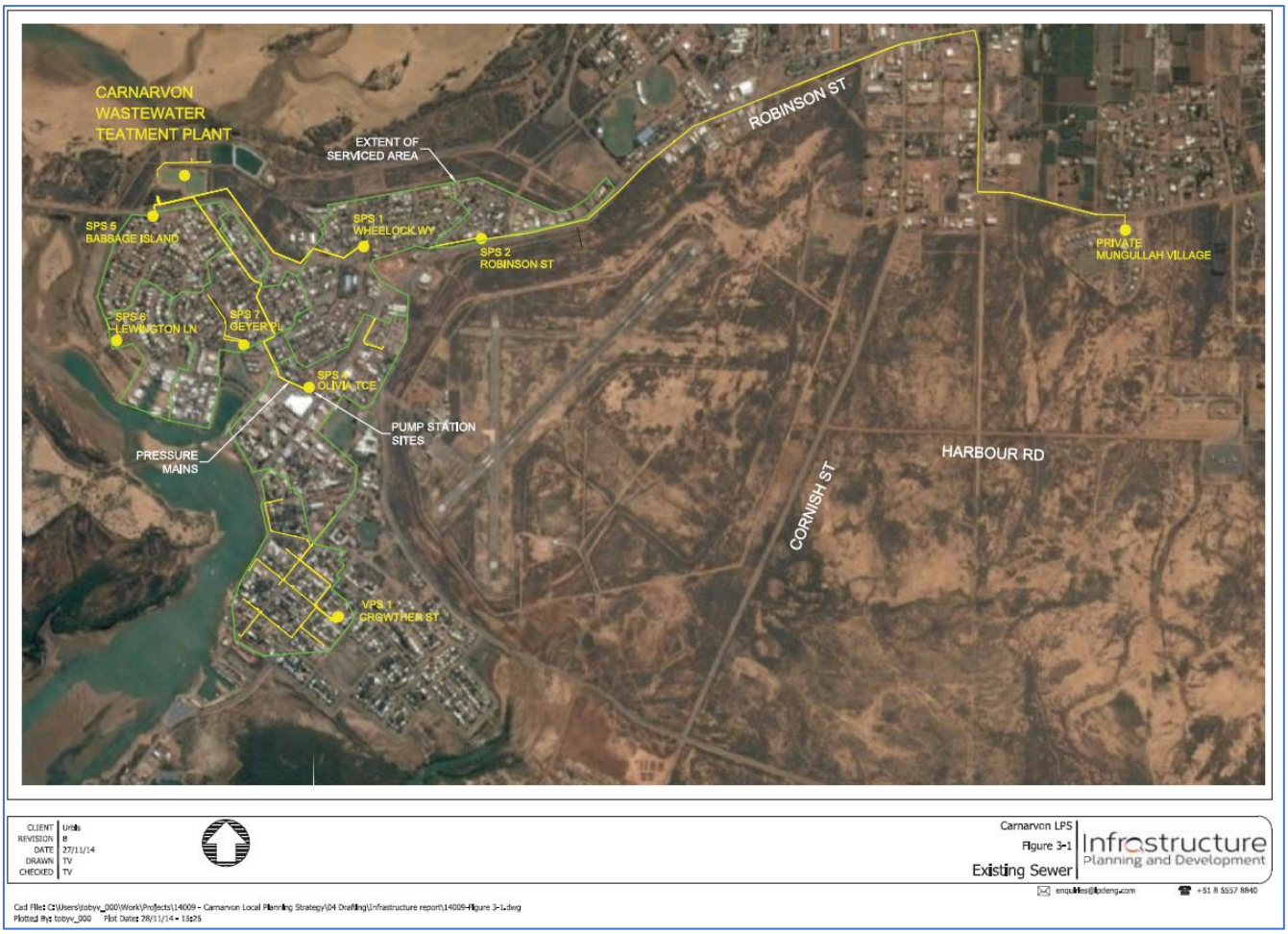

Figure 7 Shire of Carnarvon existing sewer network (Shire of Carnarvon, 2017)

3.11.3.2 Proposed Infrastructure

The developer will fund and construct any infrastructure required to connect to the existing Water Corporation sewer lines. If any upgrades are required, these must be confirmed by the Water Corporation and completed by the relevant developer as part of development.

4. Water management strategy

The following section identifies the water management principles, development requirements and strategies to achieve total water cycle management for development of the NE area.

4.1 Water conservation

Development within NE aims to optimise water conservation, maximise water reuse and incorporate water management initiatives throughout the life of the development, with opportunities at the lot development scale to achieve sustainable water management for both in-house and ex-house applications.

4.1.1 Potable water targets

The Shire of Carnarvon identifies a potable water available capacity within the existing allocation limit of 1.8 GL to accommodate for the town's forecast demand as a result of population growth and an additional 1.8 GL/annum held in reserve. It is expected the future demand will remain stable at 4 to 6 GL per year by 2050 (DWER, 2016). License entitlement has been amended by the Department of Water to ensure adequate supply to cater for future growth scenarios.

4.1.1.1 Alternative water sources

There are no plans to introduce a non-potable reticulated supply by the developer or other agency. Due to groundwater conditions, garden bores are unlikely to be a suitable non-potable supply.

4.1.2 Sustainable water use

Sustainable water use throughout NE will be achieved through implementation of a range of measures to further optimise water use efficiency and maximise water reuse wherever possible.

Buildings

For buildings throughout NE sustainable water use will primarily be achieved by the requirement for development to applicable buildings to achieve and provide certification of at least a four star green star rating under the relevant Green Star rating tool.

To achieve Green Star rating for water use efficiency development design should incorporate water efficient fittings and appliances. Fittings and appliances should be within one level of the highest level available under the Water Efficiency Labelling and Standards (WELS) system.

Utilise non-potable water sources where possible within buildings to further reduce potable water consumption. Opportunities for non-potable use include:

– Installation of infrastructure to harvest and store stormwater runoff from roof and impervious surfaces.
– Installation of greywater recycling systems, or provision of required connections and infrastructure for future conversion.
– Use of alternative fit for purpose water sources for both internal non-potable uses (toilet flushing, laundry, irrigation and potentially cooling towers) and external irrigation.

Where wastewater recycling systems (greywater and/or blackwater) are proposed, systems are to be designed in accordance with the requirements of the Department of Health. Details, including required connections to centralised infrastructure, should be provided to the Shire at Development Application stage.

Below ground infrastructure should be designed to be waterproof to minimise ongoing pumping of groundwater ingress and dewater disposal over the life of the building.

Landscape and POS areas

Landscaping will be required along the foreshore area including the POS. Landscaping will be irrigated in accordance with Water Corporation watering requirements.

4.2 Stormwater management

In the absence of local government stormwater policies or standards, it is assumed that the following requirements will apply:

– All runoff from constructed impervious area within the NE to receive treatment prior to infiltration or discharge.
– Stormwater runoff from constructed impervious surfaces generated by the first 15 mm of rainfall is to be retained or detained at or close to source.
– Roads are to remain trafficable in the 20% AEP storm, and safely collect and convey floodwaters in events up to the 1% AEP storm.
– Lots are to be protected from flooding in events up to the 1% AEP storm.

4.2.1 Road drainage

A piped network will be designed to ensure the road remains trafficable in the 20% AEP storm as described in section 4.2. Detailed modelling is presented in section 4.2.3.

4.2.2 Lot drainage

To achieve the requirements described in section 4.2, the first 15 mm of stormwater generated within lots needs to be retained within the lot. This may be achieved through a combination of one or more of the following measures:

– Infiltration via soakwells or other underground infiltration device sized for the connected impervious areas. The device will need to be located to achieve sufficient clearance from groundwater.
– Surface infiltration measures such as:
  - Rain gardens; or
  - Permeable surfaces to reduce stormwater runoff and increase local infiltration (e.g. gravel, permeable paving).
– In the levee areas, the soil composition may not allow required infiltration. In that case, storage and re-use via rainwater tanks for a range of non-potable demands including indoor non-potable uses (e.g. toilet flushing, cold water laundry) and landscape irrigation is an alternative option.

4.2.3 Hydrologic and hydraulic modelling

4.2.3.1 Approach

Hydrologic and hydraulic modelling was undertaken to size and configure stormwater infrastructure for the purpose of achieving the stormwater management objectives and confirm that the site is suitable for the proposed development.

As shown in section 4.2.3.2.2, the existing site drains towards the Fascine. The drainage strategy proposed comprises a network of pipes and overland flow routes. Flows generated in the minor storm will be conveyed by pipes discharging into the Fascine, and excess flows in the major storm contained within road reserves represented as overland flow routes in the model. Existing/ predevelopment flows for the major and minor events were estimated using a 1D DRAINS model. This approach was considered appropriate to estimate localised flows.

4.2.3.2 DRAINS model inputs

4.2.3.2.1 Design rainfall

Rainfall data was input into the hydrologic models using the methods outlined in Australian Rainfall and Runoff (ARR) (Ball, et al., 2019) Intensity-Frequency-Duration (IFD) data was obtained from the Bureau of Meteorology (BoM) (2016) for storm durations ranging from 1 hour to 48 hours, and temporal pattern data obtained from the ARR data hub service, referred to as the ARR Data Hub (Babister, Trim, Testoni, & Retallick, 2016).

Median pre-burst depths were obtained from ARR Data Hub for storm durations ranging from 1 hour to 48 hours to account for catchment antecedent moisture conditions. For storm durations with missing pre-burst depth data, the procedure detailed in Jordan et al. (2005) was adopted.

4.2.3.2.2 Contributing catchment

Catchments were delineated as reported in section 3.9.2.2. The terrain used for the catchment analysis was based on the stage 3 and 5 earthworks plan (Appendix G, Figure G.1). Generally, the catchment grades south-westerly and runoff discharges into the Fascine via multiple outlets.

4.2.3.2.3 Loss Parameters

An Initial-Continuing loss model was adopted for modelling. Adopted initial and continuing losses are presented in Table 5 below.

Table 5 Initial and continuing soil losses

Surface	Initial Loss (mm)	Continuing Loss (mm/hr)	Justification
Road impervious	1.0	0.0	Recommended by AR&R
Lot impervious (Levee areas)	1.0	0.0	Assuming an inability of levee soil to infiltrate water in the absence of levee soil composition data
Lot impervious	16.0	4.0	IL calculated from 1 mm depression loss and 15 mm of soakwell captured runoff CL estimated from performance of similar clayey sand soils
Pervious	20.0	4.0	IL and CL estimated from performance of similar clayey sand soils

4.2.3.3 DRAINS model setup

A DRAINS model was set up to simulate flows in the post development scenario. Initial losses were specified according to section 4.2.3.2.3.

The following assumptions were made in the design of stormwater infrastructure:

– Based on lot size, it was assumed that 40% of the lot area was pervious. A summary of pervious and impervious areas used in the model is given in Table 6.
– An average road width of 7.5 m was assumed in the estimation of pervious areas within road reserves.
– The minimum cover for each pipe was assumed to be 600 mm.
– Acceptable hydraulic grade line in the pipes, was assumed to be just lower than the spill level.
– No pipe outlet is submerged, i.e. an atmospheric discharge outlet was assumed for each pipe.
– The existing pipe in Catchment 8 was excluded from modelling assuming that it was already designed and constructed to cater for the contributing catchment.

Table 6 Estimated pervious and impervious areas within the Site

Catchment	Catchment Area (Ha)	Effective Impervious Area (%)	Remaining Impervious Area (%)	Pervious Area (%)
1	1.68	8.9	44.6	46.4
2	2.01	8.6	47.4	44.0
3	0.80	13.1	44.3	42.6
4	1.06	12.0	45.9	42.1
5	2.21	12.2	41.8	46.0
6	0.47	13.9	38.2	47.9
7	1.89	11.0	45.1	43.9
8	1.50	16.1	36.3	47.6

4.2.3.4 DRAINS results

Results for the 1% AEP major and 20% AEP minor critical storms, including design pipe information is summarised in Table 7. The diameter represents diameter for the final link of the pipe network (outlet) where the maximum flow rate is reached.

In the absence of an overland flow path from the existing trapped low point in Para View, pipes 5 and 6 have been designed to cater for the 1% AEP storm.Table 7 Stormwater drainage design information

Pipe ID	Digital Terrain Model (DTM) Levels		Pipe Data				
	Upstream, US (mAHD)	Downstream, DS (mAHD)	Length (m)	Diameter (mm)	Minimum Cover (mm)	US Invert Level (mAHD)	DS Invert Level (mAHD)
Pipe1	3.3	3.3	125	450	600	2.25	1.50
Pipe2	3.3	0.6	203	600	600	1.50	0.60
Pipe3	3	0.8	16	375	600	1.50	0.80
Pipe4	3	3	63	375	600	1.95	1.50
Pipe5	3	3.5	126	525	600	1.80	1.50
Pipe6	3.5	1.2	71	525	600	1.50	1.20
Pipe7	3	1.4	23	375	600	1.70	1.40

DRAINS results are available in Appendix H and summarised in Table 8.

Table 8 Maximum flows and HGL for minor and major storms

Pipe Name	20% AEP Minor Storm		1% AEP Major Storm	
	Pipe flow (m^3/s)	Road flow (m^3/s)	Pipe flow (m^3/s)	Road flow (m^3/s)
Pipe1	0.19	0.00	0.41	0.13
Pipe2	0.41	0.00	0.59	0.56
Pipe3	0.19	0.00	0.40	0.33
Pipe4	0.10	0.00	0.17	0.38
Pipe5	0.25	0.00	0.34	0.43
Pipe6	0.26	0.00	0.49	0.44

Pipe Name	20% AEP Minor Storm		1% AEP Major Storm	
	Pipe flow (m^3/s)	Road flow (m^3/s)	Pipe flow (m^3/s)	Road flow (m^3/s)
Pipe7	0.18	0.00	0.30	0.41

4.2.4 Flood management

As noted in Section 3.9.4, Stage 3, which is closest to the 1% AEP Floodplain Development Control Area, i.e., Special Control Area 3: Flood Prone Area (SCA3). SCA3 includes provisions for flood controls to provide acceptable level of protection to life, property, community infrastructure and the environment for a 1% AEP flood event. To address the provisions in SCA3, GHD assessed the 1% AEP flood levels and the flood impact of the scheme amendment, using previous flood modelling results in the area undertaken by GHD for Main Roads WA and published by Department of Water and Environmental Regulation (GHD, 2014). The results are summarised in Table 9. Further information regarding these flood risks is provided in Appendix L.

Table 9 Flooding results from DPI (2003) and GEMS (2009)

Scenario reference	Description	Reduced level (mAHD)
1	Design Surface Elevation	3.0-3.6
2	5% AEP Extreme still water level (DPI 2003)	1.77
3	5% AEP Max level of wave uprush (DPI 2003)	2.65
4	5% AEP Max level of wave uprush + factor of safety (DPI 2003)	3.11
5	Maximum WL for a cyclone category 5 (GEMS 2009)	3.3
6	1% AEP riverine flood level (GHD 2014)	1.28

It was concluded that the site is well protected from the 1% AEP riverine flood, which is 2.0m lower than the design earthwork lot levels. According to the GEMS (2009) report, the maximum storm surge level during a category 5 cyclone is 3.3 m AHD.

All new lots are set higher than 4.0 mAHD. Existing lots located to the east of the development are lower than 3.3 mAHD, however the proposed earthworks provide a continuous ridge line between the fascine and the existing lots of no less than 3.5 mAHD. There are also no subsurface pipe connections created by the development between the fascine and the exiting lots, and therefore no path for storm surge floodwaters through the proposed development.

4.3 Water sensitive urban design

Water sensitive urban design (WSUD) offers multiple benefits sought by the objectives of NE, including improvements to green space, urban heat, water quality, liveability, canopy cover, and runoff control.

At the estate scale, bioretention swales are proposed for low points in the road topography, to capture, detain, filter and treat runoff prior to discharge into the pit and pipe system (Appendix I). Other WSUD elements and water quality treatment structures are proposed for the lot and road scale as follows:

1. Soakwells which have wide-spread use in Western Australia as an at-source stormwater management control, typically in small-scale residential and commercial applications, or as roadside entry pits at the beginning of a stormwater system, and
2. “Leaky” pits which have a small storage and infiltration zone at the base of the pit, acting as soakwells and providing an opportunity for collection of sediment and sediment -bound pollutants.

4.4 Groundwater management

The overall objectives for groundwater management are to minimise changes to baseline groundwater levels and quality as a result of development by ensuring that groundwater quality leaving the site is at least the same, if not better, than the water entering the site.

4.4.1 Groundwater levels

Groundwater level management is necessary to ensure sufficient clearance between finished lot levels and groundwater levels. The observed maximum groundwater level during the monitoring period in 2006 to 2007 is 1.05 mAHD (refer 3.10.2). Preliminary indicative earthwork levels for the residential lots are between 3.5 m AHD and 4.0 m AHD, giving a minimum clearance to groundwater of 2.45 m. No subsoil drainage is required for the proposed development.

4.4.2 Groundwater quality

The main objective for the management of groundwater quality is to maintain or improve the existing groundwater quality. This can be achieved by reducing the total nutrient load into groundwater that originates from the development and treatment of surface water runoff prior to infiltrating to groundwater.

The nutrient load to groundwater from landscaping practices within the development itself will be minimised by:

– The use of slow release fertiliser.
– The use of native species and xeriscaping (which in turn reduces the need for fertilisers), and
– Minimising turf areas.

Surface water runoff treatment will comprise:

– Retention in soakwells, and
– Filtration in leaky pits.

Due to the occurrence of a groundwater dependent ecosystems nearby to the site, post development monitoring is necessary to minimise hydrological risks.

5. Monitoring

5.1 Pre-development monitoring

Section 3.10, summarises baseline groundwater levels and quality.

5.2 Post-development monitoring

No post development surface or groundwater monitoring program is proposed for the purposes of this LWMS. This does not preclude monitoring for construction phase activities associated with a construction Environmental Management Plan, if required.

6. Urban water management plans

Urban Water Management Plan (UWMP) will be required based on the Western Australia Planning Commission (WAPC) conditions. The UWMP will detail site characteristics, water use sustainability initiatives to be implemented, stormwater and groundwater management plan, outline the plan for management of subdivision works and develop the implementation plan.

7. Implementation

7.1 Roles and responsibility

The LWMS provides a framework, based upon site-specific investigations, consistent with relevant State and Local Government policies, that the proponent can utilise in establishing stormwater management methods. The responsibility for working within the framework established within the LWMS rests with the proponent, DevelopmentWA. Operation and maintenance of the stormwater management system will initially be the proponent's responsibility, ultimately reverting to the Shire following handover.

7.2 Funding

The site is owned by a single landholder and the development will be funded by the proponent.

8. Conclusion and recommendations

This LWMS demonstrates that the NE is capable of being developed for the intended residential land use by following the recommended approach to water management summarised below:

– Manage runoff for serviceability in the minor (20% AEP) storm, and flood protection in the major (1% AEP) storm.
– Retain and treat the first 15 mm of runoff as close to source as practicable using measures appropriate for lots and roads.
– Water conservation practices both within the home and in public open spaces.

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Appendices

Appendix A

Northwater Estate site and development concept plan

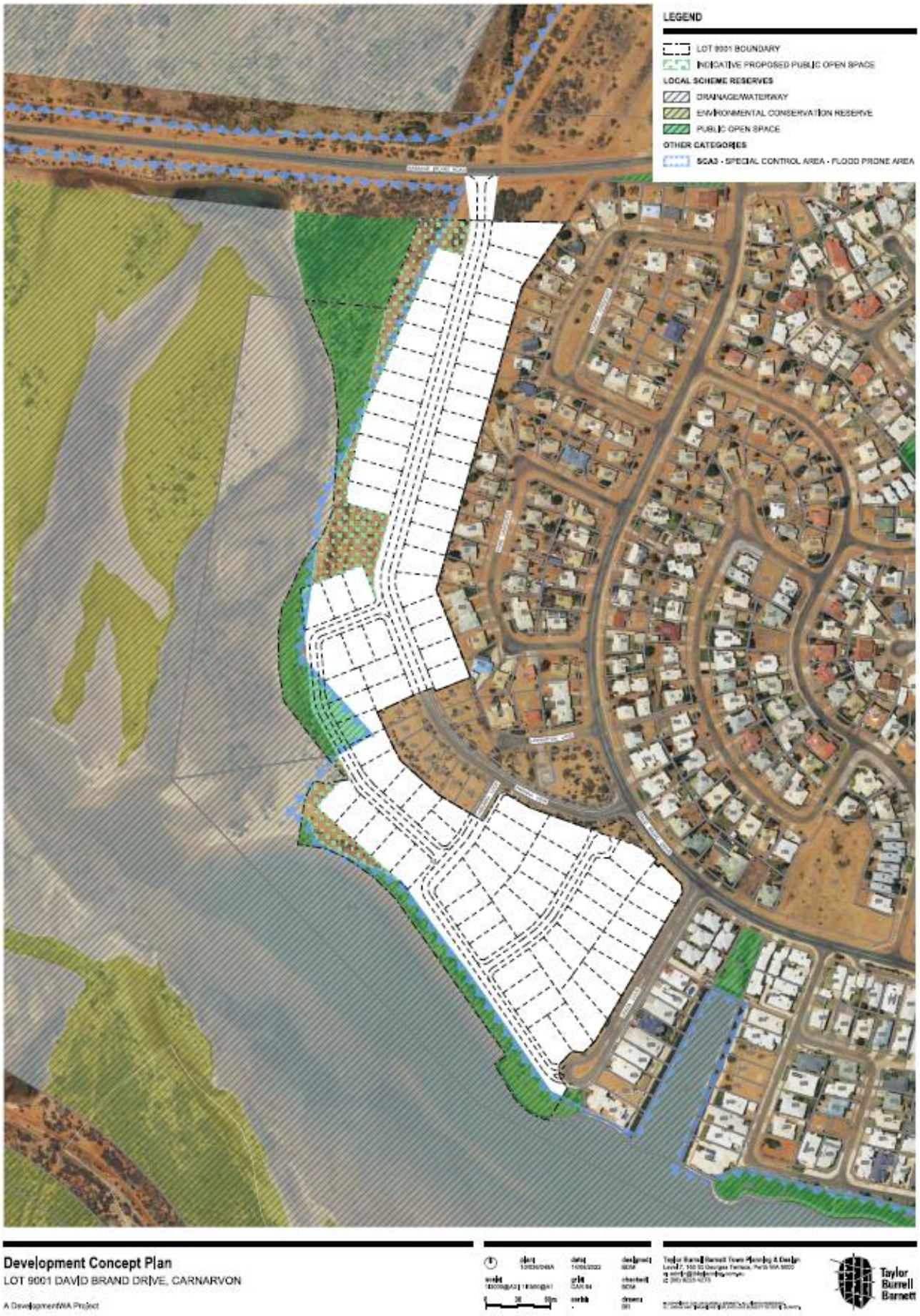


Figure A.1 Northwater Estate development concept plan

Appendix B

Disturbed land map

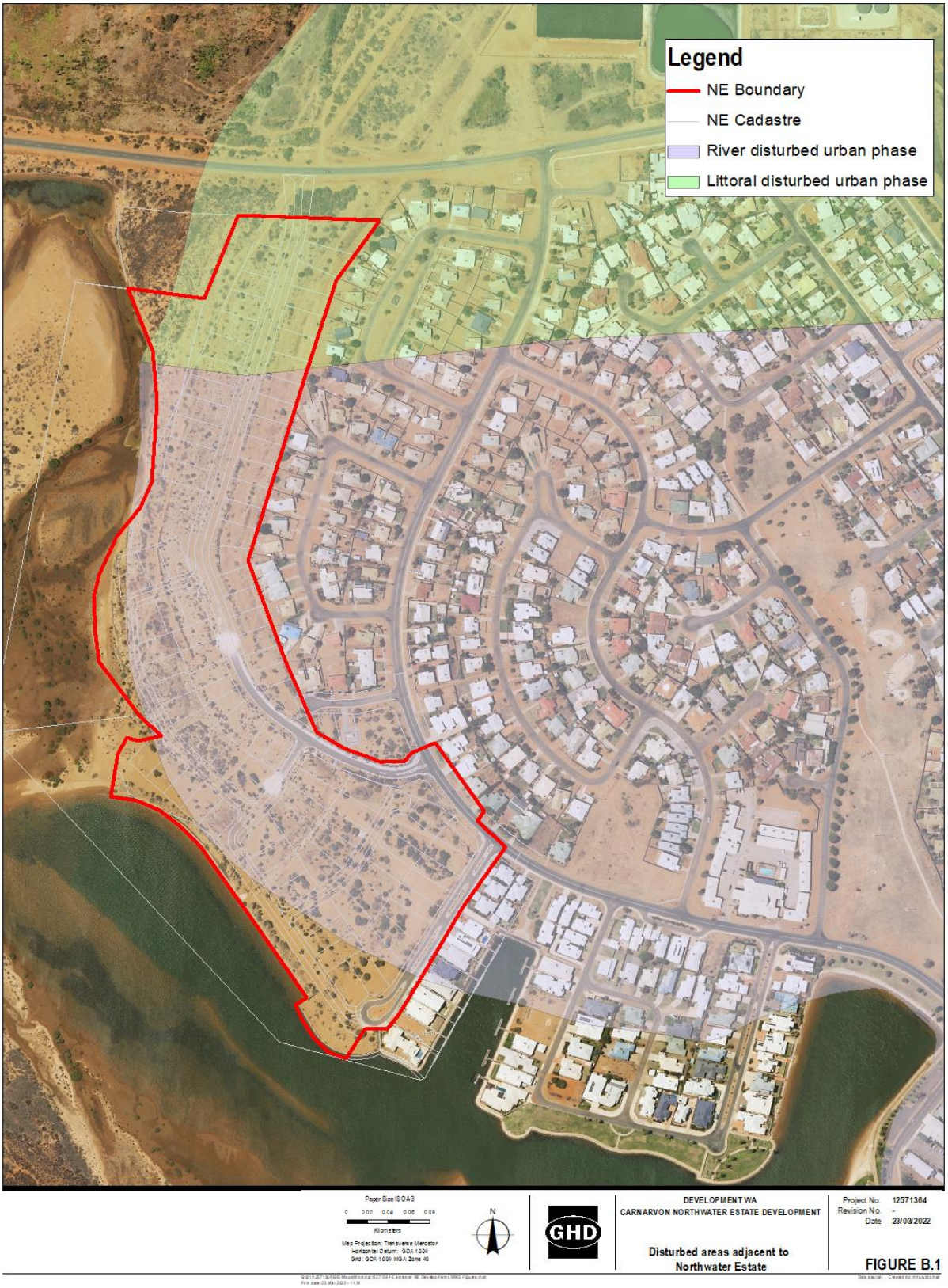


Figure B.1 Disturbed areas adjacent to Northwater Estate

Appendix C

Contaminated site map

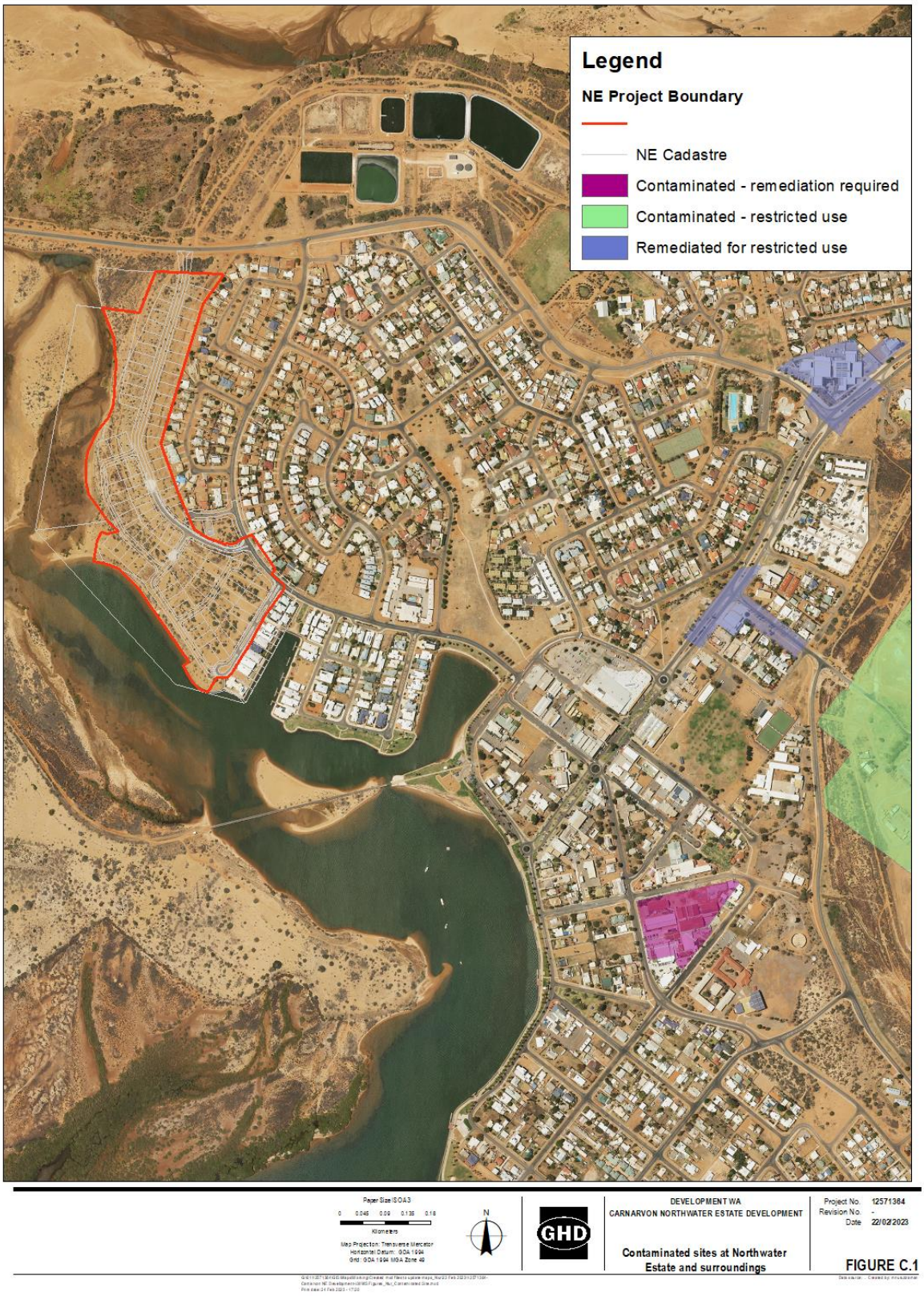


Figure C.1 Contaminated site mapping

Appendix D

Northwater estate catchments

Figure D.1 Northwater Estate local catchments

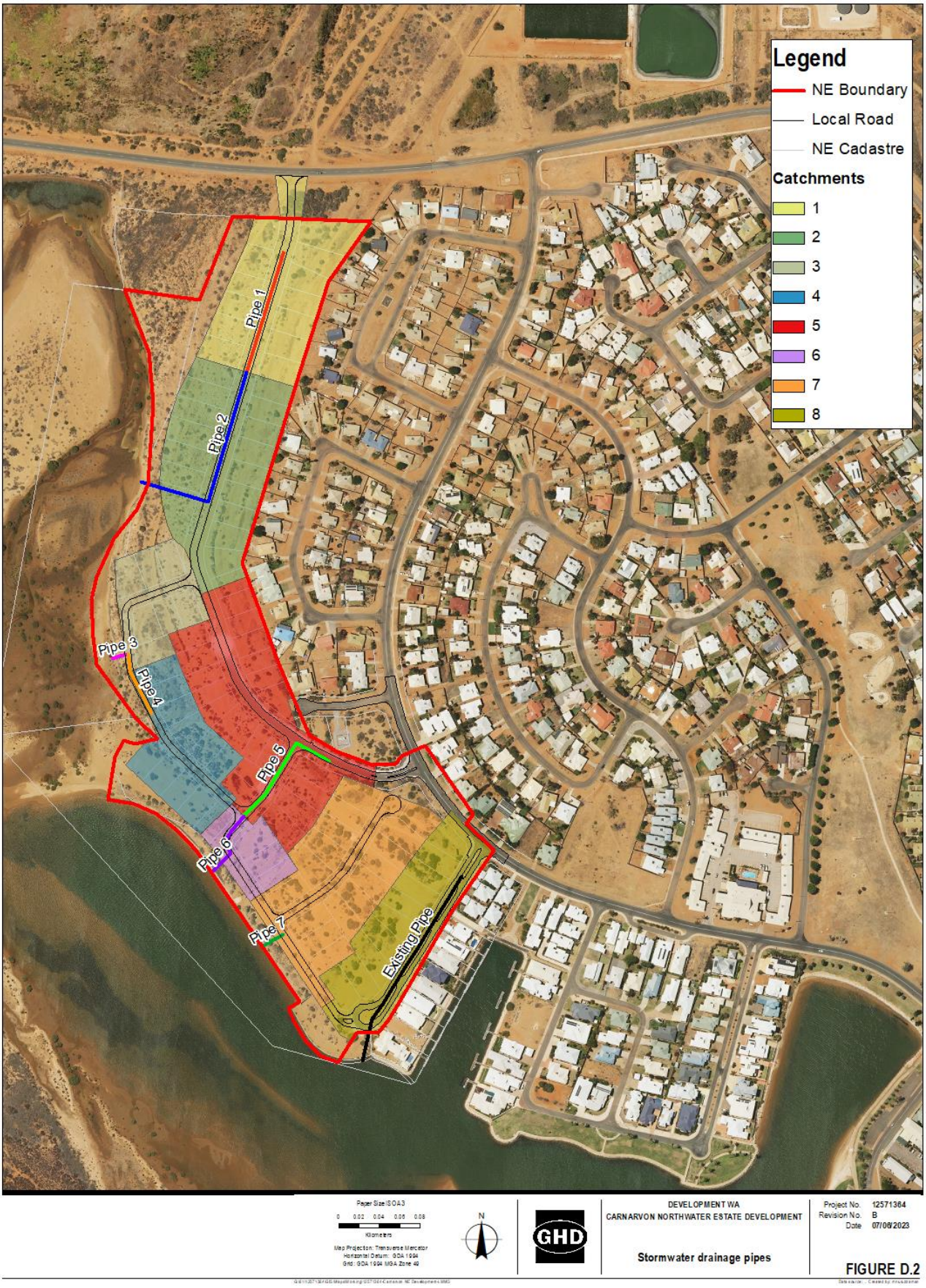


Figure D.2 Proposed stormwater drainage pipes

Figure D.3 Open Drain conveying sewer pump station overflow

Figure D.4 Shire of Carnarvon catchment plan

Appendix E

Carnarvon floodplain map

Figure E.1 Northwater Estate 1% AEP flood levels and extents

Appendix F

Groundwater Abstraction Licenses

Table 10 Groundwater Abstraction Licenses

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
44645	17/12/2027	63,000	Whitcroft, Wayne Desmond	Lower Gascoyne Alluvial
45163	29/04/2031	75,000	Borich, Ruzica, Borich, Zelko	Lower Gascoyne Alluvial
45164	12/03/2028	45,000	Chinnery, Jeremy Martin, Chinnery, Tamara Anne	Lower Gascoyne Alluvial
45165	14/03/2028	28,000	Westcott, Robert Ellis	Lower Gascoyne Alluvial
45168	12/03/2028	51,000	Andreoli, Carlo Joseph	Lower Gascoyne Alluvial
45169	14/03/2028	40,000	Gibbings, Michael Paul, Gibbings, Melissa Jane	Lower Gascoyne Alluvial
45175	10/12/2027	76,000	Guglielmana, Giordano	Lower Gascoyne Alluvial
45176	7/12/2027	133,000	Department of Primary Industries and Regional Development	Lower Gascoyne Alluvial
45177	14/11/2027	78,500	Mendes, Maria Idalina Fernandes, Mendes, Jorge Manual Florencio	Lower Gascoyne Alluvial
45180	15/12/2027	45,000	Ookuma Farm Pty Ltd	Lower Gascoyne Alluvial
45184	12/03/2028	22,000	Ciapusci, Fedele	Lower Gascoyne Alluvial
45185	17/12/2027	20,000	Le, Mary Kim, Nguyen, Andrew	Lower Gascoyne Alluvial
45186	18/12/2027	84,000	Janna Corporation Pty Ltd	Lower Gascoyne Alluvial
45274	18/12/2027	93,000	Davmark Pty Ltd	Lower Gascoyne Alluvial
45275	12/12/2027	53,000	Vo, Tuyet Xuan, Lu, Van Nghia	Lower Gascoyne Alluvial
45276	13/12/2027	30,000	LNG Australia Trading Pty Ltd	Lower Gascoyne Alluvial
45284	18/12/2027	77,000	Durmanich, Vinko	Lower Gascoyne Alluvial
45291	11/12/2027	40,000	Goran Joseph Musulin	Lower Gascoyne Alluvial
45292	17/12/2027	90,000	Williamson, Stephen Craig	Lower Gascoyne Alluvial
45299	12/03/2028	36,000	Nguyen, Le Thu, Vo, Van Thang	Lower Gascoyne Alluvial
45302	10/12/2027	59,000	Lyall, Birrell Norman Macleod	Lower Gascoyne Alluvial
45306	19/12/2027	64,000	De Boni, Domenico John	Lower Gascoyne Alluvial

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
45307	2/05/2028	36,000	Alaga, Marija	Lower Gascoyne Alluvial
45323	12/12/2027	75,000	Gibson, Gary, Gibson, Kathleen Anne	Lower Gascoyne Alluvial
45324	12/03/2028	29,000	De Abreu, Adelina	Lower Gascoyne Alluvial
45325	12/03/2028	77,000	De Abreu Lourenco, Manuel Gabriel	Lower Gascoyne Alluvial
45327	14/11/2027	75,500	Scott, Robert Ashley	Lower Gascoyne Alluvial
45328	18/12/2027	70,000	Solander Nominees Pty Ltd	Lower Gascoyne Alluvial
45331	17/12/2027	72,000	Skender, Ratko, Skender, Elaine	Lower Gascoyne Alluvial
45344	5/02/2030	47,000	D.F Wiggins & S Wiggins	Lower Gascoyne Alluvial
45346	18/12/2027	21,000	Durmanich, Alison Mary, Durmanich, Andrew James	Lower Gascoyne Alluvial
45353	12/03/2028	22,000	Durmanich, Joso	Lower Gascoyne Alluvial
45354	22/05/2028	20,000	Cvitan, Donna-Tracey, Cvitan, Steven	Lower Gascoyne Alluvial
45357	14/12/2027	102,000	Robert Bruce Munro, Munro, Darrell Anne	Lower Gascoyne Alluvial
45360	17/12/2027	65,000	Thach, Van Lac, Tram, Tuong Ngoc	Lower Gascoyne Alluvial
45413	12/12/2027	49,000	Bilicich, Marija, Bilicich, Timosenko	Lower Gascoyne Alluvial
45416	14/11/2027	80,500	Harper, Glenn Allan, Harper, Joy Lynette	Lower Gascoyne Alluvial
45437	15/10/2029	63,000	J Tran Family Company Pty Ltd	Lower Gascoyne Alluvial
45439	6/12/2027	75,000	Mundillya Farm Pty Ltd	Lower Gascoyne Alluvial
45480	30/08/2022	72,000	Thi Kim Nguyen, Thanh Van Nguyen	Lower Gascoyne Alluvial
45493	17/12/2027	43,000	Durmanich, Silvia, Durmanich, Ante	Lower Gascoyne Alluvial
45494	24/05/2028	45,000	Durmanich, Ante	Lower Gascoyne Alluvial

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
45496	12/03/2028	31,000	Wiggins, Deane Francis, Wiggins, Suzzanne	Lower Gascoyne Alluvial
45497	12/03/2028	68,000	Otway, Julie Dawn, Doug Geoffrey Otway	Lower Gascoyne Alluvial
45498	15/07/2030	58,000	Kim Tu Nguyen, Nguyen, Hoa Dinh	Lower Gascoyne Alluvial
45582	18/12/2027	20,000	Sunsweet Investments Pty Ltd	Lower Gascoyne Alluvial
45611	18/12/2027	78,500	Ord River Farmers Pty Ltd	Lower Gascoyne Alluvial
45654	12/03/2028	25,000	Rowe, Wayne James, Rowe, Lyndale Kaye	Lower Gascoyne Alluvial
45836	14/03/2028	90,000	Thomas, John Stephen	Lower Gascoyne Alluvial
45859	13/12/2027	75,000	Mark Nicholas Parry, Parry, Claire Victoria	Lower Gascoyne Alluvial
45944	26/03/2028	54,000	Andreoli, Michael	Lower Gascoyne Alluvial
46169	14/11/2027	37,500	Tran, Thanh Dung, Nguyen, Thau Thi; Huynh, Tuan Quang; Doan, Uyen Chan Ha	Lower Gascoyne Alluvial
46171	24/06/2031	39,000	Kuzmicich, Steve	Lower Gascoyne Alluvial
46172	3/11/2031	55,000	Kuzmicich, Pavo	Lower Gascoyne Alluvial
46173	14/03/2028	37,000	Mihovilovic, Marin, David Mihovilovic	Lower Gascoyne Alluvial
46275	2/06/2030	65,000	Sandra Marie Hoang, Minh Tue Hoang	Lower Gascoyne Alluvial
46347	30/07/2028	41,500	M.B Sutcliffe & S.A Sutcliffe	Lower Gascoyne Alluvial
48840	25/10/2028	50,000	Robert Gavin Gaze	Lower Gascoyne Alluvial
50807	14/03/2028	40,000	Kearney, John Francis	Lower Gascoyne Alluvial
56321	11/12/2027	78,500	Illawarra Downs Pty Ltd as Trustee for V & M Durmanich Trust	Lower Gascoyne Alluvial
56349	6/12/2027	94,000	Tipton, Darryl Mark, Tipton, Amy May; Tipton, Kenneth Noel	Lower Gascoyne Alluvial
56801	24/06/2031	53,000	Susan Peta Richardson	Lower Gascoyne Alluvial

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
56858	24/02/2031	8,000	G.C Barrett & K Barrett	Lower Gascoyne Alluvial
56859	15/07/2030	6,000	WA Coastal Properties Pty Ltd	Lower Gascoyne Alluvial
56860	22/01/2030	10,000	Summerstar Pty Ltd	Lower Gascoyne Alluvial
56886	15/03/2028	24,000	Frzop, Tony, Frzop, Anne Lena	Lower Gascoyne Alluvial
56891	14/11/2027	73,500	Raso, Michele	Lower Gascoyne Alluvial
57257	14/03/2028	31,000	Babun, Joyce Winifred	Lower Gascoyne Alluvial
57259	28/03/2031	62,000	Burkett, Kevin Francis, Burkett, Peta Dixie	Lower Gascoyne Alluvial
57260	12/12/2027	51,000	Johnston, Peter Robert, Johnston, William Saunders	Lower Gascoyne Alluvial
57262	15/03/2028	45,000	Tran, Thi Le, Nguyen, Ha Van	Lower Gascoyne Alluvial
57267	14/03/2028	39,000	Van Giang, Cuu	Lower Gascoyne Alluvial
57270	19/12/2027	50,000	Ho, Hoang Kiem, Nguyen, Thy Mai Thi	Lower Gascoyne Alluvial
57271	20/12/2027	69,000	Nobrega, Maria Da Conceicao, Nobrega, Rufino Da Silva	Lower Gascoyne Alluvial
57285	14/03/2028	20,000	Skender, Marija, Skender, Luka	Lower Gascoyne Alluvial
57286	14/11/2027	60,500	Sullivan, Kevin David	Lower Gascoyne Alluvial
57287	25/10/2031	71,000	Caidan Produce Pty Ltd	Lower Gascoyne Alluvial
57290	19/05/2031	47,000	Farelo, Fernanda Maria Yebra, Farelo, Jose Yebra	Lower Gascoyne Alluvial
57291	30/05/2029	37,000	Luke Ricard Skender, Richard Skender; Deborah Inez Skender	Lower Gascoyne Alluvial
57294	22/05/2028	46,000	Vrankovich, Katica	Lower Gascoyne Alluvial
57295	12/03/2028	52,000	Blue Glen Pty Ltd	Lower Gascoyne Alluvial
57298	13/12/2027	72,000	Sweetman Industries Pty Ltd	Lower Gascoyne Alluvial
57301	16/11/2027	73,000	Schmidt, Judith Lorraine	Lower Gascoyne Alluvial
57305	15/03/2028	46,000	Burke Cornelis Holla, Marcus John Whitehall-Holla	Lower Gascoyne Alluvial

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
57306	14/12/2027	46,000	Mladinov, Anton, Mladinov, Vjera	Lower Gascoyne Alluvial
57307	14/03/2028	20,000	Edward Charles Smith, Smith, Susan Marie	Lower Gascoyne Alluvial
57309	6/12/2027	20,000	Anthony Peter Vrankovich	Lower Gascoyne Alluvial
57310	5/02/2029	27,000	Robert Graeme Hug	Lower Gascoyne Alluvial
57312	7/12/2031	90,000	Constantine, Julian Andrew	Lower Gascoyne Alluvial
57477	12/03/2028	40,000	Paulino, Antonio Franca, Paulino, Maria Fatima	Lower Gascoyne Alluvial
57512	12/03/2028	20,000	Luis, Veronica Fernandes, Luis, Ricardo Paulo Camara	Lower Gascoyne Alluvial
58223	21/10/2029	74,000	The Phuong Trinh, Thi Be Ba Huynh	Lower Gascoyne Alluvial
58272	17/12/2027	23,000	Pham, Tuyet Ngoc Thi, Luu, Binh Quoc	Lower Gascoyne Alluvial
58297	12/12/2027	71,000	Huynh, Be Nam, Nguyen, Thang Cong	Lower Gascoyne Alluvial
58299	14/11/2027	70,500	De Gouveia, Manuel Mendes, De Gouveia, Maria Lucia Fernandes	Lower Gascoyne Alluvial
58399	12/03/2028	27,000	Byron, Phillip Craig	Lower Gascoyne Alluvial
59145	11/12/2027	90,000	Hardman, Darryl Edmund, Hardman, Cherelle	Lower Gascoyne Alluvial
59795	14/11/2027	96,500	Borich, Ruzica, Borich, Zelko	Lower Gascoyne Alluvial
60335	17/12/2027	71,000	Parry, Rodney Phillip, Parry, Susan Janet	Lower Gascoyne Alluvial
60361	12/03/2028	10,000	Shire of Carnarvon	Lower Gascoyne Alluvial
61129	15/04/2028	36,000	Gorgonio, Juanito Surbano	Lower Gascoyne Alluvial
61400	17/10/2029	70,500	Thi Tham Dinh, Van Tho Pham	Lower Gascoyne Alluvial
61529	12/03/2028	20,000	Zoric, Gojko	Lower Gascoyne Alluvial
61756	12/03/2028	25,000	Trinh, Thi My Cuc, Phan, Van Gan	Lower Gascoyne Alluvial

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
62940	16/12/2031	51,000	Lee, Jenny, Lee, Kinh	Lower Gascoyne Alluvial
63846	17/12/2027	72,000	Huynh, Thi My Dung, Nguyen, Van Duc	Lower Gascoyne Alluvial
63847	23/09/2030	21,000	Real Futures Pty Ltd	Lower Gascoyne Alluvial
64849	24/01/2028	61,000	Thi Mong Tuyen Quach, Van Ca Duong; Cuu Van Giang	Lower Gascoyne Alluvial
65550	12/03/2028	20,000	Huynh, Van Ngoi, Tran, Thi Deo	Lower Gascoyne Alluvial
65626	17/12/2027	85,000	Richards, Dean John, Jodi Richards	Lower Gascoyne Alluvial
66027	14/12/2027	43,000	Durmo Quality Produce Pty Ltd	Lower Gascoyne Alluvial
67819	24/02/2030	40,000	Rita Jeanette Byron, Byron, Phillip Craig	Lower Gascoyne Alluvial
75136	17/12/2027	51,000	MA & MC & AF & AL Da Luz	Lower Gascoyne Alluvial
92180	13/03/2028	42,000	Illawarra Downs Pty Ltd as Trustee for V & M Durmanich Trust	Lower Gascoyne Alluvial
108184	15/03/2028	72,000	Mathween George Cosh	Lower Gascoyne Alluvial
108887	15/03/2028	60,000	Stephen Lyall, Lyall, Linda Joanne	Lower Gascoyne Alluvial
110882	14/11/2027	56,500	Condo, Domenico Robert, Condo, Heather Avis	Lower Gascoyne Alluvial
110884	14/11/2027	60,500	Condo, Domenico Robert, Condo, Heather Avis	Lower Gascoyne Alluvial
110902	14/11/2027	57,500	Condo, Domenico Robert, Condo, Heather Avis	Lower Gascoyne Alluvial
150433	24/05/2028	39,000	Durmanich, Silvia, Durmanich, Ante	Lower Gascoyne Alluvial
152876	7/12/2027	63,000	Bakerco Pty Ltd	Lower Gascoyne Alluvial
153774	14/11/2027	36,500	Buzzard, Andrew David, Buzzard, Joanne Helen	Lower Gascoyne Alluvial
153783	7/12/2027	66,000	De Matos, Manuel Raimundo Fernandes, De Matos, Maria De Fatima Mata Gomes	Lower Gascoyne Alluvial

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
153790	18/12/2027	29,000	Kim Le Nominees Pty Ltd	Lower Gascoyne Alluvial
153960	25/03/2028	66,000	Hardman, Darryl Edmund, Hardman, Cherelle	Lower Gascoyne Alluvial
154546	17/12/2027	27,000	Thi Kim Nguyen, Thanh Van Nguyen	Lower Gascoyne Alluvial
155363	10/12/2027	82,000	Romeo Dante De Boni	Lower Gascoyne Alluvial
155367	14/03/2028	20,000	Barrett, Nella	Lower Gascoyne Alluvial
155368	14/03/2028	27,000	Barrett, Nella	Lower Gascoyne Alluvial
155414	17/12/2027	46,000	Sunsweet Investments Pty Ltd	Lower Gascoyne Alluvial
155421	12/03/2028	39,000	Guglielmana, Giordano	Lower Gascoyne Alluvial
155557	14/03/2028	20,000	Farelo, Fernanda Maria Yebra, Farelo, Jose Yebra	Lower Gascoyne Alluvial
155768	14/03/2028	20,000	Quach, Hong Thanh	Lower Gascoyne Alluvial
159802	18/12/2027	78,000	Leslie Charles Ball	Lower Gascoyne Alluvial
159878	12/03/2028	20,000	Pham, Van Hong, Nguyen, Thi Lieu	Lower Gascoyne Alluvial
161410	3/08/2031	20,000	Caidan Investments (WA) Pty Ltd	Lower Gascoyne Alluvial
161972	11/12/2027	69,000	Dang, Vanny, Nguyen, Hoa Dinh; Nguyen, Ba Hoang	Lower Gascoyne Alluvial
166166	16/07/2025	5,000	Northern Assets Pty Ltd	Lower Gascoyne Alluvial
177599	12/03/2028	66,000	De Ponte, Jose Bernardino, De Ponte, Virginia Geronima	Lower Gascoyne Alluvial
177604	14/03/2028	30,000	De Ponte, Jose Bernardino, De Ponte, Virginia Geronima	Lower Gascoyne Alluvial
179138	22/05/2028	20,000	Shain, Pavao Phillip	Lower Gascoyne Alluvial
179942	4/12/2027	40,000	Huynh, Thi My Dung, Nguyen, Van Duc	Lower Gascoyne Alluvial
180847	12/12/2027	20,000	Vo, Thi Nhan, Quach, Hong Thanh	Lower Gascoyne Alluvial
200056	11/07/2027	15,000	John Gerard West	Lower Gascoyne Alluvial

License Number	License Expiry Date	License Allocation (KL)	Registered party or Licence holder	Aquifer
200057	11/07/2027	20,000	Svilicich, Andy	Lower Gascoyne Alluvial
204489	30/06/2030	45,000	Thi Bich Thuy Phan, Hung Van Tran	Lower Gascoyne Alluvial
205126	22/11/2030	58,000	Tran, Thi Gai, Danny Dao; HBTT Pty Ltd	Lower Gascoyne Alluvial
205576	1/03/2031	20,000	The Trustee for the Rebola Super Fund	Lower Gascoyne Alluvial
205841	6/05/2031	9,000	Wintersun Caravan & Tourist Park Pty Ltd	Lower Gascoyne Alluvial
205905	18/05/2031	4,000	Durmo Quality Produce Pty Ltd	Lower Gascoyne Alluvial
206778	16/12/2031	56,000	Vicki Lorraine Della Bella	Lower Gascoyne Alluvial

Appendix G

Earthworks concept

Figure G.1 Northwater Estate Stage 3 and 5 Earthworks Plan

Appendix H

Hydraulic modelling results

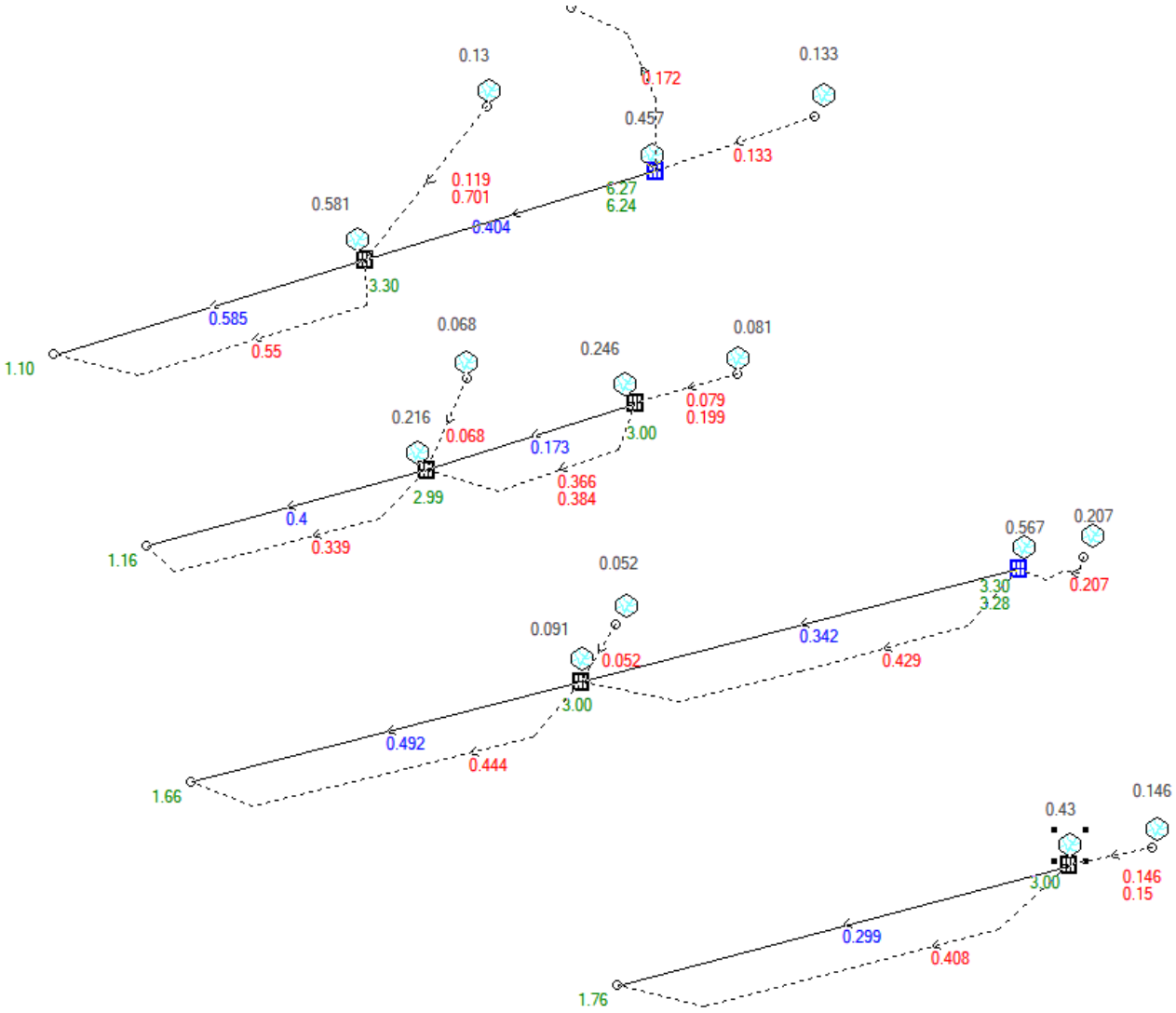


Figure H.1 *DRAINS model results for 20% AEP minor storm*

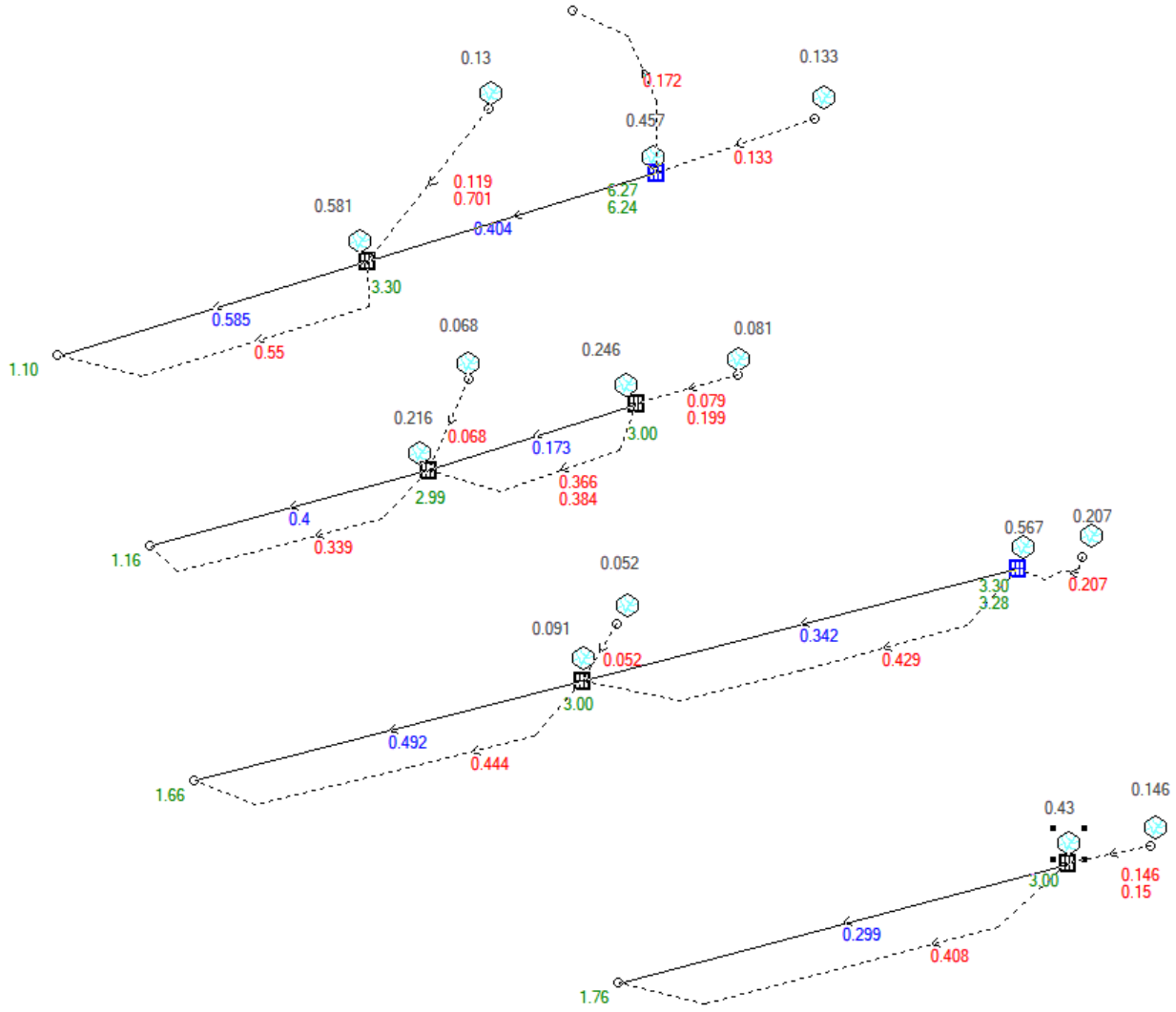


Figure H.2 DRAINS model results for 1% AEP major storm

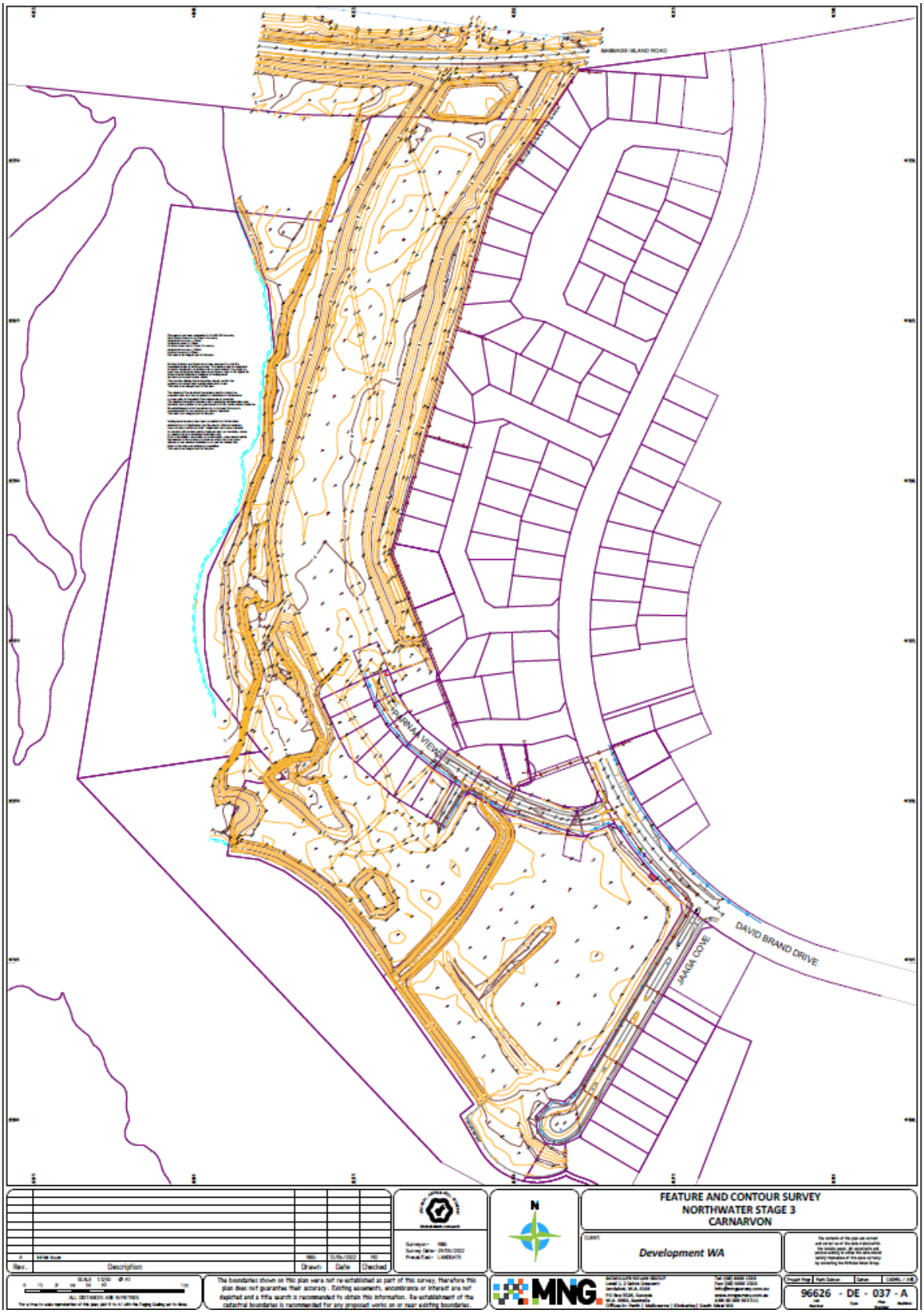
Appendix I

Northwater estate water sensitive urban design (WSUD) opportunities

Figure I.1 *Northwater Estate Water Sensitive Urban Design (WSUD) Opportunities*

Appendix J

Feature Survey


BARMADER ISLAND ROAD
DAVID BRAND DRIVE
JAAGA COVE
FEATURE AND CONTOUR SURVEY
NORTHWATER STAGE 3
CARNARVON
Development WA
MNG
96626 - DE - 037 - A

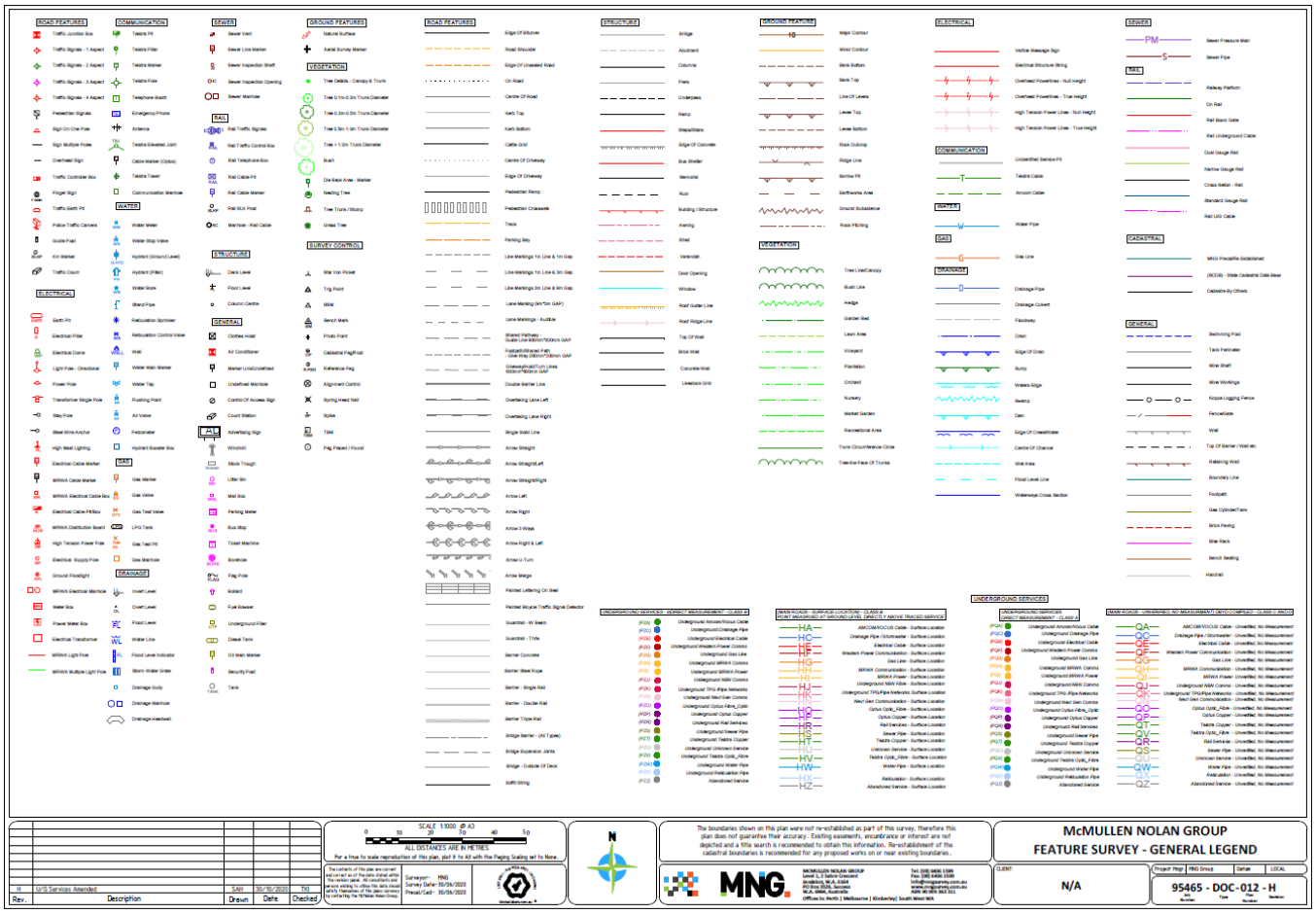


Figure J.1 Northwater Estate Feature Survey

Appendix K

DWER levee correspondence

Floodplain management advice - Carnarvon Northwater Estate - Existing Levee - Nicho...

SR

Simon Rodgers <simon.rodgers@dwer.wa.g

To Nick Deeks

Reply | Reply All | Forward

Wed 16/08/2023 2:11 PM

You replied to this message on 18/08/2023 1:54 PM.

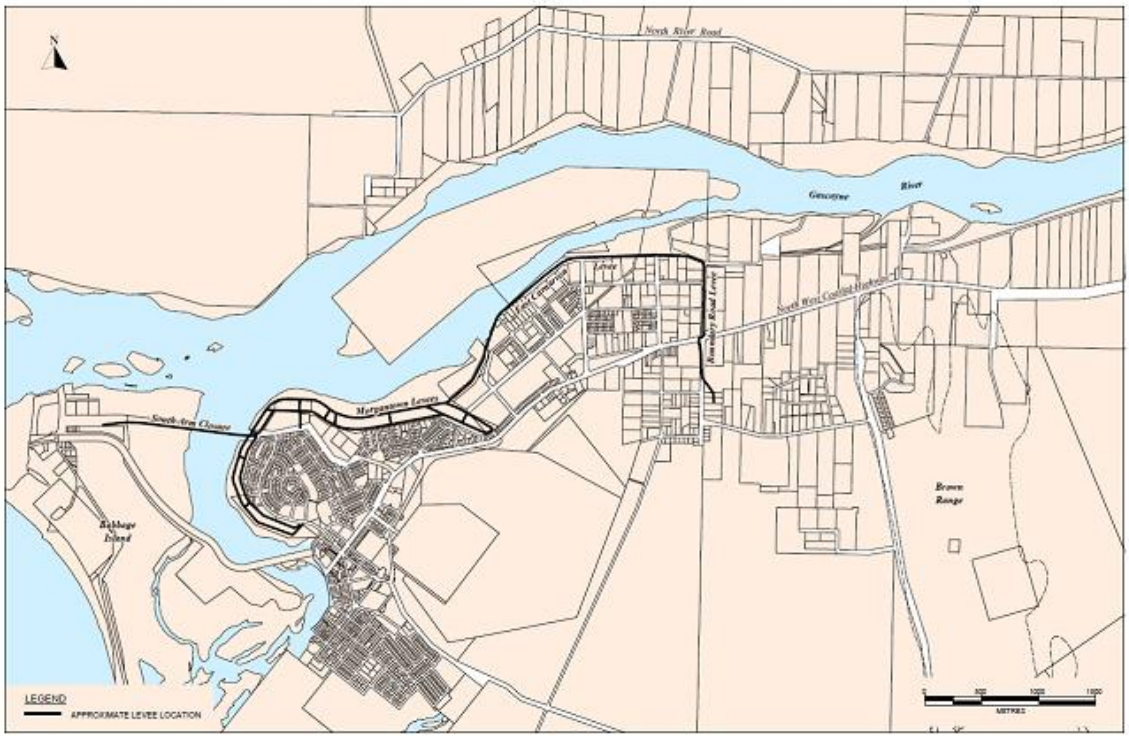
Hi Nick

With the closure of the South Arm (eg, construction of the Babbage Island Road as a levee) the small finger of the Morgantown dual levee marked on your plan below would only provide secondary protection against major river flooding should the South Arm closure (Babbage Road levee) fail. It should be noted that in December 2010, a major flood occurred, estimated to be a 50 -100 year ARI event, and the levee bank adequately coped with this magnitude of flood.

The Morgan town levees and South Arm Closure are owned and maintained by the Shire of Carnarvon. It appears that existing development has already disturbed the original levees in this area (see figure below extracted from the 2002 Lower Gascoyne River Floodplain Management Study by SKM).

FIGURE 2.3
EXISTING LEVEE SYSTEM IN CARNARVON

SINCLAIR KNIGHT MERZ



Regards

Simon Rodgers
Supervising Engineer
Surface Water Assessment and Flood Risk Science

Department of Water and Environmental Regulation
Prime House, 8 Davidson Terrace, JOONDALUP WA 6027
Locked Bag 10, Joondalup DC, WA 6919
T: (08) 6364 6923 M: 0429 080 517
E: simon.rodgers@dwer.wa.gov.au | www.dwer.wa.gov.au

Appendix L

Flooding and Storm Surge advice

999 Hay Street, Level 10
Perth, Western Australia 6000
Australia
www.ghd.com

Your ref: 10/036a
Our ref: 12571364

31 May 2022

John Milici
DevelopmentWA
40 The Esplanade
Perth, Western Australia
6000

Carnarvon Northwater Stage 3 and Stage 5 flood modelling

1. Introduction

DevelopmentWA has engaged GHD to assist with providing flood modelling information for a planning scheme amendment to a subdivision in Carnarvon Northwater Stage 3 and Stage 5. To address the provisions in Special Control Area 3: Flood Prone Area (SCA3), this document summarises the 1% Annual Exceedance Probability flood levels and the flood impact of the scheme amendment, using previous flood modelling results in the area undertaken by GHD for Main Roads WA and published by Department of Water and Environmental Regulation (GHD 2014).

During a Scheme Amendment discussion held on 19 July 2021 (Attachment 1), it was considered that residential lots could encroach into the SCA3. SCA3 includes provisions for flood controls to provide acceptable level of protection to life, property, community infrastructure and the environment for a 1% AEP flood event. The objectives of SCA3 include:

1. Identifying land at higher risk from flooding to a depth greater than one metre
2. Providing adequate protection for development from a 1% AEP flood event
3. Maintaining the free passage and temporary storage of floodwaters

2. Background

The Site comprises of Stage 3 with approximately 3.525 hectares of land with 34 lots, and Stage 5 with approximately 3.271 hectares of land with 50 lots. It is located west of Northwater Stage 2, bounded by Parnaa View immediately north, David Brand Drive north-east, Jaaga Cove south-east and the Carnarvon Fascine south and west of the site. Figure 1 indicates the extent and locality of the site. The subdivision concept plan is shown in Attachment 2.

The Carnarvon Fascine is an enclosed estuary that was previously the southern arm of Gascoyne River. The construction of Babbage Island Rd has disconnected the Fascine from the river. Due to this the Fascine is not subject to periodic river flows, making flood levels within the floodplain driven by the tide.

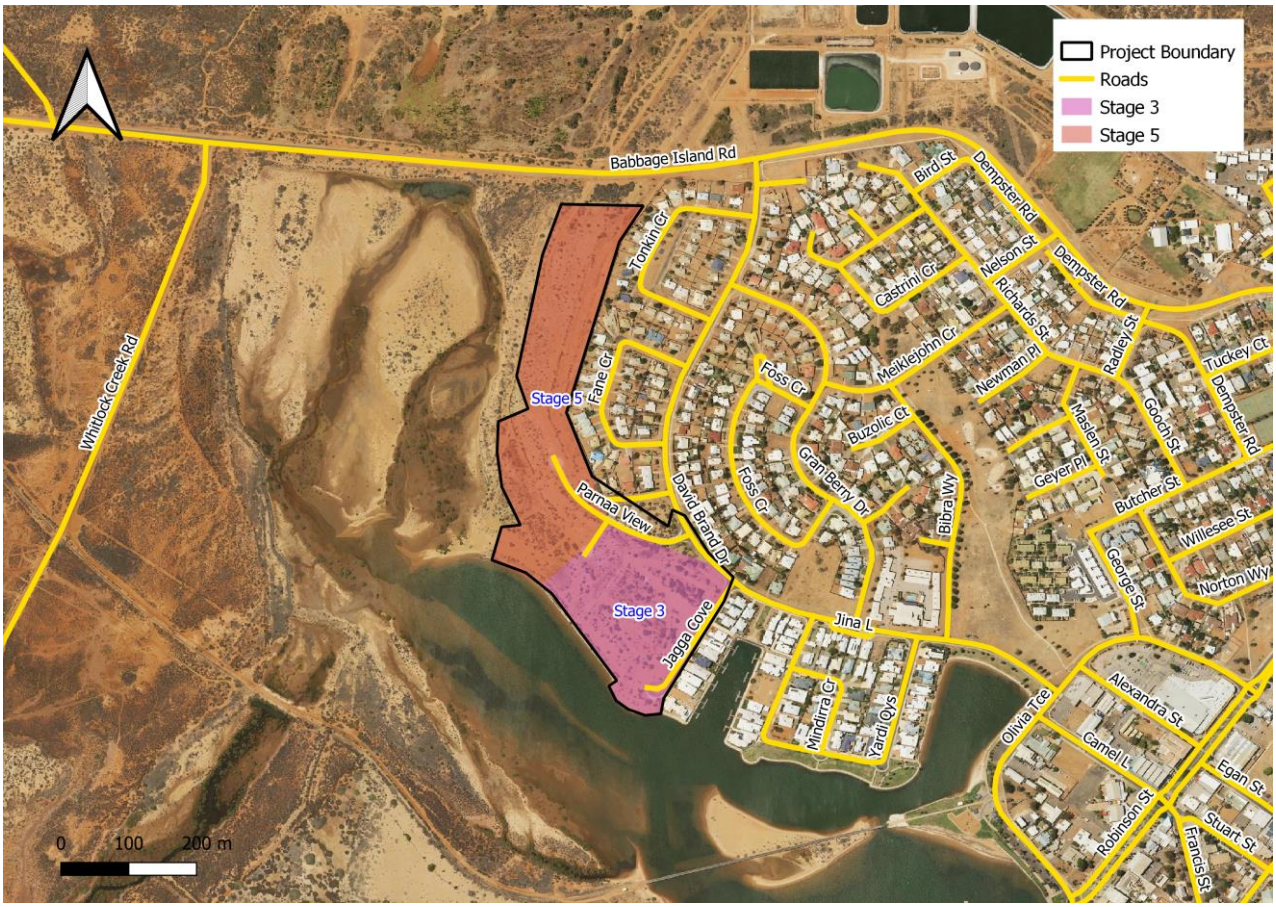


Figure 1 ***Project Location***

3. Proposed Earthworks and encroachment into SCA3

Stage 3 is closest to the floodwaters and potentially encroaches into SCA3. The proposed earthworks in that area includes filling of approximately 0.5m at the centre of the development and cutting approximately 0.5m around the boundary of the development, with approximately equal area between cut and fill. The existing levels are maintained against the south-west boundary which is against the Fascine, with levels that vary between 3.6 mAHD and 3.0 mAHD along the boundary. Lots 1-8 in Stage 3 sit against this boundary and potentially encroach into the SCA3 (As shown in Attachment 2).

Stage 5 sits north behind Stage 3 in respect to the floodwaters, thus is likely to experience less flood impacts compared to Stage 3.

4. Hydrology

Previous flood modelling of the Gascoyne River was carried out by GHD for Main Roads (GHD 2014), which includes the project area. The flood model was originally developed by Sinclair Knight Merz (SKM) in 2002 and upgraded by GHD for the study.

The methodology used to develop the model is described in GHD (2014), which includes:

- RORB model construction and calibration, for external catchment flow entering at Fishy Pond
    - Calibrations were done gauged stream flow at Fishy Pond and rainfall information, as well as flood events in 1995 and 2000

- Mike 21 model of the floodplain of interest
    - Bathymetries were provided by SKM
- Mike 11 model to route the Fishy Pool hydrograph downstream into the Mike 21 model domain, and to model floodplain structures
- Modelling considers tidal sea level changes, as well as climate change (i.e. Sea level rise and rainfall), but does not include storm surge.
- Note that the model was applied at a scale for the whole area (some 850 km^2) and does not necessarily represent flood hydraulics accurately at a smaller scale. Thus, the flood results are compared with two additional studies.

The flood modelling was also checked against two additional flood models for the area, which also consider the impact of cyclones on flood levels, as well as wave run-up. The first is a report for the South Carnarvon Surge Wall produced by the Department of Planning and Infrastructure (DPI 2003). The second is a report for the Cyclonic Inundation and Coastal Process Modelling produced by Global Environmental Modelling Systems (GEMS 2009).

5. Flood risk analysis

The flood results from previous modelling carried out by GHD for Main Roads WA is shown in Figure 2, with cross sections (shown in Figure 2) of the results shown in Figure 3, Figure 4 and Figure 5.

Flood results were compared with the design surface levels at Stage 3,which is closest to the floodwaters, The modelled 1% AEP flood levels are at 1.28 mAHD, with the design surface levels at the western boundary ranging from 3.0 mAHD to 3.6 mAHD. The results indicate a low risk of flooding as the 1% AEP flood levels are more than 1.5m lower than the design levels. Stage 5 is located further away from the floodwaters, thus is likely to have a lower risk of flooding compared to Stage 3. Thus, there were no areas identified to be at high risk of flooding greater than one meter.

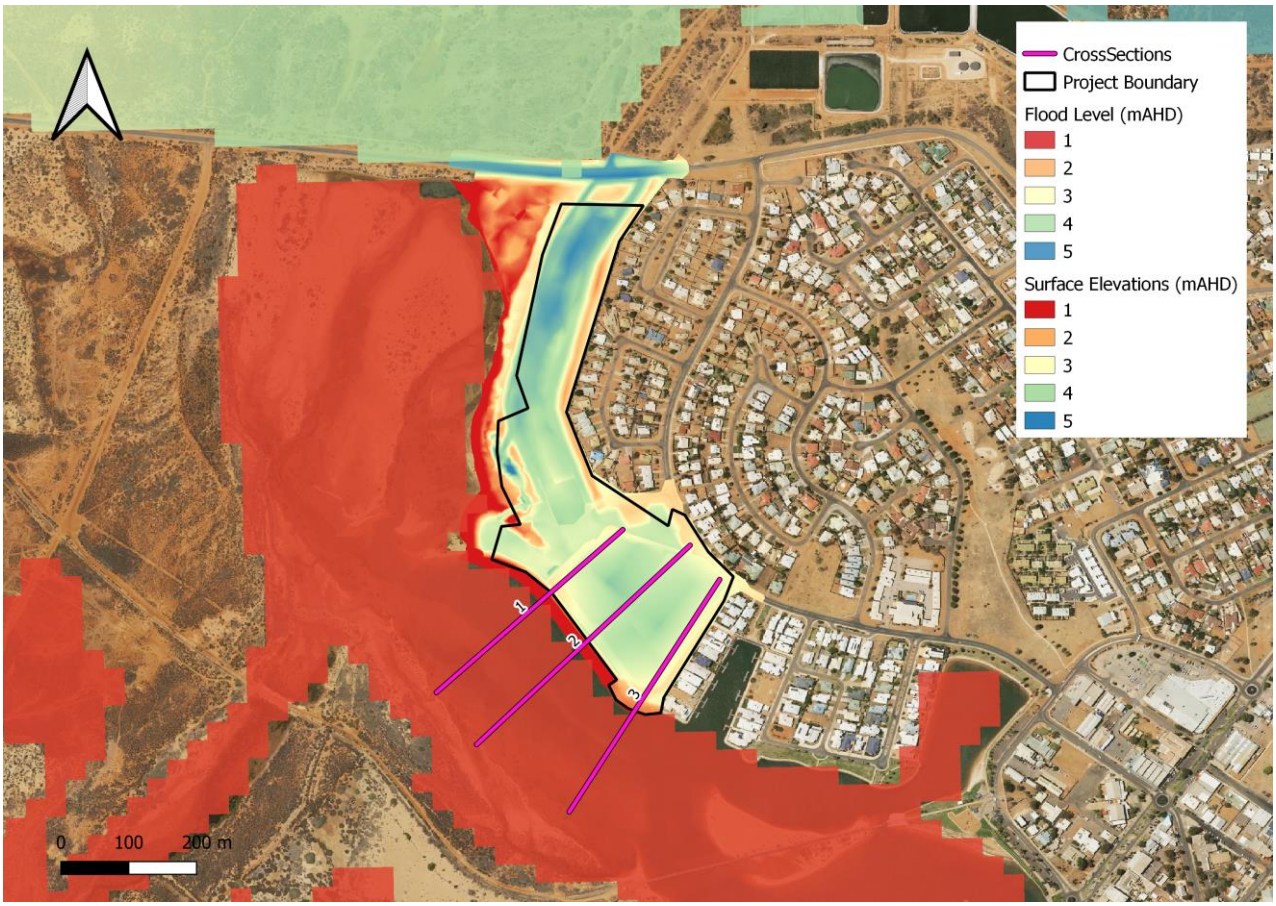


Figure 2 *Flood levels and Surface Elevations*

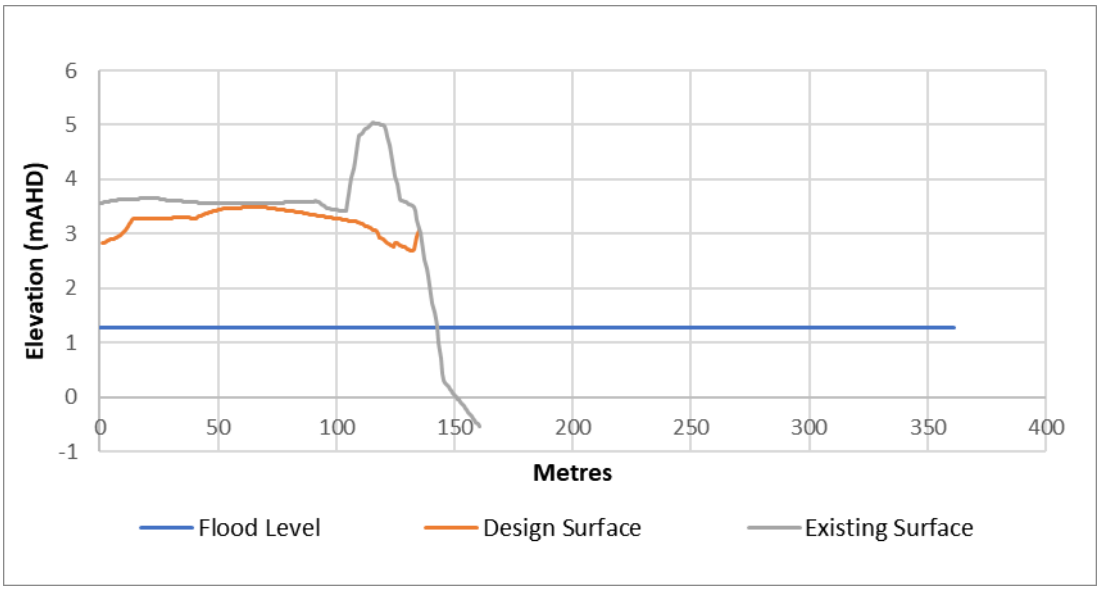


Figure 3 *Cross section 1*

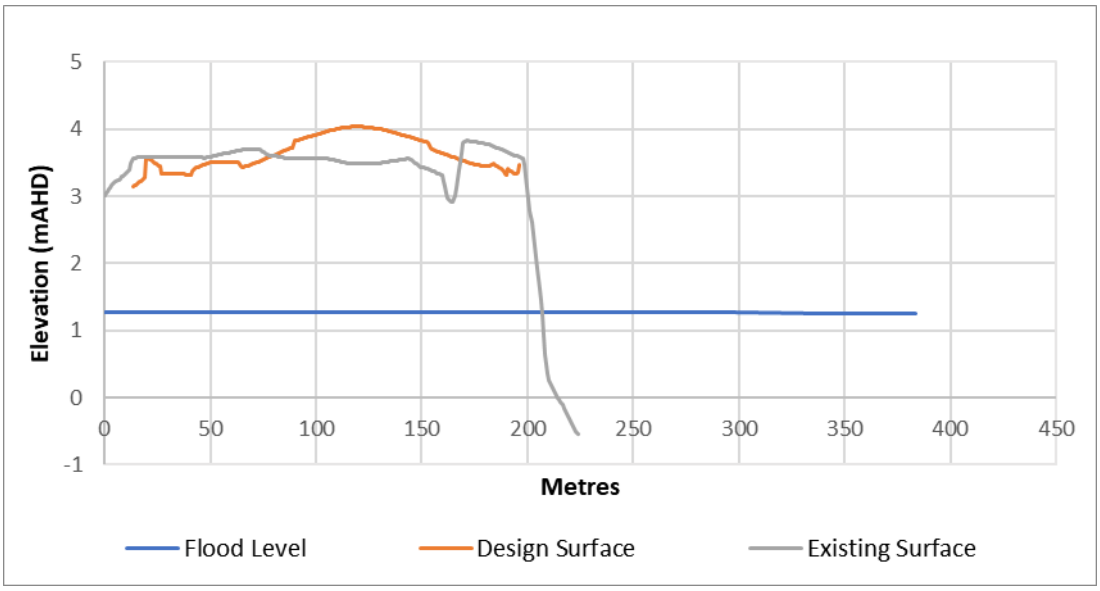


Figure 4 *Cross section 2*

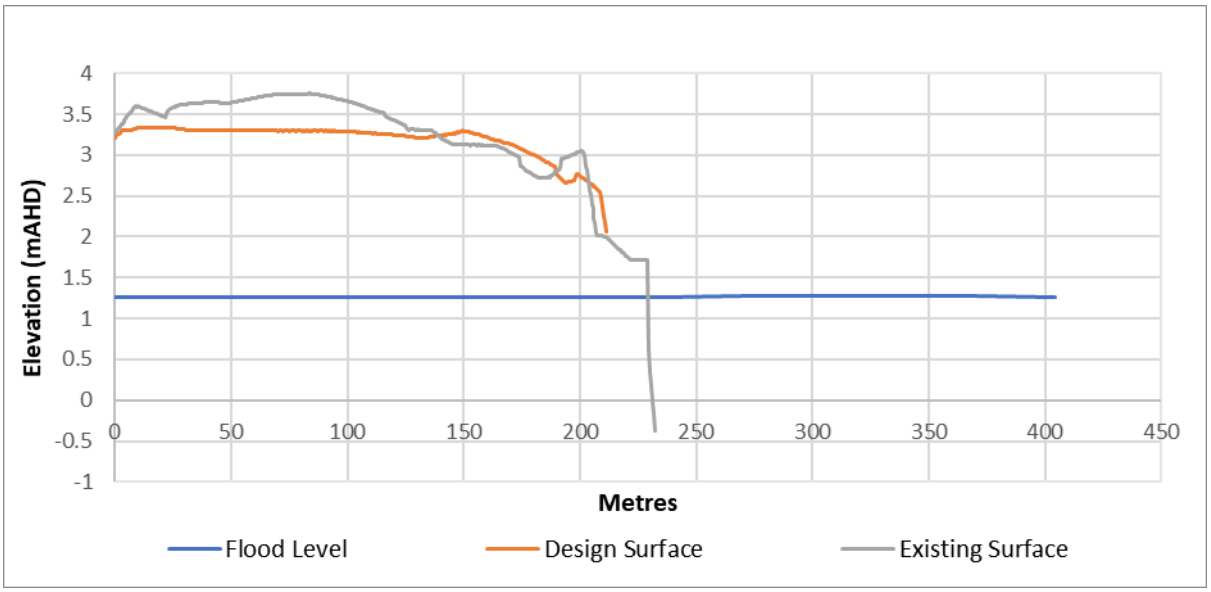


Figure 5 *Cross section 3*

The flood results and design surface are also compared against inundation results from DPI (2003) and GPI (2009), which consider cyclonic inundation and wave run up. The flood results indicate that the site will be partially inundated in scenarios 4 and 5. Maximum water levels for DPI (2003) are based on very significant cyclones with an AEP of 5%, and maximum water levels for GEMS (2009) are based on a category 5 cyclone. The results are compared with the design surface in Table 1.

Table 1 *Flooding results from DPI (2003) and GPI (2009)*

Scenario reference	Description	Design Surface level
1	Design Surface Elevation	3.0-3.6 mAHD
2	5% AEP Extreme still water level (DPI 2003)	1.77 mAHD
3	5% AEP Max level of wave uprush (DPI 2003)	2.65 mAHD
4	5% AEP Max level of wave uprush + factor of safety (DPI 2003)	3.11 mAHD
5	Maximum WL for a cyclone category 5 (GEMS 2009)	3.3 mAHD

Scenario reference	Description	Design Surface level
6	1% AEP riverine flood level (GHD 2014)	1.28 mAHD

6. Recommendations

6.1 Required protection

The site is well protected from the 1% AEP riverine flood, which are 1.5m lower than the design earthwork levels. However, if there is an objective to protect property from severe cyclones and storm surge, finished floor levels will need to be above 3.3 mAHD.

6.2 Requirements for free passage and temporary storage

With the disconnection of The Fascine from the Gascoyne River, any encroachment into The Fascine will have no impact on flood storage or free passage of floodwaters.

7. References

GEMS. (2009). *Cyclonic Inundation and Costal Process Modelling*. Carnarvon, Global Environmental Modelling Systems, June 2009. Final Report

GHD. (2010). *Carnarvon Flood Mitigation Works: 100% Design Report.* Prepared for Main Roads Western Australia.

DPI (2003). *South Carnarvon, Surge Wall, Risk Analysis and Preliminary Design*. Department of Planning and Infrastructure, March 2003. Report No. 421.

8. Conclusion

GHD has reviewed the design surface levels of the scheme amendment to a subdivision in Carnarvon Northwater to flood modelling results, including GHD (2014), DPI (2003), and GEMS (2009). The following findings were made:

- There were no areas identified to be at a higher risk of riverine flooding greater than 1m for the 1% AEP flood event. The design surface is more than 1.5m above flood levels, with flood levels at 1.28 mAHD and the design surface between 3.6-3 mAHD.
- If there is an objective to protect property from severe cyclones and storm surge, finished floor levels will need to be above 3.3 mAHD.
- Any earthworks encroaching into The Fascine will have no impact on free passage of floodwaters, or temporary storage of floodwaters.

Regards

Nicholas Deeks
Technical Director - Hydrology

Attachments

Attachment 1

Scheme Amendment Discussion minutes

MINUTES OF MEETING

Carnarvon Northwater

Scheme Amendment discussion
19 July 2021, 2.00-2.30pm
Venue: Microsoft Teams

Attendees

David Perry	Shire of Carnarvon
David Nielsen	Shire of Carnarvon
Stefan Louw	Shire of Carnarvon
Samantha Thompson	TBB
Michael Willcock	TBB

Meeting Notes

Meeting discussion was in relation to the scheme amendment proposal and subdivision for Northwater Carnarvon – Lot 9001.

TBB shared the subdivision concept plan and scheme map overlay to discuss with the Shire officers.

Southern Section of Lot 9001

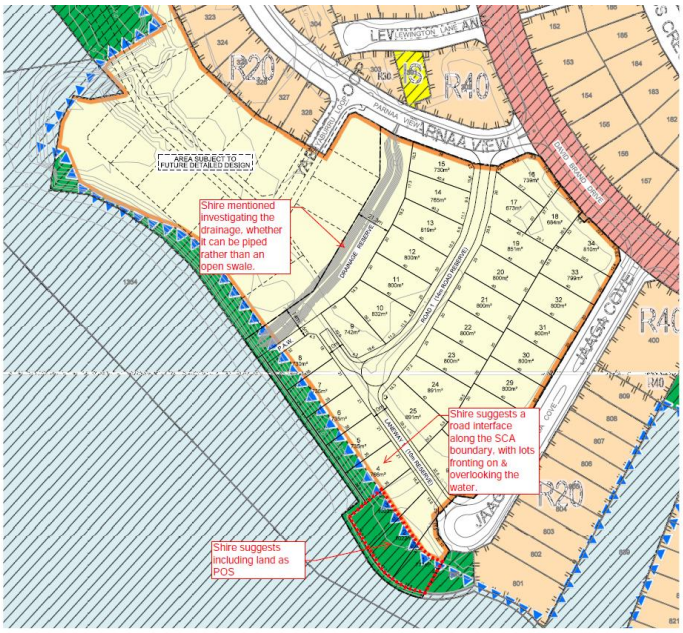


Figure 1 Southern Section of Lot 9001

The southern section of Lot 9001 was discussed initially.

The Shire's officers mentioned the concept plan had been viewed by the Shire Councillors at an informal briefing in the week of 12-16 July 2021, and the feedback was supportive for DevelopmentWA to proceed.

Shire officer advice was as follows:

- Scheme Amendment:
  - Rezoning the land to a 'Residential' zone was agreed to. No structure plan requirement.
  - SCA changes will require a review of the flood modelling; referral to agencies; will be required.
  - A Public Open Space Schedule and information will be required.
  - Servicing information will be required.
  - Traffic can be described, but no TIS/TIA was requested.
  - No BMP is required.
- Special Control Area 3 Flood Prone Area – ensuring development is not within the SCA. It was considered that the residential lots could encroach into the SCA, with controls in place to prevent development encroaching into the SCA. TBB mentioned that the SCA 3 provisions in the Shire's Scheme are detailed and provide sufficient controls. TBB and Shire considered whether design guidance for future landowners can also be captured in marketing material or land contracts, or other suitable approaches.
- The existing wall along the fascine is within DevelopmentWA's land – consideration of future ownership and maintenance.
- Jaaga Cove – the Shire considers the median landscaping within the Jaaga Cove road-pavement is not suitable for future road designs and should not be replicated, due to associated maintenance costs.
- Traffic and Movement Network:
  - Sightlines at the proposed/existing intersection sightlines at Parnaa View and David Brand Drive are 'good'.
  - Consideration should be given to facilitating pedestrian access to the public open space, 25 (Crown Lot 836) Jaaga Cove, Crown Reserve 49812 for public recreation, management order vested to Shire of Carnarvon (refer Figure 2).

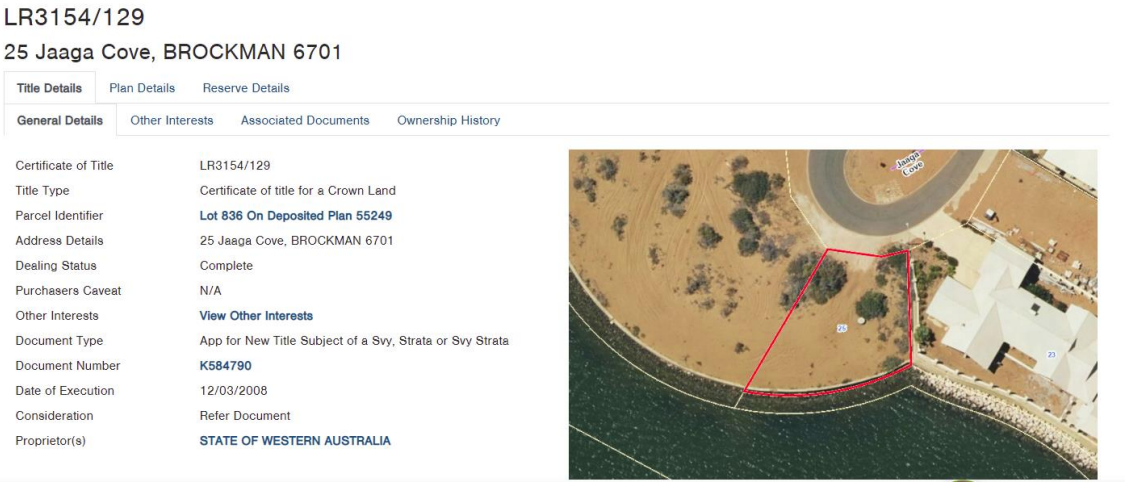


Figure 2 Crown Reserve 49812, 25 (Crown Lot 836) Jaaga Cove

Northern Sector of Lot 9001

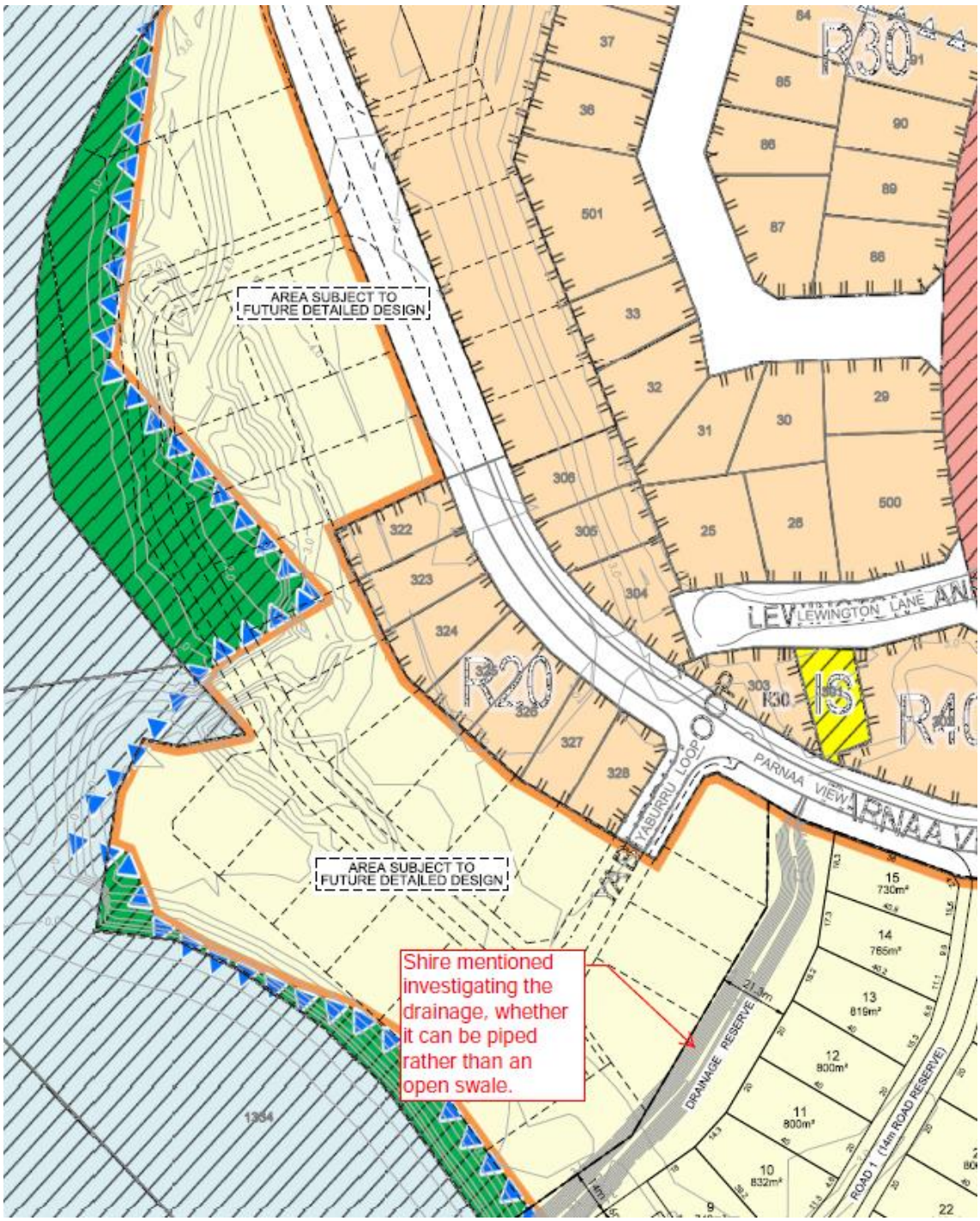


Figure 3 Northern section of Lot 9001

Shire officer's advice was as follows:

- Drainage Reserve:
  - Officers considered (based on anecdotal evidence and observations) that the swale (shown in Figure 3) did not seem to convey a significant volume of water.

- Shire considered that a drainage system be considered using piped networks within Yaburru Loop, Road 1, and future roads (refer Figure 3). This requires assessment of the capacity for the design of the piped system.
- Recommendation to DevelopmentWA is to undertake an assessment of the catchment, modelled volumes and design of the piped network to consider pump station overflow, stormwater and street runoff.
- The Shire considered that the swale in its current form could result in maintenance and litter issues, and could generate a detrimental social and safety outcome.
- The 'Area Subject to Future Detailed Design' would warrant a review of the SCA boundary, the flood overlay (refer Figure 3). It was recommended to DevelopmentWA to engage a suitably qualified engineer to consider a modification of the SCA. This would require referral to relevant agencies. This would be discussed and form part of the Scheme Amendment.

Based on Councillor and Shire officer support and advice, recommendation to proceed with the preparation of Scheme Amendment Request, supported by (summarised list):

- Coastal engineering justification to adjust the SCA boundary and flood overlay (will require referrals)
- Environmental information to support an EPA referral of the Scheme Amendment
- Engineering design for replacing the drainage swale with a street-based pit and pipe system
- POS Schedule and information
- Servicing information
- Traffic description (no TIS/TIA required)
- Description of future management of the fascine wall
- No BMP required

LEGEND

TOTAL APPLICATION AREA (3.5250ha)

LOT SUMMARY

LOT YIELD			LOT AREA	
Size	No. Lots	% Total Lots	Average Size	% of Total Area
600m² - 699m²	2	5.88%	678m²	4.96%
700m² - 799m²	11	32.35%	750m²	30.15%
800m² - 899m²	18	52.94%	820m²	53.95%
900m² - 999m²	1	2.94%	970m²	3.54%
1000m²+	2	5.88%	1012m²	7.40%
Number of Lots	34			
Minimum Lot Size 673m² Maximum Lot Size 1022m²			Average Lot Size 805m² Total Lot Area 27372m²	

AREA SUBJECT TO FUTURE DETAILED DESIGN

AREA SUBJECT TO FUTURE DETAILED DESIGN

LEWINGTON LANE

YABURRU LOOP

PARNAA VIEW

DAVID BRAND DRIVE

JAAGA COVE

DRAINAGE RESERVE

ROAD 1 (14m ROAD RESERVE)

LANEWAY 1 (10m RESERVE)

P.A.W.

Subdivision Concept Plan

LOT 9001 DAVID BRAND DRIVE, CARNARVON

A DevelopmentWA Project

DRAFT

plan: 10/036/040 | date: 22/02/2021 | designed: BDM
scale: 1:1500@A3 | 1:750@A1 | grid: CAR 94 | checked: BDM
0 15 30m | aerial: - | drawn: BR

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000
e: admin@tbbplanning.com.au
p: (08) 9226 4276

Taylor Burrell Barnett

3. SPECIAL CONTROL AREA 3: FLOOD PRONE AREA

Purpose	Objectives	Additional Provisions
	1.	
Provide an acceptable level of protection to life, property, community infrastructure and the environment from flooding that would occur in a 1% Annual Exceedance Probability (AEP) flood event.	1. Identify land at higher risk from flooding to a depth greater than one metre. 2. Provide adequate protection for development from a 1% AEP flood event. 3. Maintain the free passage and temporary storage of floodwaters.	1. The SCA applies to land within the floodplain of the Gascoyne River considered to be at high risk of flooding based on modelling for a 1% AEP event for the town of Carnarvon. 2. No new development shall detrimentally impact, alter or modify the extent of flood impact and existing flooding regime as reflected in the latest flood modelling available from the State agency responsible for water or in an approved District Water Management Strategy. 3. No new development shall be approved in designated floodways, including fences, filling and earthworks but excludes irrigation systems that are relocatable and do not hinder the free passage of water. 4. Notwithstanding any other provisions of the Scheme, a person shall not commence or carry out any works or uses within or partially within SCA3 where those works or uses may constitute an obstruction to flooding and detrimentally impact the existing flood regime without having first applied for and obtained development approval under Part 8 and Part 9 of the deemed provisions. 5. The local government shall provide a copy of any application for development approval that may constitute an obstruction to flooding and detrimentally impact the existing flood regime to the State agency responsible for water under Clause 66 of the deemed provisions. 6. The local government, on the recommendation of the State agency responsible for water and in accordance with Clause 63(1) of the deemed provisions, may require an applicant to undertake hydraulic modelling and/or other assessment to demonstrate that the existing flood regime shall not be detrimentally affected by the proposed development. 7. The local government in considering an application for development approval within SCA3 shall have due regard to matters referred to in Clause 67 of the deemed provisions, in particular: 7.1. Clause 67 (c and f) State Planning Policy 2 Environment and Natural Resources Policy and State Planning Policy 3.4 Natural Hazards and Disasters and relevant policies of the State agency responsible for water; 7.2. Clause 67(q) any hydraulic modelling or/and other study that assesses flood risk and potential impacts on the 1% AEP flooding regime; 7.3. Clause 67(r) the scale and nature of the proposed development: whether a minor extension of an existing (approved and constructed) non-habitable building or structure; a non-habitable building or structure that is ancillary development to a dwelling or habitable building

Purpose	Objectives	Additional Provisions
		(approved and constructed) on the same lot; or a non-habitable buildings or structure that replaces a similar (approved and constructed) structure is proposed; 7.4. Clause 67 (y) the advice and recommendations of the State agency responsible for water

4. SPECIAL CONTROL AREA 4: BROWN RANGE POWER HOUSE

Purpose	Objectives	Additional Provisions
Designate land surrounding the Brown Range Power House where sensitive land uses shall not be permitted.	1. Identify land that may be affected by emissions such as noise and dust from the power house. 2. The long-term operation of the power house is not constrained by land use and development decisions. 3. Provide for the development of compatible land uses in areas affected by potential off-site impacts of the power house.	1. Notwithstanding any other provisions of the Scheme, a person must not commence or carry out any works or development within SCA4, without first having applied for and obtained the development approval of the local government under Part 8 and Part 9 of the deemed provisions. 2. The local government shall provide a copy of any development application that applies to land within or partially within SCA4 to the operator of the Brown Range Power House and the State agency responsible for environmental regulation under Clause 66 of the deemed provisions. 3. Notwithstanding any other provisions in the Scheme, the use and development of a dwelling and any other sensitive land use shall not be permitted. 4. The local government in considering an application for development approval within SCA4 shall have due regard to matters referred to in Clause 67 of the deemed provisions, in particular: 4.1. Clause 67 (c and f) State Planning Policy 4.1 State Industrial Buffer Policy and relevant policies of the State agency responsible for environmental regulation; 4.2. Clause 67(m, n and r) the compatibility of the use or development with the power house facility and associated emissions such as from noise; 4.3. Clause 67(v) whether the use or development would have a detrimental impact on the long term operation of the power house facility; 4.4. Clause 67 (y) the advice and recommendations of the operator of the power house and the agency responsible for environmental regulation.

Attachment 2

Subdivision Concept Plan

LEGEND

TOTAL APPLICATION AREA (12.1551ha)

EXISTING CONTOURS

SERVICES

WATER

PIPE

SEWER

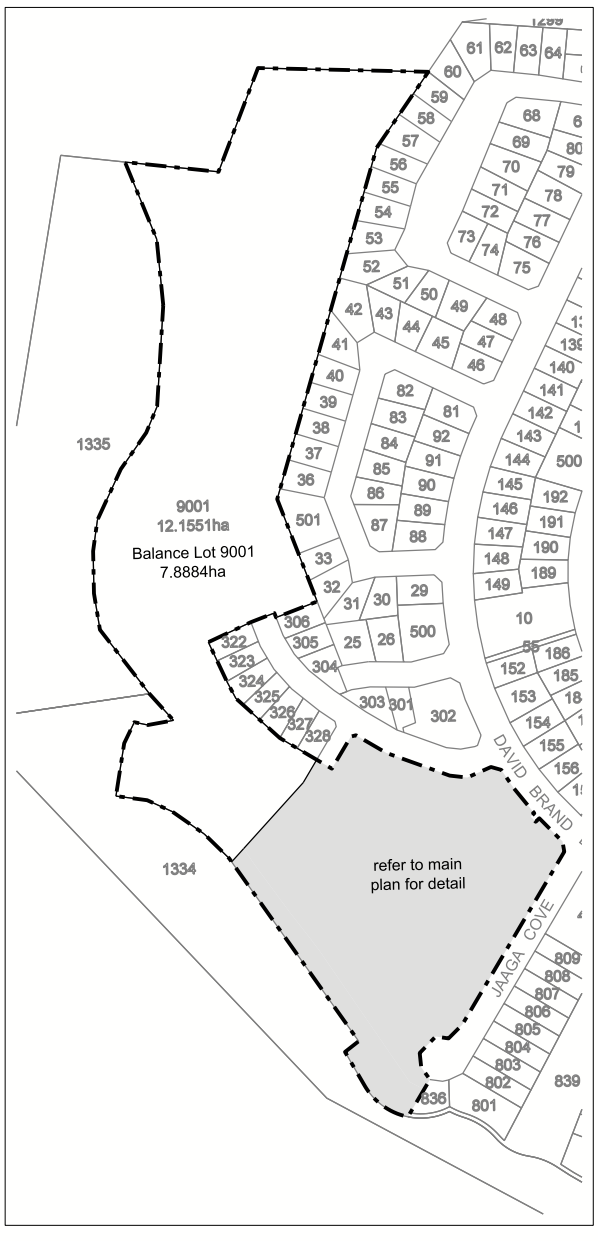
CONNECTION

GRAVITY PIPE

LOT SUMMARY

LOT YIELD			LOT AREA	
Size	No. Lots	% Total Lots	Average Size	% of Total Area
700m² - 799m²	7	21.21%	781m²	18.67%
800m² - 899m²	12	36.36%	843m²	34.52%
900m² - 999m²	9	27.27%	941m²	28.93%
1000m² - 1499m²	5	15.15%	1047m²	17.88%
Total Number of Lots	33			
Minimum Lot Size 741m² Maximum Lot Size 1109m²			Average Lot Size 887m² Total Lot Area 29303m²	
Public Open Space	1	0.4652ha		
Road Reserve 1	1	0.5331ha		
Road Reserve 2	1	0.3353ha		
Balance Lot	1	7.8884ha		
Total Number of Lots	37			

OVERALL SUBDIVISION



Plan of Subdivision - Freehold

LOT 9001 DAVID BRAND DRIVE, CARNARVON

A DevelopmentWA Project

plan: 10/036/043C
date: 26/04/2022
designed: BDM
scale: 1:1500@A3 | 1:750@A1
grid: CARN94
checked: BDM
0 15 30m
aerial: DD/MM/YYYY
drawn: CR

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Taylor Burrell Barnett

ghd.com

The Power of Commitment

Appendix C

Carnarvon Inundation Modelling Summary Report

m p rogers & associates pl ABN 14 062 681 252
creating better coasts and ports

R1789 Rev 0

April 2023

DevelopmentWA

Carnarvon Inundation Modelling Summary Report

marinas
boat harbours
canals
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jetties
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w: www.coastsandports.com.au

K2045, Report R1789 Rev 0
Record of Document Revisions

Rev	Purpose of Document	Prepared	Reviewed	Approved	Date
A	Draft for MRA review	J Chen	C Doak	C Doak	30/03/23
0	Issued for Client Use	J Chen	C Doak	C Doak	6/04/23

Form 035 18/06/2013

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1. Introduction

DevelopmentWA (DWA) is completing a structure plan for Stages 4 and 5 for Lot 9001 David Brand Drive, Brockman, located within the Shire of Carnarvon. Part of the lot is also located within the Special Control Area 3 (SCA3): Flood Prone Area. Therefore, numerical modelling is required to provide justification for future subdivision within the SCA3. The location of the site is shown in the following figure.

Figure 1.1 Location plan

1.1 Background & Scope

Part of the proposed development site falls within the SCA3. The Local Planning Scheme No.13 (LPS13) requires that development in the SCA3 provide an acceptable level of protection to life, property, community infrastructure and the environment from flooding that would occur in a 1%

Annual Exceedance Probability (AEP) flood event (this is equivalent to a flood event with a 100 year Annual Reoccurrence Interval (ARI)). The compliance of the LPS13 is required to be demonstrated via hydraulic modelling.

The hydraulic modelling for flood events was completed by GHD for DWA in 2022. This study assessed the potential overland flood levels associated with rainfall and runoff. The finding from this assessment suggested that, at this location, the overland flooding elevations are likely to be below the ocean inundation levels experienced during the passage of severe tropical cyclone events.

To determine the extreme ocean water levels for design, DWA requested a proposal from M P Rogers & Associates Pty Ltd (MRA) to undertake the ocean inundation modelling. Upon review of the LPS13 it is clear that the LPS13 requirement for SCA3 is on the basis that the primary inundation risk to this area is overland flood flows associated with rainfall and runoff events. This is a requirement of the Department of Water and Environmental Regulation (DWER) and is also referenced in State Planning Policy (SPP) 3.4: Natural Hazards & Disasters.

However, given the site is located within the Carnarvon Fascine which is tidal in nature, the requirements of Tate Planning Policy 2.6 – the State Coastal Planning Policy (SPP2.6) should apply to any assessment completed for this area. A key feature of SPP2.6 that relates to inundation modelling is that it requires consideration of an event with an AEP of 0.2%, which is equivalent to a 500 year ARI event.

Therefore, to address DWA's request for hydraulic modelling, the following scope of works were proposed and accepted by DWA.

- Collation of background information.
- Setup and calibrate a numerical model to allow simulation of cyclonic events.
- Simulate the 100 and 500 year ARI cyclonic events, based on technical guidance developed for the Department of Transport, to determine the design water levels that correspond to each of these events at the site.
- Prepare a report summarising the outcome of the modelling;

This report provides a summary of the findings from the numerical modelling.

2. Assessment Methodology

Assessment of extreme ocean water level requires consideration of events with an AEP of 1% and 0.2% - commonly referred to as the 100 and 500 year ARI events respectively. Given the location of the site within the Carnarvon Fascine, events of this magnitude will be associated with the passage of Tropical Cyclone events.

Due to the short availability of water level data within the study region (which are reliably only available for a period with a duration totalling around 33 years – between 1989 and 2022) compared to the required recurrence interval for prediction, the approach adopted for this study utilises numerical modelling techniques.

The methodology for estimating the 100 and 500 year ARI water level events is based on the recommendations of *Design Storms for Western Australia Coastal Planning: Tropical Cyclones* (Seashore 2018). The report, prepared for the Department of Transport (DoT), provides a simplified approach to define inundation or erosion hazard zones associated with tropical cyclones.

Utilising the recommendations of Seashore (2018) a summary of the approach to the coastal hazard assessment is provided below.

- Setup, calibrate and validate the Delft3D cyclone and hydrodynamic model for the region using the raw measurements associated with the recommended design cyclone for the site.
- Calibrate and validate the model via comparison of the measured water level data at Carnarvon tide gauge during the design cyclone event and the outputs of the model for the design cyclone at the same location.
- Synthesise design cyclones for inundation modelling using the recommended event with modified central pressure, track and radius to maximum winds as outlined in Seashore (2018).
- Simulate the design cyclones using the calibrated Delft 3D cyclone and hydrodynamic model with a background water level of Mean High Water Springs (MHWS) to extract wave and water level conditions at a location offshore from the site during the events.
- Use the extracted wave and water level conditions as boundary conditions in the beach profile evolution model SBEACH to assess wind and wave setup that needs to be included in the inundation level to determine the design water levels at the site.

With regard to the modelling of cyclone events, it should be noted that this methodology is not as robust for assessing coastal hazards in cyclone dominated areas as comprehensive 'synthetic storm database' modelling approaches, as recognised within Seashore (2018). However, it is generally a more conservative approach and therefore appropriate for assessing coastal hazards in locations not sensitive to small increases in peak conditions.

3. Delft Model Setup & Calibration

The Delft3D suite of models provides an integrated model approach that can be used to simulate atmospheric pressure differentials, wind fields, wave climates and water levels associated with the passage of tropical cyclones (Deltares, 2011a). The Delft suite of models has been extensively used around the world and are recognised as high quality models. This integrated modelling approach has been adopted for this study in order to best represent the physical processes that generate storm surge.

The physical processes that lead to the generation of cyclonic storm surge operate on a spatial scale equivalent to that of the cyclone itself. For this reason, to adequately model cyclonic storm surge requires large model domains. However, due to computational limitations it is not efficient to model large areas at high resolutions, therefore the domain decomposition and nesting modelling techniques have been utilised within the Delft3D model for this study.

Domain decomposition and nesting allow sections of the overall grid to be modelled at significantly greater resolution to capture the key features and bathymetry surrounding the area of interest. The grid size for different regions in the model domain is presented in Table 3.1.

Table 3.1 Model Grid Size

Region	Grid Size
Coarse Outer Grid – A Grid	9 km
Shark Bay to Macleod – B Grid	450 m
Carnarvon Fascine (Coastline and Nearshore Waters)	28 m

Figure 3.1 shows the model domain and bathymetry for the A grid, Figure 3.2 shows the bathymetry B grid and Figure 3.3 shows the bathymetry for the area of interest of this study. Bathymetry and topography data was sourced from hydrographic survey information provided by the Department of Transport (DoT), local nautical charts, available LIDAR survey provided by the DoT, data from NASA's Shuttle Radar Topography Mission (SRTM) and the Australian Bathymetry and Topography dataset obtained from Geoscience Australia (Whiteway, 2009).

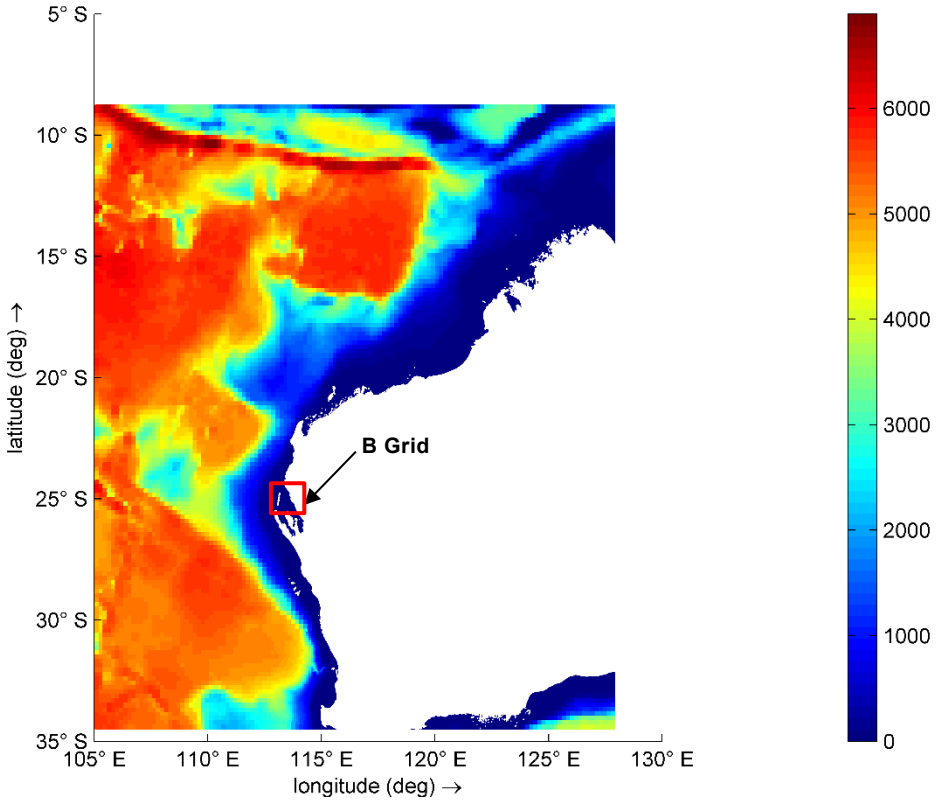

Figure 3.1 Model Domain & Bathymetry for Delft3D A Grid

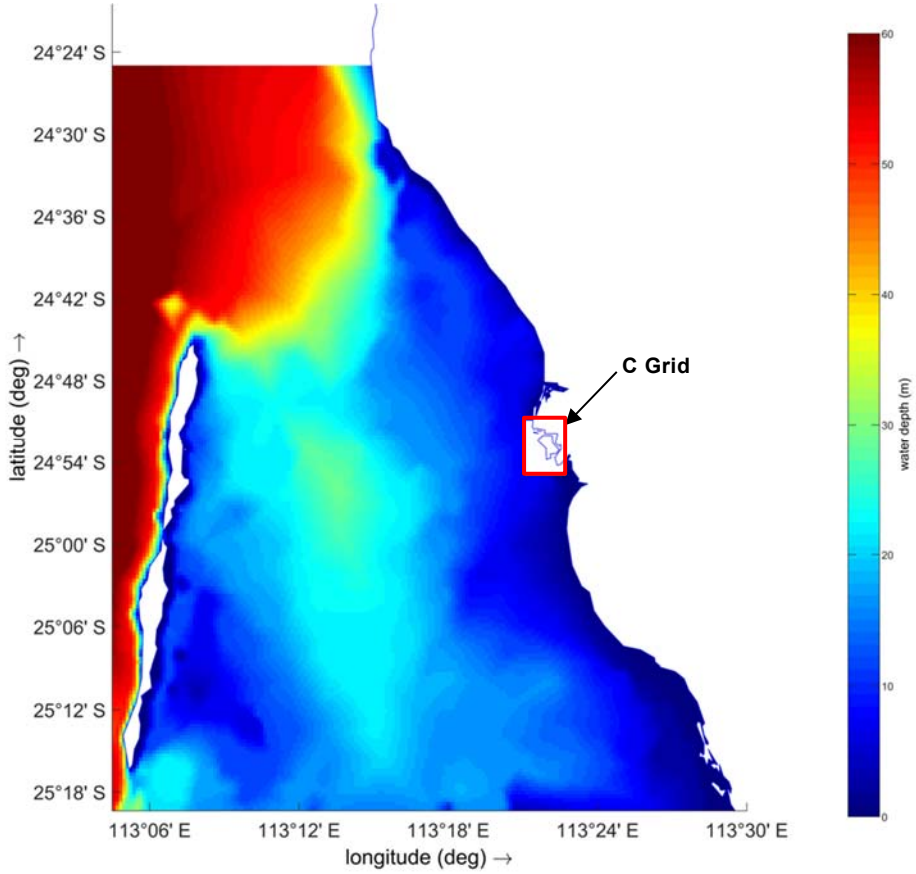

Figure 3.2 Model Domain & Bathymetry for Delft3D B Grid

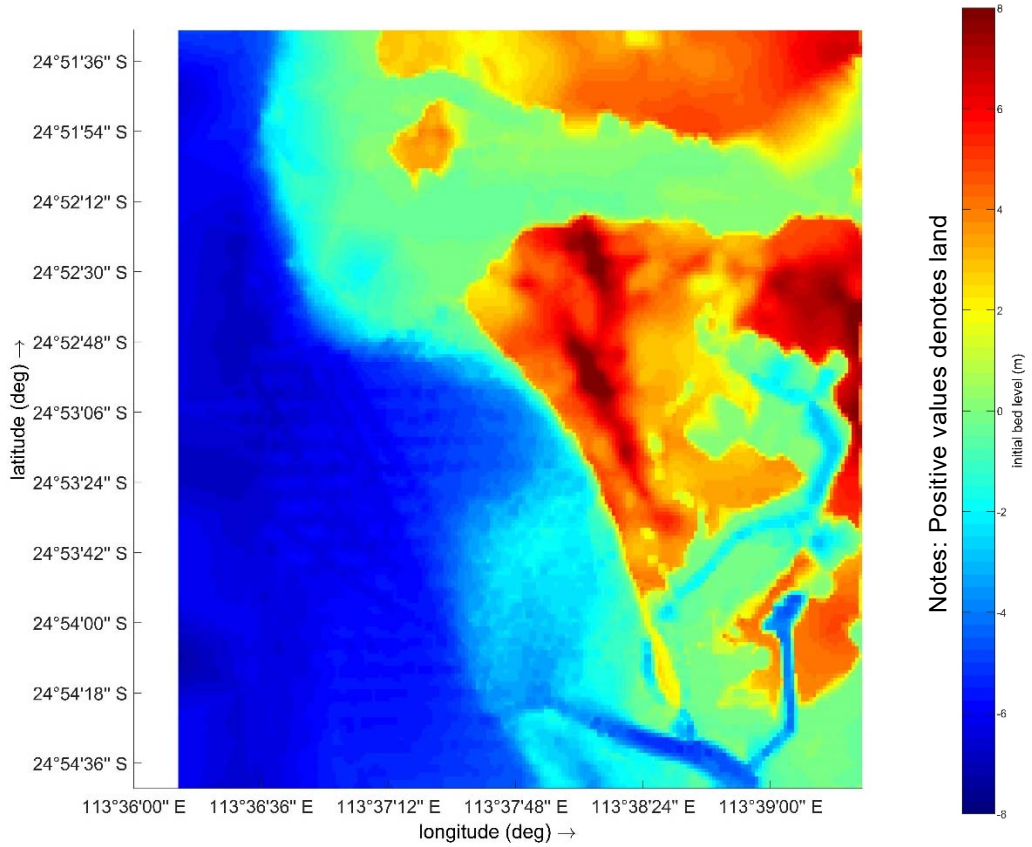

Figure 3.3 Model Domain & Bathymetry for Delft3D C Grid

3.1 Design Cyclones

Design events consistent with the requirements of SPP2.6 are required to simulate and assess coastal hazards at the site. To be suitably conservative the design event must represent the 'worst case' conditions at the site for the chosen ARI. At this site, the most severe events are caused by tropical cyclones generating extreme onshore winds. The resulting storm surge is a function of the following tropical cyclone parameters:

- Cyclone intensity, typically described by central pressure deficit;
- Proximity of the system centre to the point of observation;
- Radius of maximum winds; and
- Cyclone forward speed.

Seashore (2018) suggested that tracks corresponding to cyclones producing the highest measured surge at tidal stations around WA provided an indication of the track that should be considered for a 'worst-case' approach in the near vicinity of the station. These characteristics were used by Seashore to determine a set of design storm paths, based on historic storms, for each of the town sites of interest. For Carnarvon, the cyclone that provides the 'worse case' approach is Tropical Cyclone Narelle. The path of this cyclone is shown in Figure 3.3.

To determine appropriate scaling of central pressure and radius to maximum winds, Seashore (2018) also assessed characteristics of tropical cyclones along the Western Australian coast within 5º latitude-longitude cells. Within each cell the Bureau of Meteorology tropical cyclone

database was interrogated to evaluate distributions of cyclone central pressure and radius. The results of this were combined with the 'worst case' approach to define design cyclone events. The characteristics of the design cyclones for the site are shown in the figure below.

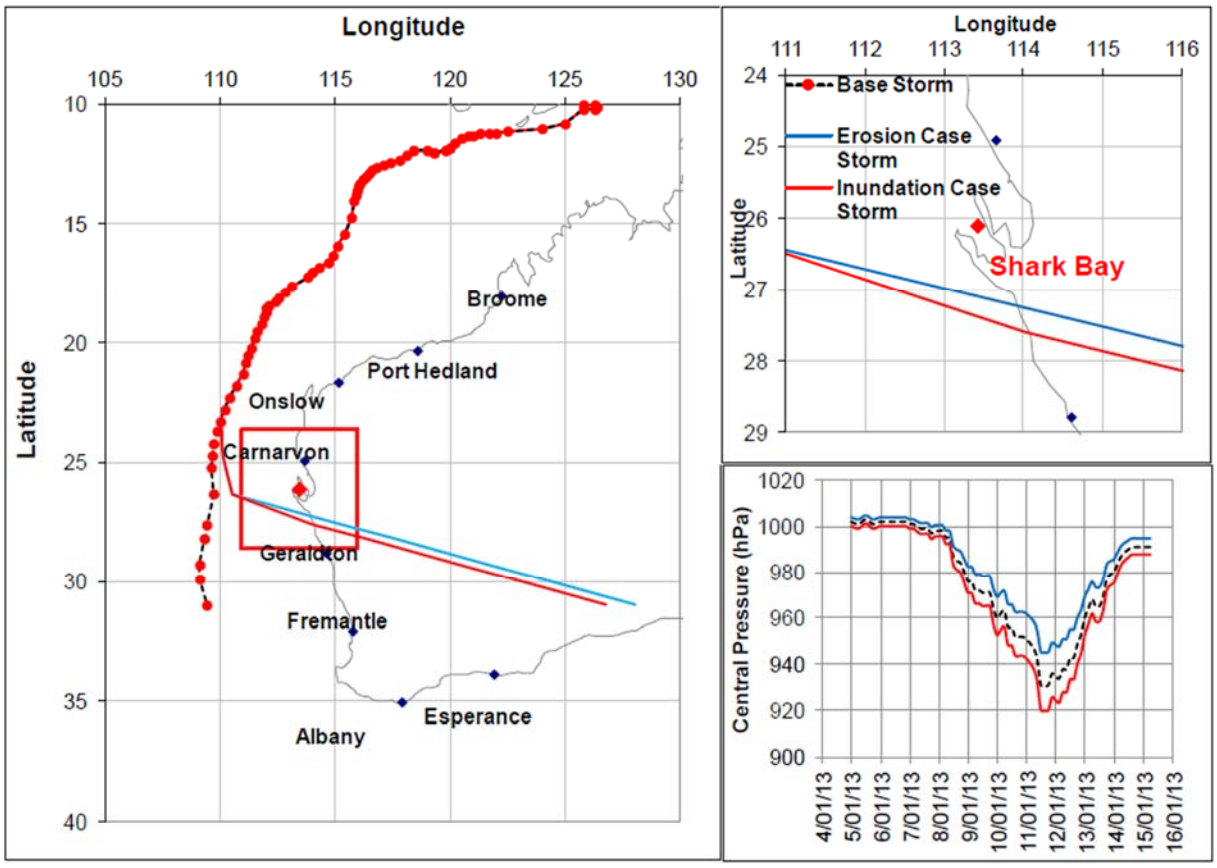

Figure 3.4 Design event based on TC Narelle

The design cyclones shown in Figure 3.3 were modelled to assess erosion and inundation hazards. These results are discussed further in the report.

3.2 Water Level Calibration & Validation

With the model grids established, calibration and validation of the model system was undertaken to ensure model predictions adequately reflect reality. MRA has validated the Delft 3D model at numerous locations across Western Australia's coastline including Geraldton (MRA 2015), Wickham & Cossack (MRA 2016), Maitland (MRA 2017) Learmonth (MRA 2019).

To further validate the model's ability to accurately represent conditions at the site, track, central pressure and wind radius data for Tropical Cyclones Frank, Olwyn and Steve was simulated within the model domain to determine if the model predictions match the observed record.

The observed record of historical water levels was obtained from the Carnarvon tide gauges. The locations of the recording devices are shown in the following figure with further details regarding the measurement locations provided in the table below.

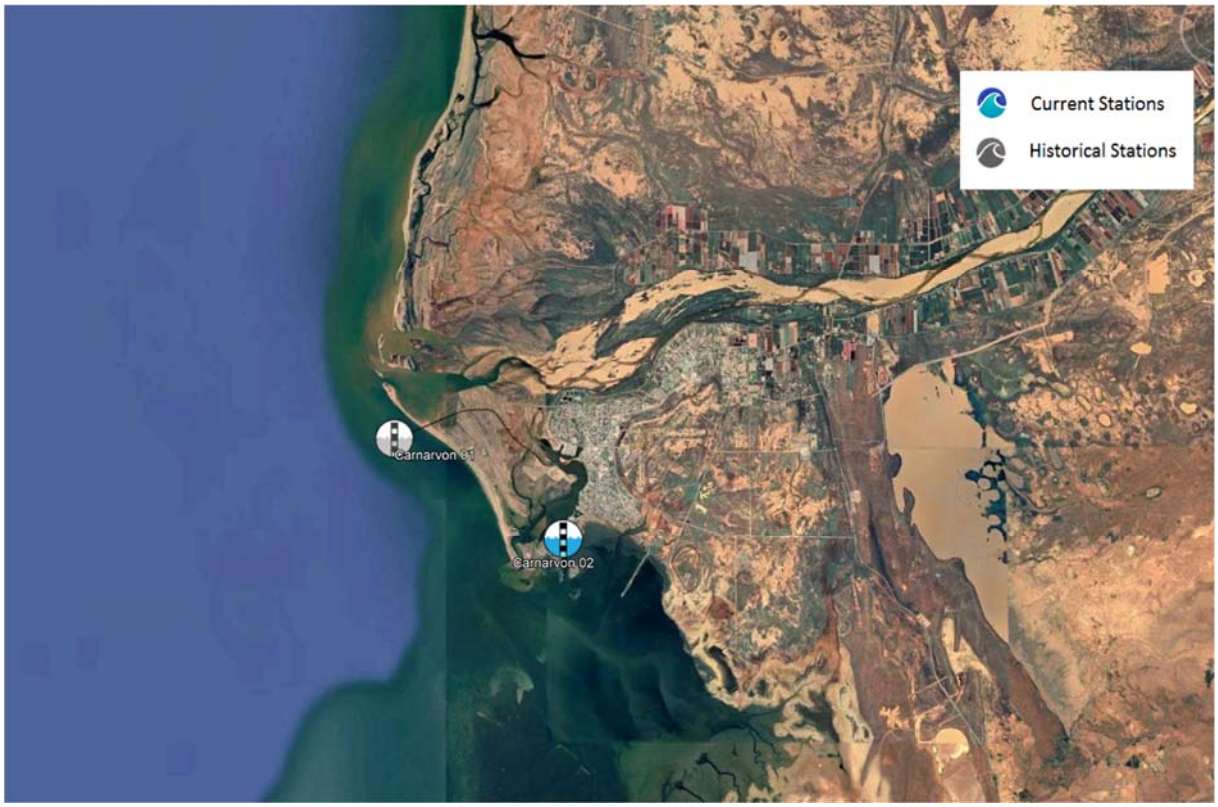

Figure 3.5 Recording device locations (source: Google Earth)

Table 3.2 Available Metocean Measurement Data

Data	Location	Recorded Data	Depth
Carnarvon 01	-24.8804° 113.6174°	1990 - 1999	~3 m
Carnarvon 02	-24.8987° 113.6510°	1996 - Ongoing	~3 m

Given the information above, three separate events were chosen for the calibration and validation of the Delft3D model. These events were selected as they generated a reasonably high storm surge, and also had good data coverage within the historical cyclone database and water level record. The chosen events are as follows.

- TC Frank for calibration and validation with the observed water level record at Carnarvon 01.
- TC Olwyn for calibration and validation with the observed water level record at Carnarvon 02.
- TC Steve for calibration and validation with the observed water level record at Carnarvon 02.

Track and intensity plots for TC Frank, TC Olwyn and TC Steve are presented in Figures 3.6, 3.7 and 3.8 respectively.

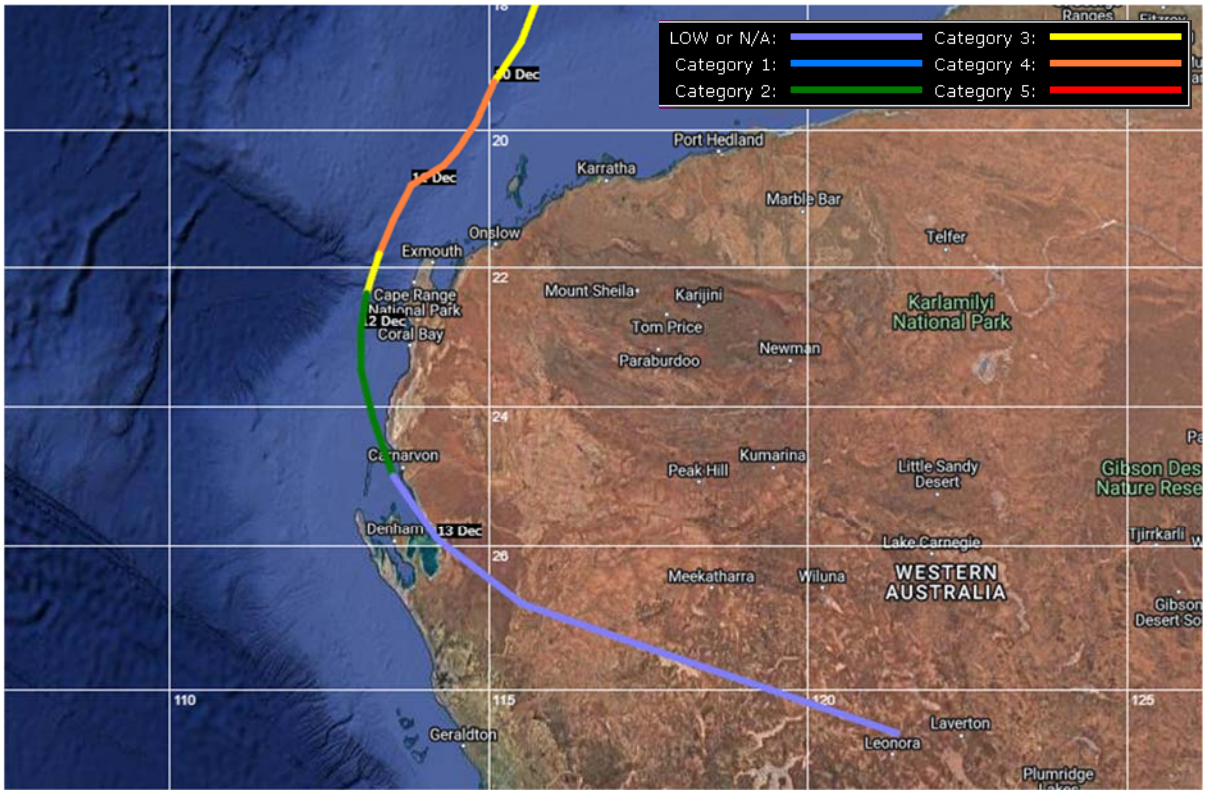

Figure 3.6 Tracks & Severity Plot for TC Frank

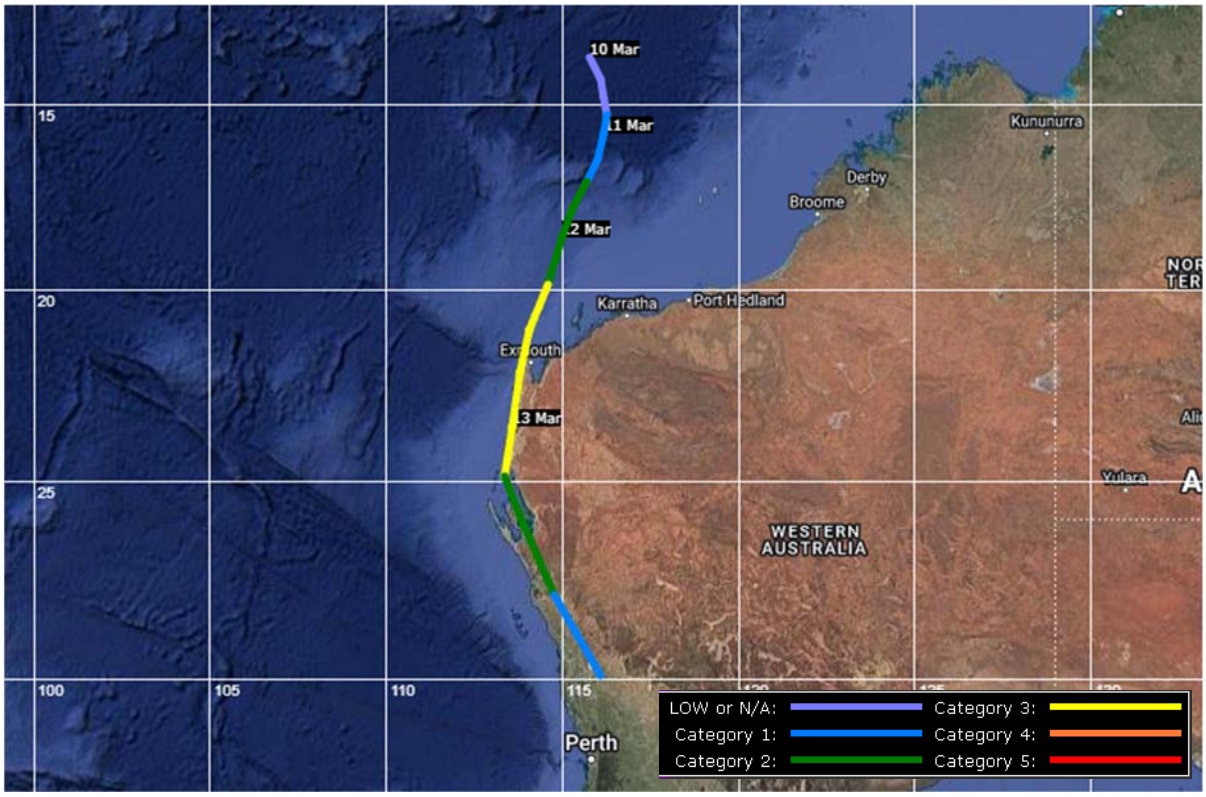

Figure 3.7 Tracks & Severity Plot for TC Olwyn

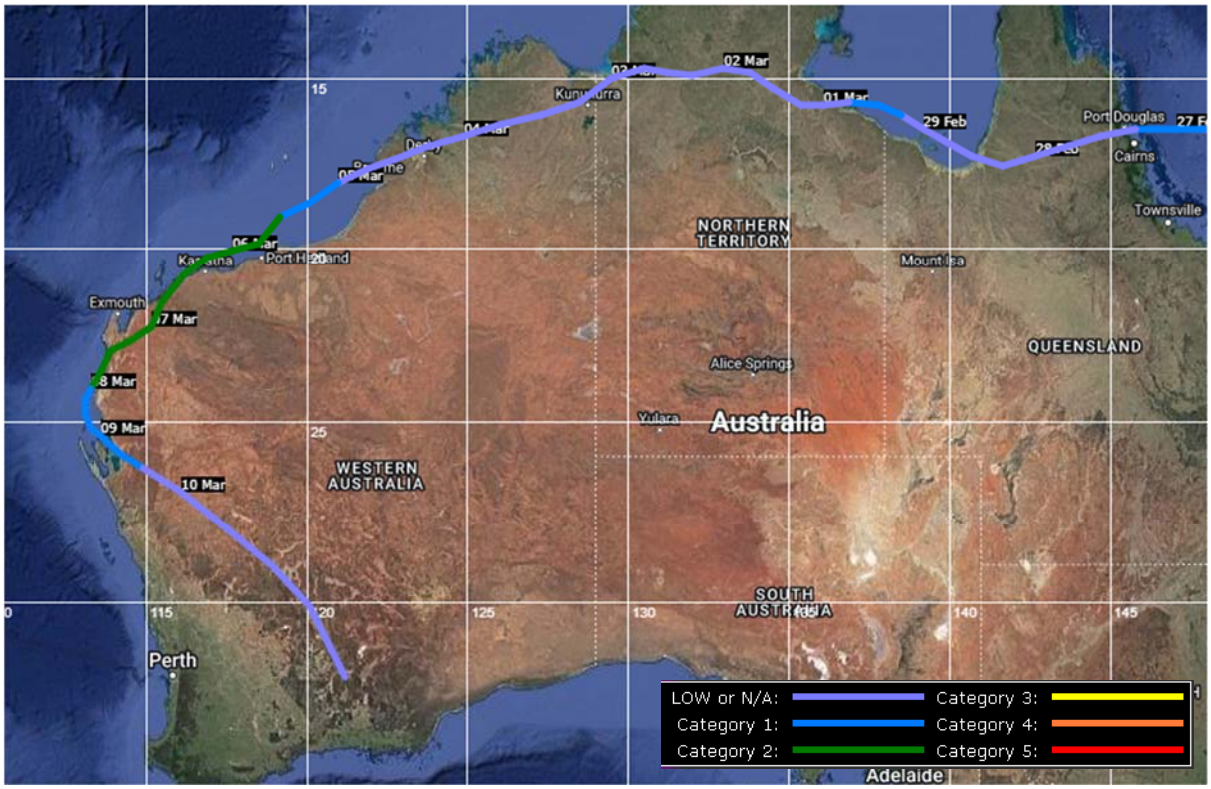

Figure 3.8 Tracks & Severity Plot for TC Steve

MRA has previously adopted this method of calibration at other locations, such as Geraldton, Denham, Cape Lambert and Port Hedland. The result of the validations at these locations indicates a good agreement between the modelled output and the historical measurements.

A comparison between the observed and modelled water level records was undertaken. The following figures show the observed data record and the model outputs at the tide gauge locations during each of the tropical cyclones.

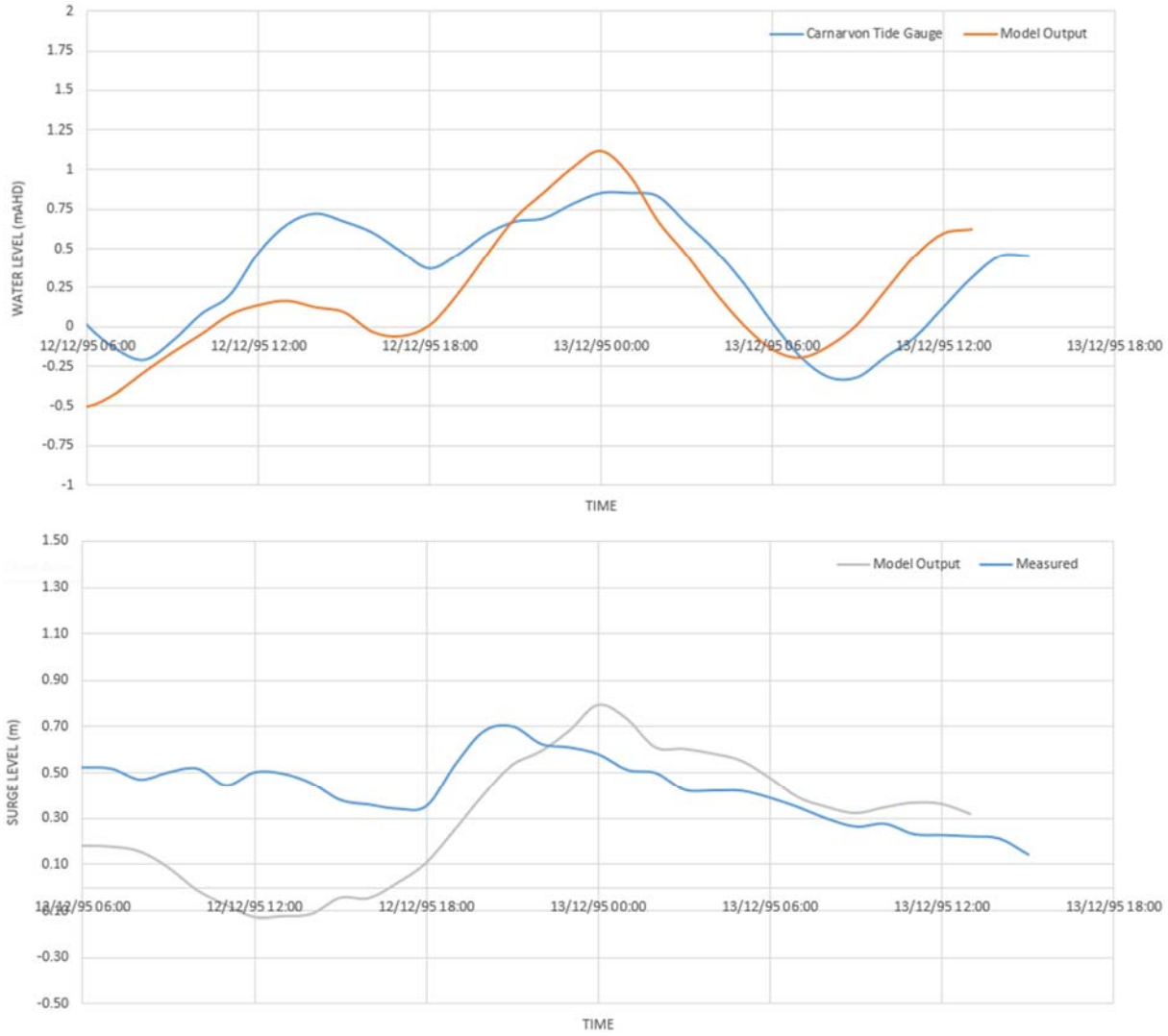

Figure 3.9 TC Frank (Top: Water Level; Bottom: Surge)

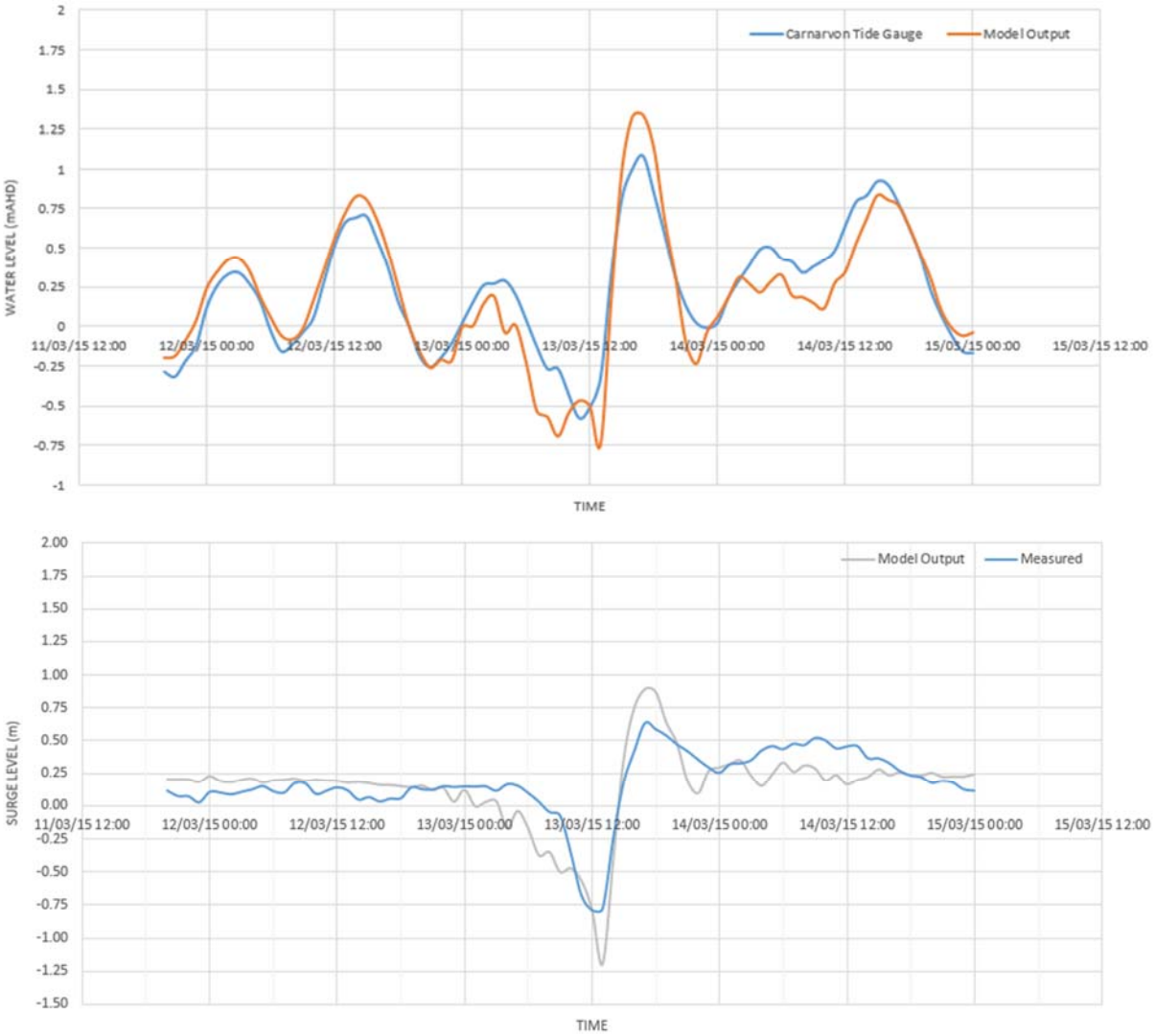

Figure 3.10 TC Olwyn (Top: Water Level; Bottom: Surge)

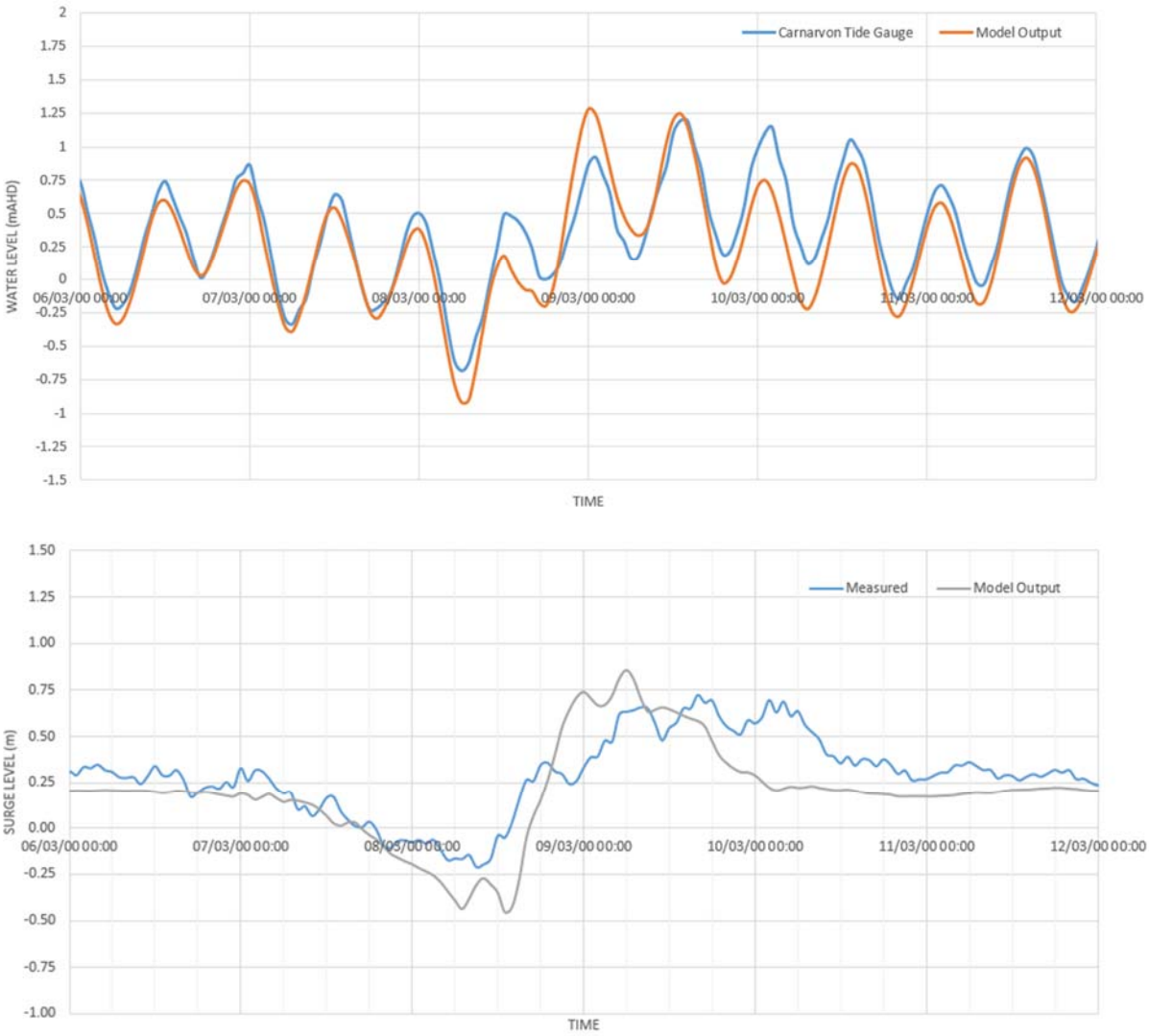

Figure 3.11 TC Steve (Top: Water Level; Bottom: Surge)

As shown, observations at the tide gauge are generally well reflected in the model, although the peak water level is slightly overestimated. There are some differences in the occurrence of the peaks\ water levels observed at the tide gauges and the model outputs. This difference is likely a result of the accuracy of the cyclone track data, which is only available in 3 hourly or even 6 hourly intervals.

The water level comparison also suggests that there appears to be a surge of water level before and/or following passages of the cyclone that are not fully matched by the model outputs. These "surges" are caused by a number of difference factors (e.g. shelf waves from passage of the cyclone and/or presence of another low-pressure system/cold front etc). These larger phenomena are therefore not expected to be able to be fully resolved by the numerical model

Nevertheless, based on the comparison of the model outputs it appears that the model provides a reasonable, if slightly over-estimated (conservative) representation of the observed conditions (especially the peak water level which is critical to this study). Therefore, this provides confidence in the model as a reliable predictive tool.

4. Storm Surge Inundation Modelling Results

With respect to coastal inundation, SPP2.6 requires that development consider the potential effects of an event with an AEP of 0.2% per year. This is equivalent to an inundation event with an ARI of 500 years. In addition, to satisfy the requirement of LPS13 and SPP3.4, an event with an AEP of 1% per year, or the 100 year ARI event is also considered.

Accurate and statistically relevant predictions of the 100 and 500 year ARI event cannot be made solely using the available historical water level measurements along the Western Australian coastline due to the relatively short durations of the records. This is due to the fact that a continual water level record of about a third (34 and 167 years) of the recurrence interval in question (100 and 500 years) is required to ensure statistical relevance of the prediction. This is greater than the length of the observed record at the closest tide gauge (Carnarvon). Therefore, in the absence of sufficient water level data other methodologies must be considered to provide meaningful predictions of the 100 and 500 year ARI event.

For this site the 100 year ARI and 500 year ARI water level event will be caused by a tropical cyclone generating extreme onshore winds and storm surge. Therefore, recommendations provided in Seashore (2018) have been used to synthesise the 100 and 500 year ARI cyclone event. The storm track is based on Tropical Cyclone Narelle, whilst central pressure and radius to maximum winds were scaled based on statistical interrogation of the observed record completed by Seashore (2018).

The 100 and 500 year ARI events were modelled across the established model domain. Spatial plots of the water levels (relative to AHD) from the modelled events are presented in Figure 4.1 and 4.2 respectively. These plots show the point of the peak water level near the site. It should be noted that the water level plot excludes the impact of nearshore wave setup processes that occur on a finer scale than the model simulation. Wave setup can result in an increased water level, which will vary based on the local bathymetry and incident waves. This is illustrated in Figure 4.3.

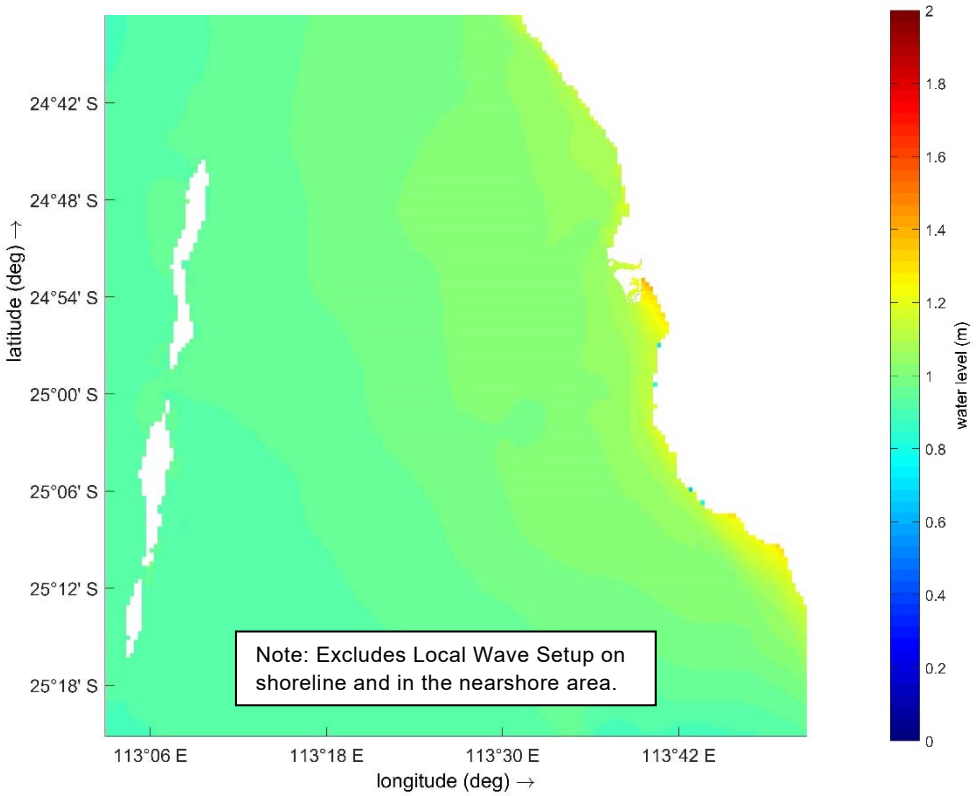

Figure 4.1 Delft3D output plot showing the 100 year ARI water level event for the site

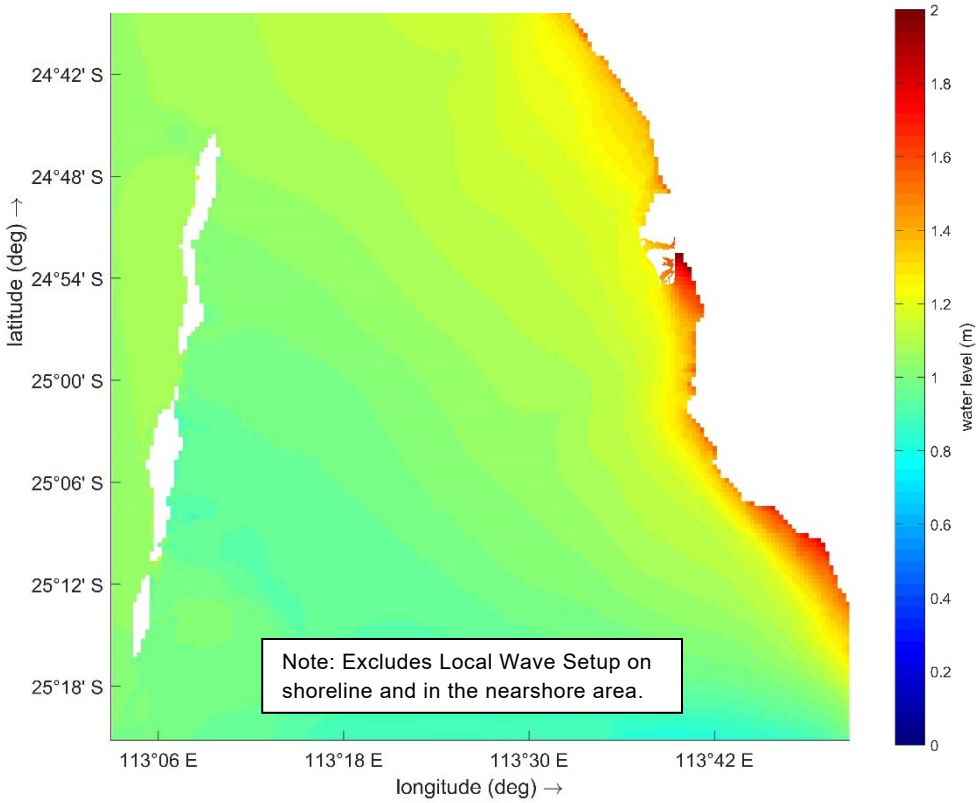

Figure 4.2 Delft3D output plot showing the 500 year ARI water level event for the site

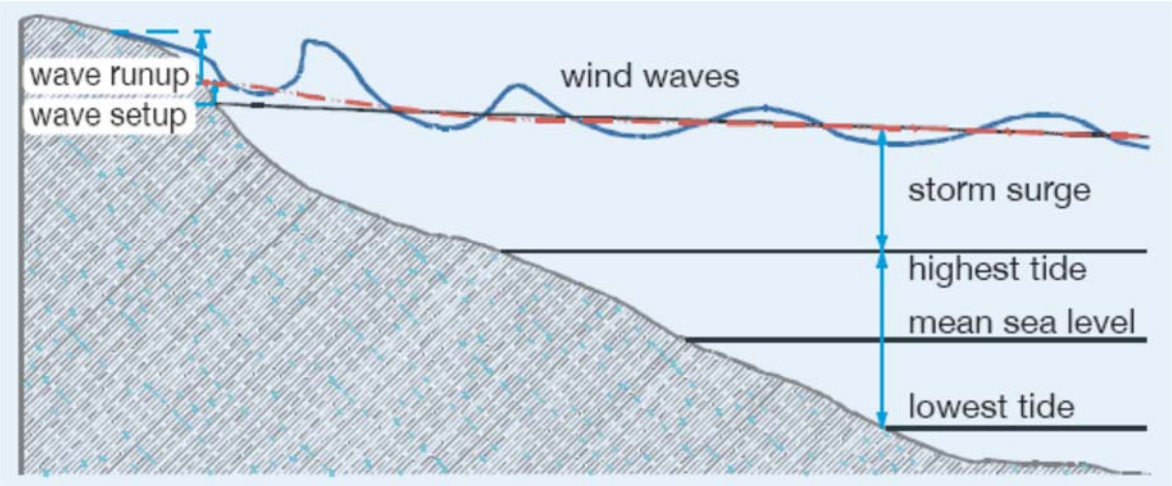

Figure 4.3 Components of inshore water levels

Inshore wave setup is described by Dean and Walton (2008), who provide a comprehensive review of investigations into the extent of wave setup on beaches. Dean & Walton (2008) outline that wave setup is the additional water level that is due to the transfer of wave related momentum to the water column during the wave breaking process. The extent of the inshore wave setup can be substantial depending on the incident wave conditions and local bathymetry.

As a result, site specific assessment of the inshore wave setup has been completed for this study to translate the estimated water levels from the cyclone modelling to the shoreline.

The SBEACH model was used to simulate the changes to nearshore water levels from the nearshore area to the shoreline. Using this modelling approach, it was established that additional wave setup could be in the order of 0.8 m and 1.2 m during the 100 and 500 year ARI event respectively. This has been included in estimates of the appropriate inundation levels for the present-day case as well as for a 100 year planning horizon to 2123 (which incorporates an allowance for sea level rise in accordance with guidance provided within DoT (2010)). The resulting inundation levels are presented in Table 4.1.

Table 4.1 Design Storm Surge Inundation Levels for the Site

ARI (years)	Inundation Level Present Day (mAHD)	Sea Level Rise Allowance to 2023 from Dot (2010)	Inundation Level 2123 (mAHD)
100	2.3	0.98	3.3
500	3.0	0.98	4.0

Based on the survey of the site provided, the potential coastal inundation levels are higher than portions of the site and will likely result in some areas being undated during these events. Therefore, consideration of the risks of coastal inundation should be considered for the proposed development based on the proposed elevations. Filling of development areas above these levels should be considered as a means of managing potential inundation risks.

The 100 year ARI and 500 year ARI event have been included in order to help provide guidance regarding the potential development level to comply with SPP2.6 and LPS13.

Based on the results outlined above, to accord with the requirements of SPP2.6 new freehold development at the site would need to be developed at or above a level of 4.0 mAHD.

5. Conclusions

The absence of sufficiently long records of water level at Carnarvon makes it impossible to develop meaningful estimates of design ocean inundation levels from interrogation of the water level record on its own. This is particularly problematic given that LPS13 requires demonstration of protection for development during a 100 year ARI event, and SPP2.6 requires that freehold development levels be set based on the 500 year ARI inundation level plus an allowance for sea level rise.

To determine the design ocean inundation levels at Carnarvon a numerical model was set up, calibrated and validated to simulate the ocean surge caused by the passage of tropical cyclones. The cyclones used to estimate the extreme ocean inundation levels were synthesised to meet the recommendations of Seashore (2018).

The results of this simulation have shown that, to meet the requirements of SPP2.6, new freehold development would need to be located at or above an elevation of 4.0 mAHD which is the predicted level of the 500 year ARI event plus a 0.98 m allowance for sea level rise.

6. References

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Appendix D

Servicing Report

999 Hay Street, Level 10
Perth, Western Australia 6000
Australia
www.ghd.com

Your ref:
Our ref: 12571364

06 October 2023

John Milici
DevelopmentWA
John.Milici@developmentwa.com.au

Northwater Carnarvon Stages 4 & 5 Residential Subdivision – Servicing Approach

Dear John

As requested, below is a summary of the servicing approach for Stages 4 and 5 of the Carnarvon Northwater development based on the TBB's Structure Plan dated October 2022 (attached).

Existing Levels & Earthworks

Existing surface levels generally grade north to south from Babbage Island Road (north) at approximately 4.8m AHD, towards the existing northern extent of Parnaa View at 3.5mAHD. The site has an existing levee on the western interface with the Fascine. The eastern side of the levee is lower than adjacent development, forming a long, depressed area at the rear of existing properties.

An existing sump/formed low area is located at the northern end of Stage 5. .

During development, the site will be earth worked to provide level lots where practical, excepting the eastern boundary lots which will interface to existing lots with a batter and small 1.0m wide cutoff drain. The western levee is proposed to be removed, following confirmation of its redundancy from the Department of Water and Environmental Regulation. Refer to the attached GHD Earthworks Concept Plan for further details and typical sections.

Retaining walls will be required between lots where 1 in 6 batters are not desired or practical. The height, length and location of any walls will be determined during detailed design.

Sewer Reticulation

Existing DN225 gravity sewer mains are located at the rear of existing development on Tonkin Crescent and Fane Crescent. There is also an existing DN150 gravity sewer main within Parnaa View western verge.

Previous Water Corporation planning for Stage 4B in 2013 (which did not proceed) proposed connection of the northern section of the stages via new DN150 to a new access chamber on the DN225 main within the rear of 25 (lot 60) Tonkin Crescent. This planning will need to be confirmed during detail design, as this lot is developed and will require access to private property.

The southern section of Stage 4 is proposed to connect at Parnaa View, via extension of a DN150 gravity sewer main.

Proposed sewerage will be designed in accordance with Water Corporation design standard DS50.

Water Reticulation

Stages 4 and 5 are located within an existing Water Corporation water reticulation network. A DN150 water main exists within Parnaa View on the standard 2.1m alignment from existing boundaries. A DN375 water main is located within the northern verge of Babbage Island Road.

The proposed water reticulation network to service the stages will be designed in accordance with Water Corporation design standard DS63. Network planning proposes an extension of the DN150 water main within Parnaa View through to the DN375 within Babbage Island Road.

Each individual lot will be provided with its own connection.

Stormwater Drainage

Existing stormwater assets in the area are owned and maintained by the Shire of Carnarvon. Infrastructure including grated stormwater pits are present in the surrounding roads, including on David Brand Drive and Parnaa View.

GHD's Local Water Management Strategy (LWMS), 2023, proposes capture of stormwater via an underground drainage pipe system for up to the 20% AEP Minor Storm event, and discharge to the Gascoyne River. Gross pollutant traps (GPT) will be incorporated into the drainage system as required.

Lot drainage will be directed into the road reserves and ultimately into the Fascine.

Larger events are to be conveyed via the road network to adjoining waterways using current best management practices.

Two outlets are proposed for the drainage catchments within Stage 5. Indicative locations and further assumptions are represented in the LWMS, with exact locations to be confirmed during detailed design and discussion with the Shire of Carnarvon.

Roads & Paths

Surrounding roads to the south of Stage 4 were constructed during earlier stages of the development. Within Stages 4 and 5 development, Parnaa View is proposed to be extended to Babbage Island Road in the north. Pavement width and pavement details are subject to further advice from traffic and geotechnical assessment.

Babbage Island Road is a single lane, east-west bound road with a posted speed limit of 80 km/h at the proposed intersection location and heading west, and a posted speed limit of 60km/h heading east. Potential adjustment to the location of the speed limit change will be reviewed during design, such that the intersection can be located within the 60km/h zone. This will require consultation and due process with the Shire of Carnarvon, as well as likely requiring Main Roads WA input and agreement.

Alternatively, and pending traffic advice, upgrades will be required at the Babbage Island Road intersection such as widening to facilitate dedicated turn lanes for the higher speed limit.

An existing path network is also present along some existing roads. The new stage may require rationalisation of the existing network, including new paths on existing roads.

Underground Power

Street lighting is required, particularly at intersections, to meet Local Government Authority lighting compliance requirements.

An existing transformer located on David Brand Drive has multiple LV (low voltage) feeders that currently supplies residential lots and street lighting within the subdivision.

Horizon Power's Distribution Design Rules Rev 0 assigns a DADMD (capable maximum demand) of 6kVA per residential lot for this area. This would equate to 318kVA for the additional (approximately) 53 lots proposed under Stages 4 and 5 of this development. It should however be noted that Horizon Power may request an increased DADMD based on current power usage of existing lots in the area. The nominated DADMD would only be confirmed by Horizon Power when the Design Information Package (DIP) is requested. On this basis, it is possible that either new high voltage infrastructure may be required or alternatively the existing Modular Packaged Substation (MPS) in the area could be converted to a Non-MPS arrangement to allow a larger 1MVA transformer to be installed.

Once the DIP is received, a detailed design will be completed to confirm the final requirements for the additional lots in this stage of the development.

Telecommunications

The site is located within an existing Telstra network. The existing network can be extended to service the lots within Stage 5.

Provision of a telecommunications pit and pipe network will be required, including a service agreement with Telstra to provide cabling/fibre to the proposed lots.

Gas Supply

No underground gas network exists in Carnarvon.

Regards

PP.

Louise Johnson
Senior Civil Engineer

+61 8 62228110
louise.johnson@ghd.com

Copy to: Taylor Burrell Barnett / Michael Willcock, Farida Farrag

Attachment: TBB Structure Plan 10/036/049B dated 31 October 2022
GHD Earthworks Concept Plan 12571364-002-SK01

Appendix E

Traffic Impact Statement

Transport Impact Statement

Northwater Carnarvon

Stage 4 and 5

Prepared for DevelopmentWA

Prepared by Taylor Burrell Barnett

February 2024

Taylor Burrell Barnett

Document Information

Transport Impact Statement

Northwater Carnarvon Stages 4 - 5

DevelopmentWA

Prepared by: Taylor Burrell Barnett

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PERTH WA 6850

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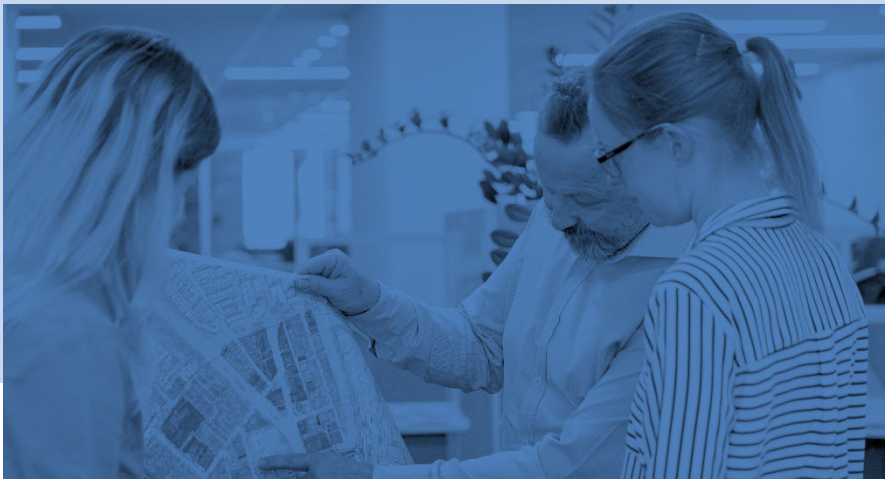

Revision	Status	Author	Approved by	Date Issue
1.0	Draft	F Farrag	M Willcock	01/03/2024

1.0 Introduction

Taylor Burrell Barnett (TBB) has been commissioned by DevelopmentWA to undertake an assessment of the existing and proposed transport network and provide a Transport Impact Statement (TIS) to support a structure plan.

This TIS been prepared having regard to the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines* for Structure Plans: Volume 2 – Planning Schemes, Structure Plans and Activity Centre Plan and Volume 3 – Subdivision (August 2016). The purpose of the TIS is to consider the existing transport situation at Northwater Carnarvon and potential impacts of subdivision and development in accordance with the proposed Structure Plan.

1.1 Structure Plan Area

The structure plan area comprises part of Lot 9001 on Deposited Plan 402324. The southern portion of Lot 9001 has been granted subdivision approval (WAPC ref: 162432), which is referred to as Stage 3.

The structure plan area will be delivered as Stages 4 and 5, refer **Figure 1**.

Stage 4 will be the next stage of subdivision and will facilitate development adjacent to the existing residential area (Stage 3, WAPC ref: 162432). The extension of existing roads Parnaa View and Yaburru Loop will be developed as part of Stage 4, with a temporary cul-de-sac head for the extension of Parnaa View, unless a road connection through to Babbage Island Road is required. It is anticipated that the estimated lot yield for Stage 4 will be 30 residential lots.

Upon completion of Stage 4, the Stage 5 area will be investigated as the site is situated within the buffer zone of Special Control Area 1 – Carnarvon Waste Water Treatment Plant. Stage 5 will deliver the extension of Parnaa View through to Babbage Island Road providing dual access and egress for lots within the Structure Plan area. The estimated yield for Stage 5 is 23 lots which will finalise the extent of residential development in the western portion of the Carnarvon Townsite.

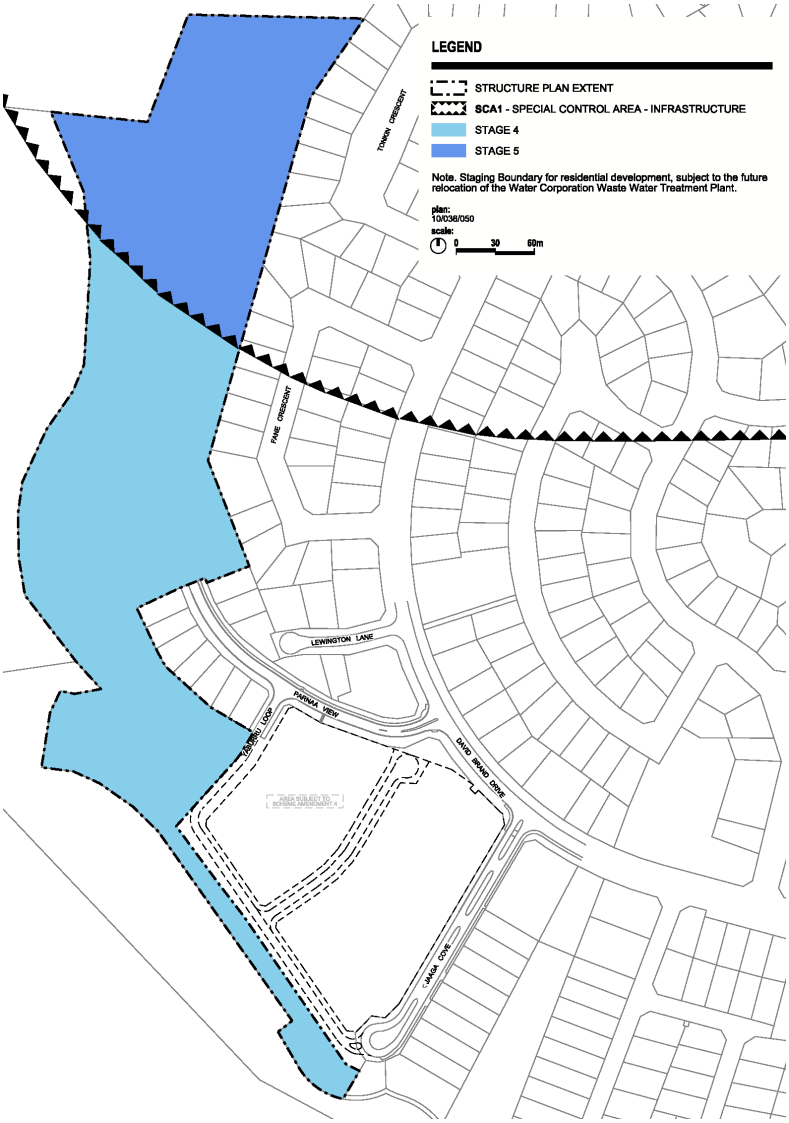

Figure 1 Northwater Carnarvon Stage 4 & 5 Structure Plan – Staging Boundary

2.0 Structure Plan Outline

2.1 Regional Context

Carnarvon is the main population centre for the Gascoyne region and is the commercial and administrative centre for the local government area. Carnarvon is regarded to be a significant and important regional settlement that provides opportunities for lifestyle living with convenient access to employment, services and recreational activities. The structure plan area is less than a kilometre from the town centre and is an ideal location to cater for residential development adjacent to the Carnarvon Fascine. A diverse range of services and amenities ensures the town is a desirable location for young families, job seekers and people seeking a lifestyle change.

The structure plan area seeks to leverage its proximity to economic and employment opportunities. The structure plan area has ready access to the town centre via David Brand Drive, Parnaa View, Olivia Terrace and Robinson Street. Furthermore, the structure plan area is located approximately 5km west of the North West Coast Highway, which provides regional access to Carnarvon's horticulture industry, and future areas of employment (future general and light industrial areas).

2.2 Proposed Land Uses

The land uses proposed through the structure plan are outlined in **Table 1** below.

Table 1 Proposed land uses in the structure plan area

Proposed Zones and Reserves	Description
Residential Zone	The structure plan aims to deliver approximately 53 residential lots, facilitating approximately 53 single houses. The 'R12.5-R25' residential density code range applies to all future lots in the Structure Plan area to facilitate single houses. The proposed density code range facilitates flexibility and opportunity for a mix of dwellings within the Structure Plan area, whilst continuing to maintain the character of the surrounding area.
Local Road Reserve	The structure plan depicts an indicative road network for the suitable distribution of traffic, future connections and efficient residential lot layout. The structure plan proposes a 20m wide road reserve extension of Parnaa View, and a 14m-15m wide road reserve providing a connection from Yaburru Loop to the Parnaa View extension. Future subdivision applications shall have due regard to this indicative road layout, ensuring roads are designed to a suitable standard appropriate for residential development.
Public Open Space Reserve	The structure plan identifies an area of public open space (POS) along the western boundary of Lot 9001 and is the equivalent to approximately 2.1277 hectares. The POS is proposed to provide adequate amenity along the Carnarvon Fascine and will provide a suitable landscaped interface between the waterway and residential development. The POS will be maintained to a low-threat vegetated state and will be landscaped to ensure a low maintenance outcome for the local government. The POS is not intended to be a major traffic generator.

2.3 Major Attractors and Generators

There are a number of key locations beyond the structure plan area which would act as attractors for traffic movements to and from the structure plan area. An overview of these are provided in context to the structure plan area, refer **Figure 2**.

The Carnarvon town centre provides local services, employment, amenities and recreation. The convenient proximity of the structure plan area provides opportunities for walking, cycling, public transport use and private vehicle use.

The structure plan area is located within 2km of the following educational, retail, community services and civic uses:

- St Mary Star of the Sea Catholic School;
- Carnarvon Christian School;
- Carnarvon Community College;
- Carnarvon Library and Galle
- Granny Glasgow Day Care Centre;
- Carnarvon Hospital;
- Carnarvon Airport;
- Retail, services and food and beverage options; and
- Tourism services including the Port Hotel-Motel, Carnarvon Sea Change Apartments, Backpackers Inns, and the Carnarvon Central Apartments.

The local road network will primarily be used by residents of the approximately 53 lots within Stages 4 and 5 of the structure plan area. There is limited through traffic due to the locational characteristics of the structure plan area being on the edge of the Carnarvon Fascine.

A footpath network is provided between the Carnarvon townsite and along David Brand Drive. The proposed road network within the structure plan will deliver a footpath to at least one side of proposed roads, providing further connectivity between the structure plan, the Carnarvon Fascine and the existing residential development. This will continue to facilitate walking and cycling.

There is sufficient capacity within the existing bus services and road network to accommodate forecast transport requirements. Consequently, there is not expected to be any need for additional bus services to cater to the structure plan area.

Figure 2 Structure Plan Area Context Plan

3.0 Transport Networks

3.1 Internal Transport Networks

The internal transport network includes proposed subdivisional roads which will result in the extension of existing road reserves, Parnaa View and Yaburru Loop, and will provide new road connections within and external to the structure plan area. The site is well located with existing road linkages, public transport networks and footpath infrastructure. The structure plan area has road connectivity to Jaaga Cove, David Brand Drive, Parnaa View, Yaburru Loop and intends to provide future access to Babbage Island Road.

Access within the structure plan area will be facilitated through road connections to Babbage Island Road and Parnaa View, providing the site with dual access ensuring compliance against *State Planning Policy 3.7 – Planning in Bushfire Prone Areas*.

Parnaa View is proposed to extend northwards to intersect with Babbage Island Road. Residential lots would have direct front loaded garages and crossovers along the entire eastern interface and portion of the western interface. The proposed extension of Yaburru Loop to the west will intersect with a 15-metre road reserve (local access street) providing the extension of residential lots north, parallel with Parnaa View. A portion of the local access street will provide a road interface to the Fascine.

The internal roads seek to provide a high level of connectivity and where appropriate have a road design that moderates vehicle speeds. Footpaths will be provided to one side of all residential streets to further support walking and cycling within the structure plan area. The road network will be logical and interconnected and through the design of the structure plan, will also provide a sense of arrival by converging with a road frontage in places, to proposed public open space that will be located adjacent the Fascine.

Parnaa View will be proposed with a 20-metre-wide road reserve to maintain consistency with the existing road. Local access streets within the structure plan area will be proposed with a 14m-15-metre-wide road reserve consistent with *Liveable Neighbourhoods*. The road network will supportive of emergency service access and waste collection. The road network along Parnaa View would be capable of supporting school bus services.

A description of the transport networks internal to the Structure Plan area is summarised in **Table 2** below.

Table 2 Proposed Internal Transport Networks

Transport Matter	Proposal
Proposed subdivision	Anticipated yield of 53 lots and 53 dwellings (1 per lot) across both Stages 4 and 5 of the structure plan.
Vehicle Access and Parking	Access will be via new subdivisional roads that connect to Yaburru Loop and an extension of Parnaa View towards Babbage Island Road. It is anticipated parking of vehicles will be capable of being contained on-site, including in garages and outbuildings. All lots will be front-loading and driveways would interface with roads.
Provision for service vehicles	Road network widths would facilitate service vehicles such as for house construction, waste collection, and emergency services.
Daily traffic volumes and vehicle types	The proposed road network will ensure sufficient capacity for daily traffic volumes. Likely vehicle types would be cars and service vehicles.
Traffic management on frontage streets	Traffic management would be undertaken as required for new road connections. Road reserve widths provide suitable sightlines for residential crossovers.
Public transport access	The 803 bus route travels east of the subject site, along David Brand Drive. Bus stops are within walkable distance of the structure plan area.
Pedestrian access	A 15m wide road reserve is proposed to connect to Yaburru Loop and travel north, connecting to the Parnaa View extension. A 20m wide road reserve is proposed to be maintained for the Parnaa View extension. Consistent with Liveable Neighbourhoods these roads would provide footpaths to facilitate walking.

Transport Matter	Proposal
Cycle access	15m – 20m road reserves provide sufficient verge width to facilitate cycling on footpaths or on the street pavement.
Site specific issues	None identified.
Safety issues	None identified. The land is relatively clear of vegetation and road reserve widths will offer sightlines for vehicles entering/existing lots.

3.2 External Transport Networks

Surrounding roads to the south of Stage 4 will be constructed in accordance with the Stage 3 subdivision approval (WAPC ref: 162432).

Within the structure plan area, Parnaa View is proposed to be extended to Babbage Island Road in the north. Babbage Island Road is a single lane, east-west bound road with a posted speed limit of 80 km/h at the proposed intersection location and heading west, and a posted speed limit of 60km/h heading east. The potential adjustment speed limits may be reviewed during detailed design, such that the intersection can be located within the 60km/h zone. This will require consultation with the Shire of Carnarvon and Main Roads WA.

Alternatively, and pending traffic advice, upgrades will be required at the Babbage Island Road intersection such as widening to facilitate dedicated turn lanes for the higher speed limit. However, as previously mentioned in **section 1.1**, the Stage 5 area is constrained by the Special Control Area 1 – Carnarvon Waste Water Treatment Plant. It may be some time before a road connection to Babbage Island Road is provided.

Appendix F

Bushfire Management Plan

Bushfire Management Plan Coversheet

This Coversheet and accompanying Bushfire Management Plan has been prepared and issued by a person accredited by Fire Protection Association Australia under the Bushfire Planning and Design (BPAD) Accreditation Scheme.

Bushfire Management Plan and Site Details

Site Address / Plan Reference: Lot 9001 David Brand Drive (Carnarvon Northwater Stages 4 and 5)

Suburb: Brockman **State:** WA **P/code:** 6701

Local government area: Shire of Carnarvon

Description of the planning proposal: Structure Plan

BMP Plan / Reference Number: JBS&G 64444 | 155,180 **Version:** R01 Rev 0 **Date of Issue:** 13/12/2023

Client / Business Name: DevelopmentWA

Reason for referral to DFES	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?	☐	☑
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the BPC elements)?	☐	☑
Is the proposal any of the following special development types (see SPP 3.7 for definitions)?		
Unavoidable development (in BAL-40 or BAL-FZ)	☐	☑
Strategic planning proposal (including rezoning applications)	☑	☐
Minor development (in BAL-40 or BAL-FZ)	☐	☑
High risk land-use	☐	☑
Vulnerable land-use	☐	☑

If the development is a special development type as listed above, explain why the proposal is considered to be one of the above listed classifications (E.g. considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

The proposal is a Structure Plan, which is a strategic planning proposal.

Note: The decision maker (e.g. local government or the WAPC) should only refer the proposal to DFES for comment if one (or more) of the above answers are ticked "Yes".

BPAD Accredited Practitioner Details and Declaration

Name	Accreditation Level	Accreditation No.	Accreditation Expiry
Zac Cockerill	Level 2	BPAD37803	31/08/2024
Company		**Contact No.**	
JBS&G Australia Pty Ltd		(08) 9792 4797	

I declare that the information provided within this bushfire management plan is to the best of my knowledge true and correct

Signature of Practitioner **Date** 13/12/2023

Lot 9001 David Brand Drive, Brockman

DevelopmentWA

Bushfire Management Plan (Structure Plan)

JBS&G 64444 | 155,180

13 December 2023

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

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Appendices

1. Proposal details

1.1 Background

DevelopmentWA is seeking to lodge a Structure Plan application to guide future urban residential development within Lot 9001 David Brand Drive, Brockman in the Shire of Carnarvon, known as Carnarvon Northwater Stages 4 and 5 (hereon referred to as the project area). The Structure Plan (Figure 1) identifies:

- proposed residential cells
- proposed internal road layout
- areas of proposed Public Open Space (POS).

1.2 Site description

The project area is predominantly comprised by degraded shrubland on the fringe of the Gascoyne River, Carnarvon Fascine and Babbage Island floodplain and is surrounded by (see Figure 2):

- Babbage Island Road and the Gascoyne River mouth to the north
- the Carnarvon Fascine and Whitlock Island to the south
- existing residential development to the east
- future residential development to the southeast (area subject to Scheme Amendment 4)
- an area of floodplain for the Gascoyne River and Babbage Island to the west.

1.3 Bushfire prone designation

A portion of the project area is designated as bushfire prone on the *Map of Bush Fire Prone Areas* (DFES 2021; see Plate 1).

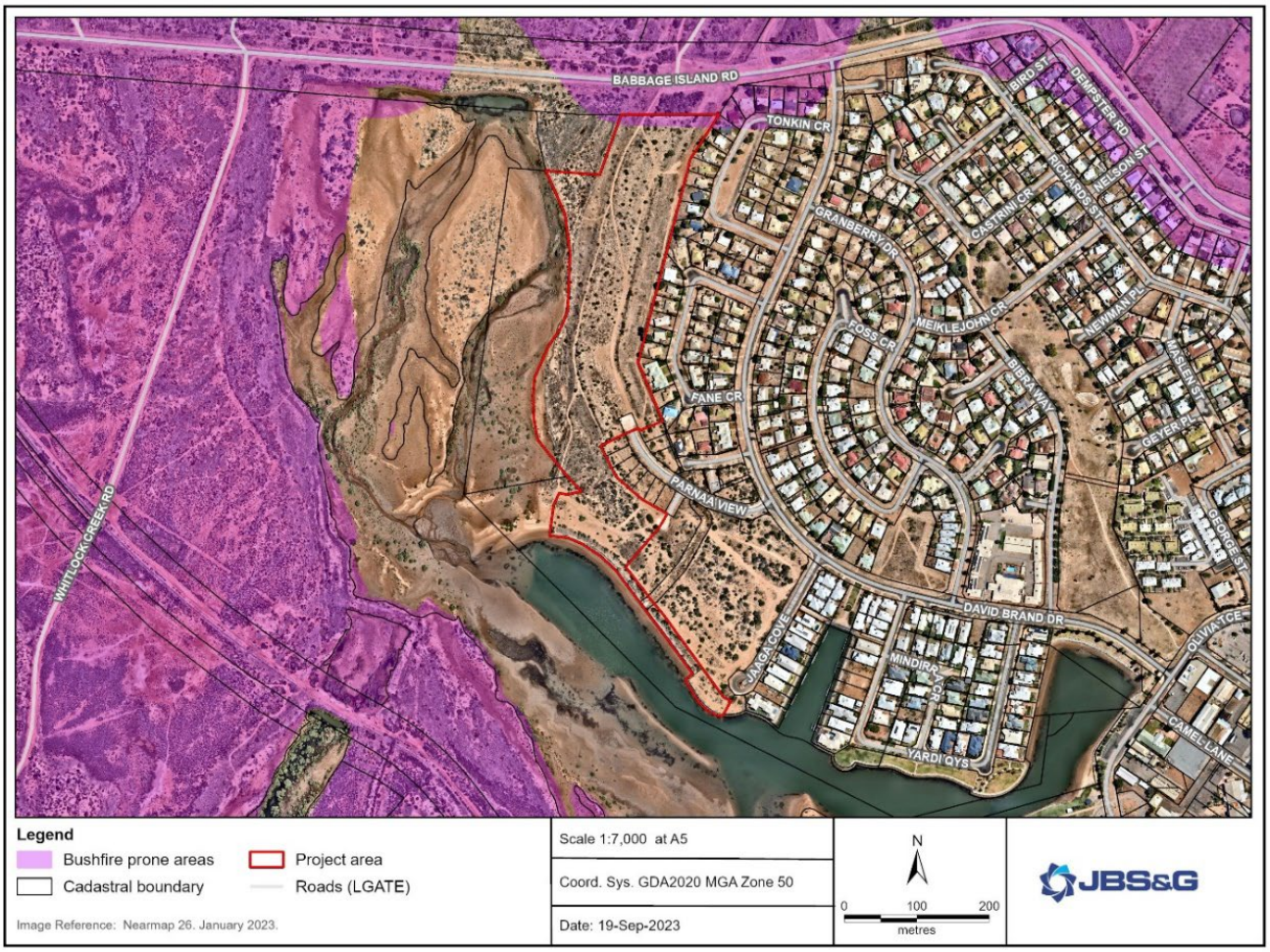


Plate 1: Map of Bush Fire Prone Areas (DFES 2021)

1.4 Purpose of this report

This Bushfire Management Plan (BMP) has been prepared to address requirements under Policy Measures 6.2 and 6.3 of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP3.7; WAPC 2015) in accordance with *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (the Guidelines; WAPC 2021).

This report provides an assessment of the proposed development, bushfire risk context, and required bushfire mitigation measures and includes:

- a review of existing pre-development and anticipated post-development vegetation classifications and effective slope within the project area and surrounds
- results of a pre and post-development Bushfire Hazard Level (BHL) assessment to determine the applicable BHLs across the project area and adjoining land
- details of any bushfire hazard issues relevant to the site and proposed development
- a compliance assessment to demonstrate the proposed development can comply with the bushfire protection criteria of the Guidelines at subsequent planning stages.

1.5 Other plans/reports

There are no known bushfire or environmental reports or assessments that have been prepared previously for the project area.

LEGEND

STRUCTURE PLAN EXTENT

LOCAL SCHEME RESERVES

PUBLIC OPEN SPACE

LOCAL ROAD

LOCAL SCHEME ZONES

RESIDENTIAL R12.5 - R25

OTHER CATEGORIES

SCA3 - SPECIAL CONTROL AREA - FLOOD PRONE AREA

SCA1 - SPECIAL CONTROL AREA - INFRASTRUCTURE

Staging Boundary for residential development, subject to the future relocation of the Water Corporation Waste Water Treatment Plant.

* A Local Development Plan may be required for the identified areas

Appropriate modeling and assessment to inform the adjustment to the SCA 3 boundary to accommodate residential development.

BABBAGE ISLAND ROAD

TONKIN CRESCENT

FANE CRESCENT

LEWINGTON LANE

PARNAA VIEW

YADDRU LOOP

DAVID BRAND DRIVE

JAGA COVE

R12.5-R25

AREA SUBJECT TO SCHEME AMENDMENT 4

INSET - NORTHWATER CARNARVON STAGE 4 AND 5

Structure Plan - Northwater Carnarvon Stage 4 and 5

LOT 9001 DAVID BRAND DRIVE, CARNARVON

A DevelopmentWA Project

scale: 1:3000@A3 | 1:1500@A1

0 30 60m

plan: 10/036/049B

date: 31/10/2022

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000
e: admin@tbbplanning.com.au
p: (08) 9226 4276

Taylor Burrell Barnett

Legend

- Project area
- Cadastral boundary
- Highway
- Major road
- Minor road
- Track

JBS&G

0 500 metres

Lot 9001, David Brand Drive
Brockman, WA

SITE OVERVIEW

Job Number: 64444		Scale 1:14,000 at A3		
Client: DevelopmentWA		Coord. Sys. GDA2020 MGA Zone 49		
Drawn By: jcrute	Checked By: ZC	Version: Rev A	Date: 19-Sep-2023	FIGURE: 2

Document Path: C:\Users\jcrute\JBS&G Australia\JBS&G - DCS - Internal - Documents\Projects\DevelopmentWA\64444_BrockmanSP_BMP\GIS\02_MapProjects\64444_BMP_R01_RevA\64444_BMP_R01_RevA.aprx
Image Reference: www.nearmap.com© - Imagery Date: 26. January 2023.

2. Environmental considerations

2.1 Environmental values

A search of publicly available environmental databases is summarised in Table 1 to provide an overview of the environmental values associated with the project area and proposed development.

Potential environmental impacts resulting from implementation of the proposal will be addressed by the proponent under standard State and Federal environmental assessment processes where required under the *Environmental Protection Act 1986* and *Environment Protection and Biodiversity Conservation Act 1999*.

Table 1: Summary of environmental values

Environmental value	Present within or adjacent to the project area	Description
Environmentally Sensitive Area (ESA)	Adjacent	The Shark Bay Marine Park is located 1.5 km to the south of the project area.
Swan Bioplan Regionally Significant Natural Area	N/A	N/A
Ecological linkages	N/A	N/A
Wetlands	Within and Adjacent	Within and adjacent to the project area is the Shark Bay East wetland which is registered in the Directory of Important Wetlands in Australia by Department of Climate Change, Energy, the Environment and Water (DCCEEW).
Waterways	Adjacent	The Gascoyne River foreshore is located approximately 350 m north of the project area. The Gascoyne River floodplain leading to the Carnarvon Fascine is to the west and south of the project area.
Threatened Ecological Communities listed under the EPBC Act	Potentially adjacent	Subtropical and Temperate Coastal Saltmarsh TEC is mapped as being likely to occur adjacent to project area.
Threatened and priority flora	N/A	None known
Fauna habitat listed under the EPBC Act	N/A	N/A
Threatened and priority fauna	Potentially within and adjacent	The project area is mapped as potentially containing or being adjacent to habitat for 7 reptile and 21 bird MNES threatened species.
Bush Forever Site	N/A	N/A
DBCA managed lands and waters (includes legislated lands and waters and lands of interest)	N/A	N/A
Conservation covenants	None Known	N/A

2.2 Native vegetation – modification and clearing

The project area is in a predominantly degraded state with historical clearing evident from past land uses, adjacent residential development and impacts from past flood events. A number of tracks exist throughout the project area that have also contributed to a reduced level of native vegetation cover and overall reduction in environmental value.

The project area is likely to be fully earthworked to facilitate residential development across the site. In this regard, it is anticipated that any remnant native vegetation within the project area will be modified to and maintained thereafter in a non-vegetated and/or low threat managed state on final development build out, including throughout POS areas.

2.3 Revegetation / Landscape Plans

No revegetation of classifiable vegetation is proposed throughout the project area. Some minor replanting may occur throughout landscaped POS areas; however, this will be limited to the following low threat managed areas that will be excludable under Clause 2.2.3.2 of *AS 3959-2018 Construction of Buildings in Bushfire-Prone Areas* (AS3959; SA 2018), as depicted in the Landscape Masterplan contained in Appendix A:

- low threat streetscaping and shade trees
- low threat coastal planting
- irrigated turf areas
- feature planting for entry statement.

Proposed exclusion of POS areas is discussed further in Section 3.2.

3. Bushfire assessment results

3.1 Bushfire Hazard Level Assessment

A Bushfire Hazard Level (BHL) assessment has been undertaken in accordance with Appendix 2 of the Guidelines. The assessment methodology categorises land as having either a Low, Moderate, or Extreme BHL based on the AS3959 vegetation classification and effective slope. BHLs provide an indication of the potential intensity of a bushfire event associated with vegetation within and adjacent to the project area.

Table 2 lists the three BHLs and their associated characteristics. BHLs have been applied to land within the project area and adjoining 150 m (the assessment area) to assess current (pre-development) bushfire hazard conditions, as well as the anticipated post-development bushfire hazard conditions.

Table 2: Bushfire hazard levels and characteristics

Bushfire hazard level	Characteristics*
Extreme	• Class A Forest • Class B Woodland (05) • Class D Scrub • Any classified vegetation with a greater than 10° slope.
Moderate	• Class B Low woodland (07) • Class C Shrubland • Class E Mallee/Mulga • Class G Grassland, including sown pasture and crops • Class G Grassland: Open woodland (06), Low open woodland (08), Open shrubland (09) • Vegetation that has a low hazard level but is within 100 metres of vegetation classified as a moderate or extreme hazard, is to adopt a moderate hazard level.
Low	• Low threat vegetation may include areas of maintained lawns, golf courses, public recreation reserves and parklands, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and windbreaks • Managed grassland in a minimal fuel condition (insufficient fuel is available to significantly increase the severity of the bushfire attack). For example, short-cropped grass to a nominal height of 100 millimetre • Non-vegetated areas including waterways, roads, footpaths, buildings and rock outcrops.
*Vegetation classifications from AS 3959-2018 Table 2.3.	

3.2 Assessment inputs

3.2.1 Vegetation classification

Assessment of classified vegetation and exclusions was undertaken via bushfire inspection within the project area and adjoining 150 m (the assessment area) through on-ground verification on 25 July 2023 in accordance with AS3959 and the *Visual Guide for Bushfire Risk Assessment in Western Australia* (DoP 2016). Georeferenced site photos and a description of the vegetation classifications and exclusions are contained in Appendix B.

Pre-development vegetation was assessed based on the current extent of classified vegetation within the assessment area (as depicted in Figure 3), including:

- Class D scrub containing shrubs 2–6 m in height with a continuous horizontal fuel profile within the southern portion of the project area and adjacent land to the north, west and southeast
- Class C shrubland containing shrubs less than 2 m in height with a continuous horizontal fuel profile within the northern and central portions of the project area and adjacent land to the northwest, west and south
- Class G grassland containing understorey grasses and weeds greater than 100 mm in height at maturity within the northeast corner of the project area and adjacent land to the northeast.

All remaining land within the assessment area was deemed to have a pre-development exclusion under Clauses 2.2.3.2 (e)/(f) of AS3959 as being either existing non-vegetated land (i.e. buildings, roads, tracks, water bodies, footpaths, driveways, etc) or low threat managed vegetation (i.e. existing urban street verges, managed gardens, floodplains devoid of vegetation, etc).

Post-development vegetation was assessed taking into consideration the anticipated clearing and modification of vegetation to a low threat state that will occur as part of proposed development, as depicted in Figure 4. This will result in additional exclusions under AS3959 including:

- land within the project area that is proposed to be modified to a non-vegetated/low threat managed state to facilitate proposed urban residential development, including within proposed POS areas (as documented in Section 2.3 and the Landscape Masterplan in Appendix A)
- land to the north of the project area that will be required to be cleared to facilitate proposed road extension and connection with Babbage Island Road
- existing vegetation within Lots 302 and 303 Lewington Lane (to the east of the project area), which are anticipated to have a post-development exclusion under Clause 2.2.3.2 (b), being vegetation that is less than 1 ha in size and not within 100 m of any other areas of classified vegetation.

3.2.2 Effective slope

Effective slope under classified vegetation was assessed within the assessment area through on-ground verification on 25 July 2023 in accordance with AS3959. Results were cross-referenced with DPIRD 1–5 m contour data, as depicted in Plate 2.

The assessment area is generally flat, ranging predominantly between 1–3 mAHD; however, there are two noticeable short, sharp level changes that have been assigned a downslope of >0–5 degrees as a precaution, including:

- an elongated, north-south orientated section along the western edge of the project area under Class C shrubland and Class D scrub vegetation
- an elongated, east-west orientated section along Babbage Island Road to the north of the project area under Class D scrub vegetation.

All other land was assessed to be flat or upslope in relation to the project area.

Plate 2: Topographic contours across the assessment area (DPIRD 2019)

3.2.3 Summary of pre-development inputs

A summary of the pre-development classified vegetation, exclusions and effective slope within the assessment area are listed in Table 3 and illustrated in Figure 3.

Table 3: Pre-development vegetation classifications/exclusions and effective slope

Vegetation Plot	Vegetation classification/ exclusion	Effective slope under the classified vegetation	Comments
1	Class D Scrub	Downslope >0–5°	Scrub vegetation 2–6 m in height with a continuous horizontal fuel profile
2	Class D Scrub	Flat/upslope (0°)	Scrub vegetation 2–6 m in height with a continuous horizontal fuel profile
3	Class C Shrubland	Downslope >0–5°	Shrub vegetation less than 2 m in height with a continuous horizontal fuel profile
4	Class C Shrubland	Flat/upslope (0°)	Shrub vegetation less than 2 m in height with a continuous horizontal fuel profile
5	Class G Grassland	Flat/upslope (0°)	Grasses and weeds greater than 100 mm in height at maturity
6	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Existing non-vegetated areas (i.e. buildings, roads, tracks, water bodies, footpaths, driveways, etc) and low threat managed vegetation (i.e. existing urban street verges, managed gardens, floodplains devoid of vegetation, etc)

3.2.4 Summary of post-development inputs

A summary of the anticipated post-development classified vegetation, exclusions and effective slope within the assessment area are listed in Table 4 and illustrated in Figure 4.

Table 4: Post-development vegetation classifications/exclusions and effective slope

Vegetation Plot	Vegetation classification/ exclusion	Effective slope under the classified vegetation	Comments
1	Class D Scrub	Downslope >0–5°	Scrub vegetation 2–6 m in height with a continuous horizontal fuel profile
2	Class D Scrub	Flat/upslope (0°)	Scrub vegetation 2–6 m in height with a continuous horizontal fuel profile
3	Class C Shrubland	Flat/upslope (0°)	Shrub vegetation less than 2 m in height with a continuous horizontal fuel profile
4	Class G Grassland	Flat/upslope (0°)	Grasses and weeds greater than 100 mm in height at maturity
5	Excluded – Clause 2.2.3.2 [b]	N/A	Single area of vegetation less than 1 ha in size and not within 100 m of any other areas of classified vegetation

Vegetation Plot	Vegetation classification/ exclusion	Effective slope under the classified vegetation	Comments
6	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Existing non-vegetated areas (i.e. buildings, roads, tracks, water bodies, footpaths, driveways, etc) and low threat managed vegetation (i.e. existing urban street verges, managed gardens, floodplains devoid of vegetation, etc)
7	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])	N/A	Areas to be modified to a non-vegetated/low threat managed state as part of proposed development

3.3 Assessment outputs

3.3.1 Bushfire Hazard Level assessment results

Pre-development results

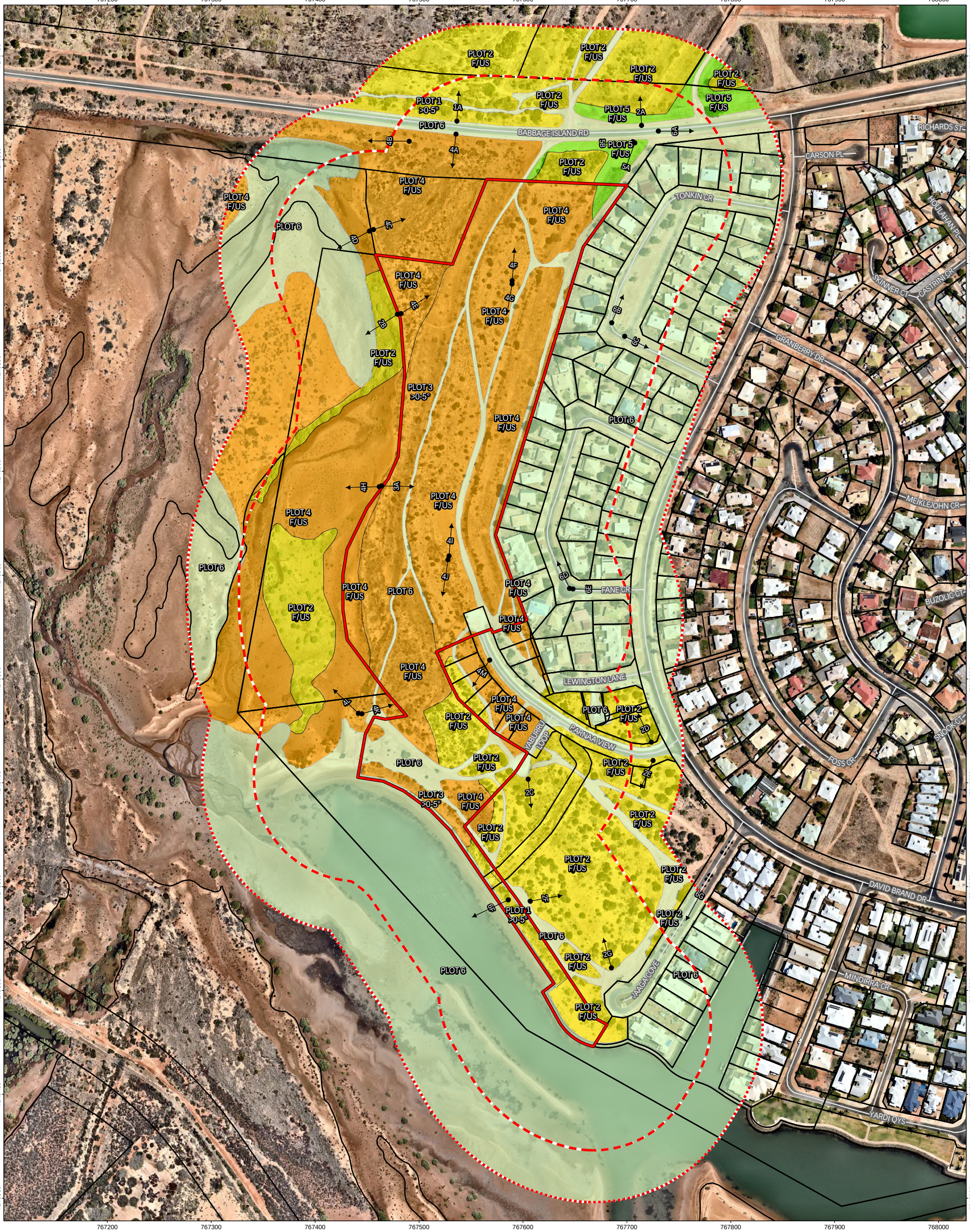
Pre-development BHLs have been mapped within the assessment area on the basis of the pre-development vegetation discussed in Section 3.2.3 and depicted in Figure 3. The pre-development BHL assessment map (Figure 5) demonstrates that existing land within the assessment area comprises a predominant **Moderate** BHL, with smaller pockets of **Extreme** BHL throughout areas of Class D scrub vegetation. Two areas are designated a **Low** BHL, with one over the existing Brockman residential estate to the east and another over the Carnarvon Fascine to the south.

Land with an Extreme BHL is not suitable for development and the Structure Plan provides a design response to the bushfire hazards to ensure no development occurs within these areas, as outlined below.

Post-development results

Post-development BHLs have been mapped within the assessment area on the basis of the anticipated post-development vegetation discussed in Section 3.2.4 and depicted in Figure 4.

The post-development BHL assessment map (Figure 6) demonstrates that all proposed development areas will be located on land with either a **Low** or **Moderate** BHL. This achieves compliance with Element 1 of the bushfire protection criteria of the Guidelines, as discussed in Section 5.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary

Vegetation classification

- Class C Shrubland
- Class D Scrub
- Class G Grassland
- Clause 2.2.3.2 (e) & (f)

- Photo point directions
- Minor road
- Track

JBS&G

0 100 metres

Lot 9001, David Brand Drive
Brockman, WA

PRE-DEVELOPMENT
VEGETATION CLASSIFICATION
AND EFFECTIVE SLOPE

Job Number: 64444		Scale 1:3,400 at A3	
Client: DevelopmentWA		Coord. Sys. GDA2020 MGA Zone 49	
Drawn By: jcrute	Checked By: ZC	Version: Rev A	Date: 05-Oct-2023

FIGURE: 3

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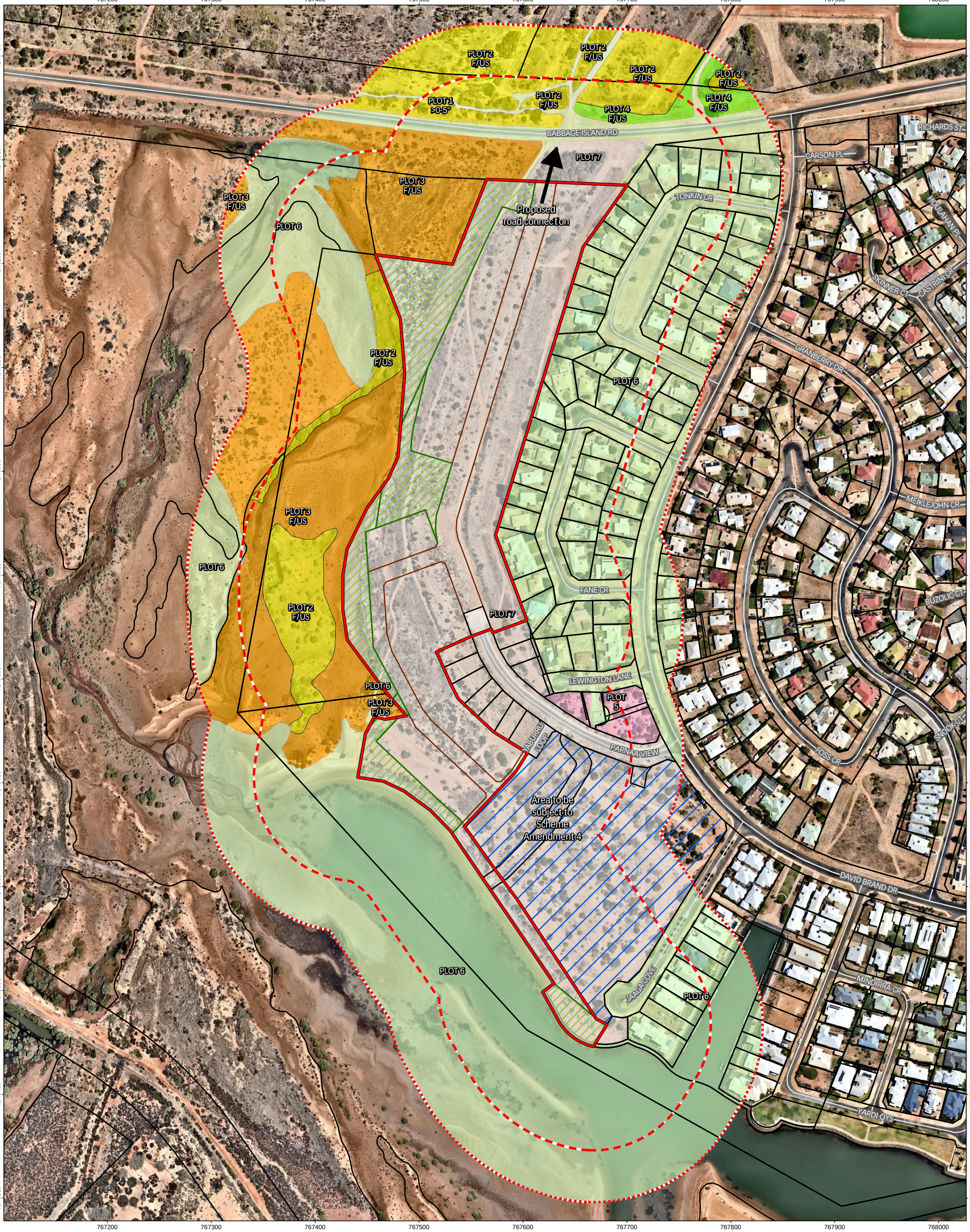
Image Reference: www.nearmap.com© - Imagery Date: 26. January 2023.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary
- POS
- Proposed cell layout
- Area to be subject to Scheme Amendment 4
- Minor road
- Track

Vegetation classification

- Class C Shrubland
- Class D Scrub
- Class G Grassland
- Clause 2.2.3.2 (b)
- Clause 2.2.3.2 (e) & (f)
- Area to be modified to non-vegetated and low threat state

JBS&G

0 100 metres

Lot 9001, David Brand Drive
Brockman, WA

POST-DEVELOPMENT
VEGETATION CLASSIFICATION
AND EFFECTIVE SLOPE

Job Number: 64444		Scale 1:3,400 at A3	
Client: DevelopmentWA		Coord. Sys. GDA2020 MGA Zone 49	
Drawn By: jcrute	Checked By: ZC	Version: Rev A	Date: 07-Feb-2024

FIGURE: 4

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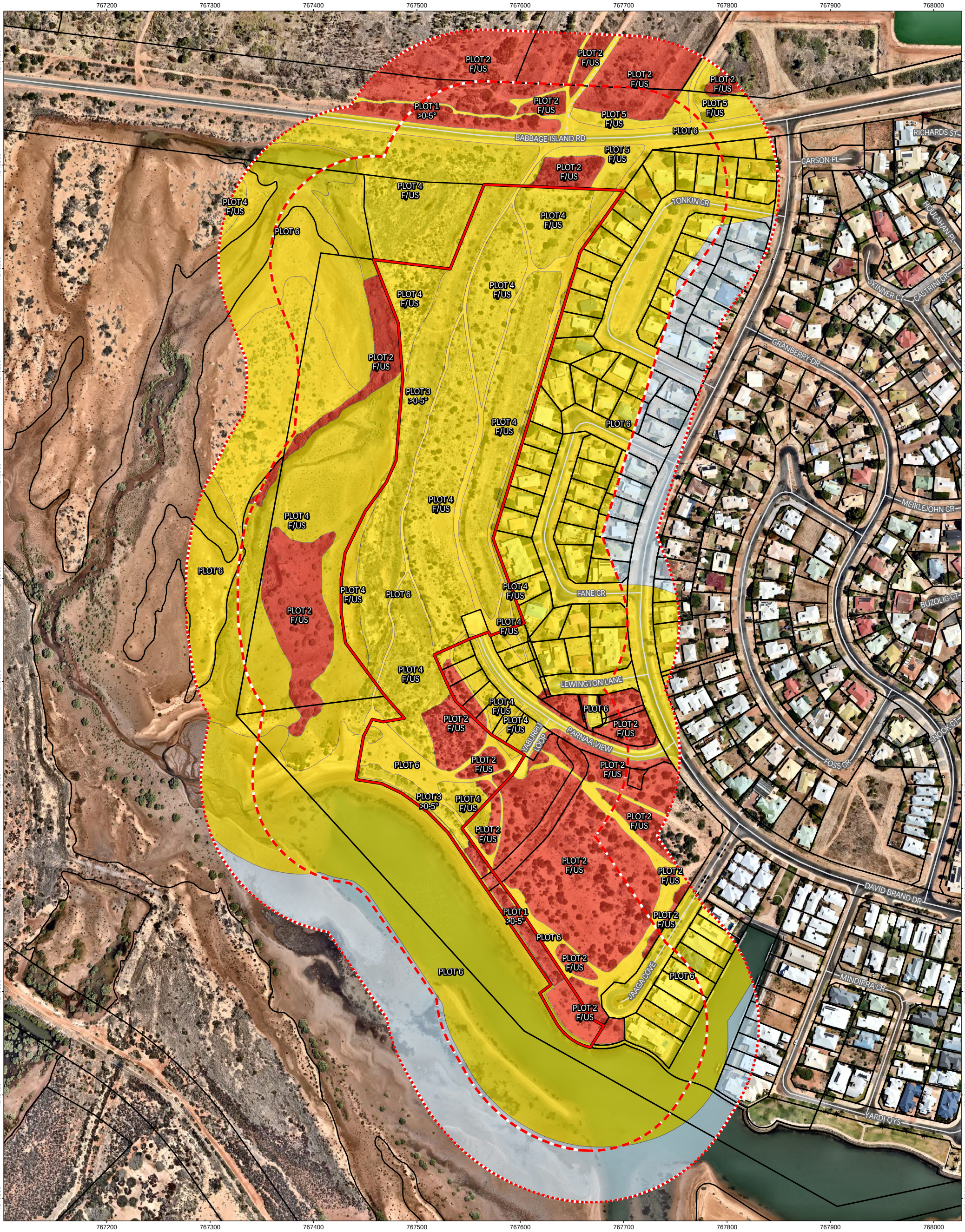
Image Reference: www.nearmap.com© - Imagery Date: 26. January 2023.



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary

Bushfire hazard level

- Extreme
- Moderate
- Low

- Minor road
- Track

JBS&G

0 100 metres

Lot 9001, David Brand Drive
Brockman, WA

PRE-DEVELOPMENT
BUSHFIRE HAZARD LEVELS

Job Number: 64444		Scale 1:3,400 at A3		
Client: DevelopmentWA		Coord. Sys. GDA2020 MGA Zone 49		
Drawn By: jcrute	Checked By: ZC	Version: Rev A	Date: 05-Oct-2023	FIGURE: 5

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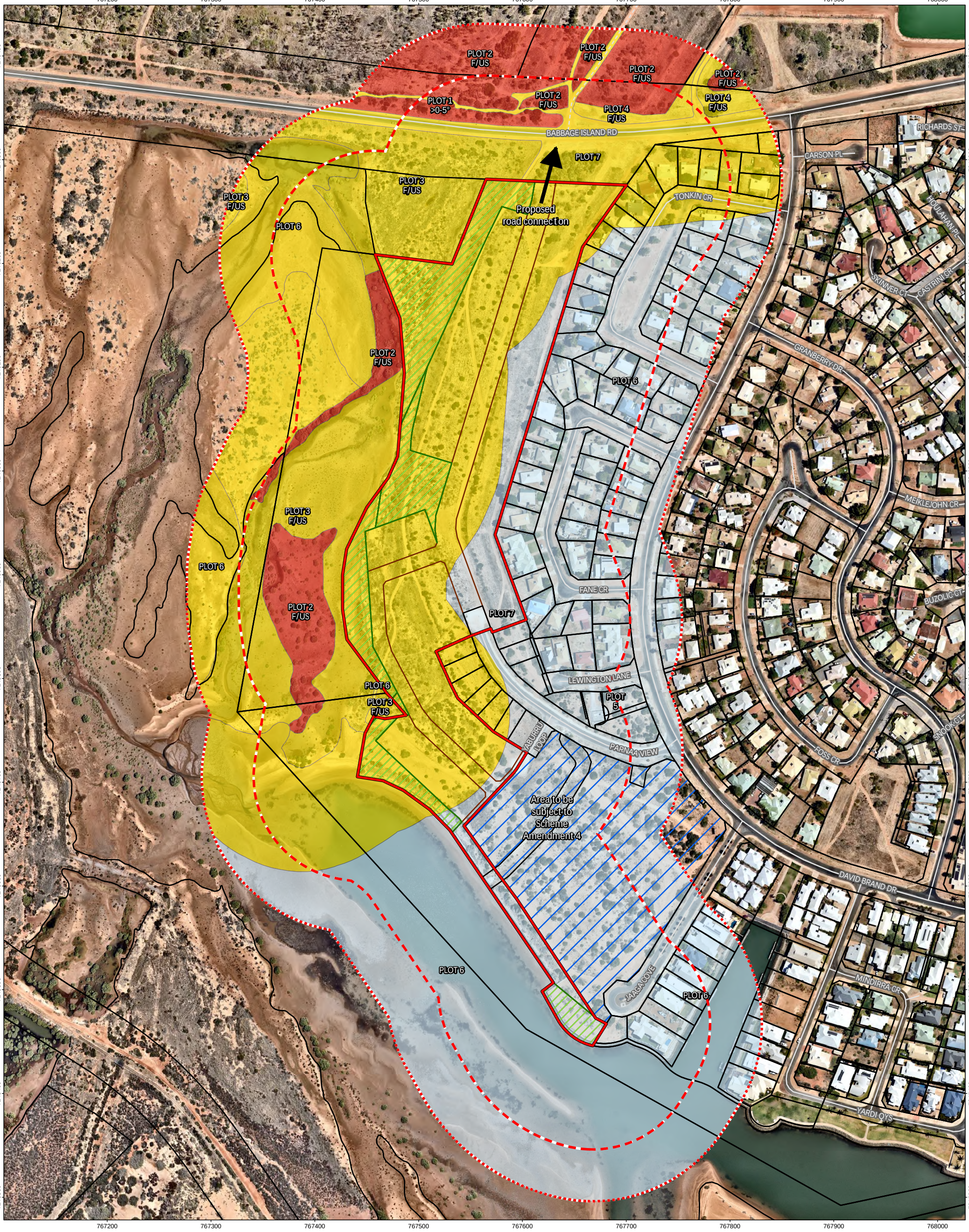

Legend

- Project area
- 100m assessment area
- 150m assessment area
- Cadastral boundary
- POS
- Proposed cell layout
- Area to be subject to Scheme Amendment 4
- Minor road
- Track

Bushfire hazard level

- Extreme
- Moderate
- Low

JBS&G

0 100 metres

Lot 9001, David Brand Drive
Brockman, WA

POST-DEVELOPMENT
BUSHFIRE HAZARD LEVELS

Job Number: 64444		Scale 1:3,400 at A3	
Client: DevelopmentWA		Coord. Sys. GDA2020 MGA Zone 49	
Drawn By: jcrute	Checked By: ZC	Version: Rev A	Date: 07-Feb-2024

FIGURE: 6

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Image Reference: www.nearmap.com© - Imagery Date: 26. January 2023.

4. Identification of bushfire hazard issues

4.1 Bushfire context

Whilst there is vegetation situated within and around the project area in the local vicinity and the broader Carnarvon Shire, there is not considered to be a landscape scale bushfire risk to the project area due to the following factors:

- the fire run to the north is approximately 275 m long (i.e. not landscape scale), fragmented by the Gascoyne River and Babbage Island Road
- there is no bushfire threat to the east due to the location of adjacent residential development
- there is limited bushfire threat to the west (fire run of up to 100 m through flood and salt-prone vegetation), fragmented by non-vegetated tidal/salt flats and water bodies
- there is no bushfire threat to the south due to the location of the Carnarvon Fascine and future residential area subject to Scheme Amendment 4.

In the broader landscape, the Carnarvon townsite is situated to the east and southeast of the project area and provides a substantial buffer to potential bushfire runs further east, which is fragmented additionally by significant infrastructure corridors of the Carnarvon airport and North West Coastal Highway. The broader fire run from the south is limited by the townsite and the Indian Ocean in Massey Bay. Horticultural plantations to the northeast are irrigated, increasing the low threat buffer in that direction, similar to the Gascoyne River and floodplain to the north. Babbage Island is situated west of the project area, which is separated by a causeway and floodplain that is dry and largely non-vegetated and provide a substantial buffer to vegetation situated further west towards the coastline.

4.2 Bushfire hazard issues

Examination of strategic development design in accordance with the Structure Plan, bushfire context and pre/post-development BHL assessment has identified the following bushfire hazard issues to be considered at future planning stages (i.e. subdivision).

4.2.1 Land with an Extreme BHL

The project area contains pre-development Extreme BHL not suitable for habitable development. However, the post-development BHL assessment demonstrates that on completion of development, all habitable development areas will be located on land with a Low or Moderate BHL (Figure 4). A BAL contour assessment will be commissioned at future planning stages (i.e. subdivision) to demonstrate at a more detailed level that all development will be located within areas of BAL-29 or below. Therefore, the development can comply with Acceptable Solution A1.1 of the Guidelines.

4.2.2 Post-development on-site vegetation

Development design is likely to include minor replanting throughout landscaped POS areas; however, as stated in Section 2.3, this will result in establishment of low threat vegetation that will be excludable under Clause 2.2.3.2 of AS3959, as depicted in the Landscape Masterplan contained in Appendix A. A detailed landscape plan will need to be prepared at the subdivision and/or clearance stage that confirms the anticipated low threat POS areas.

All other land within the project area is anticipated to be modified to a non-vegetated/low threat managed state through clearing, earthworks and construction of roads and residential lots. Land directly abutting the project area to the south/southeast is subject to future residential development under Scheme Amendment 4 (as depicted in Figure 1) and is therefore considered to represent a temporary bushfire risk that will ultimately be removed. Staging provisions (as stated in Section 4.2.5) will be adopted to manage this risk.

4.2.3 Habitable building setbacks

Applicable of setbacks to habitable buildings from external sources of classified vegetation required to achieve BAL-29 will be determined through site-specific BAL contour map analysis at the subdivision stage, but are likely to be:

Vegetation classification (post-development)	Effective slope	Separation to achieve BAL-29
Class D Scrub	Flat/ Upslope	13 m
	Downslope >0–5 degrees	15 m
Class C Shrubland	Flat/ Upslope	9 m
Class G Grassland	Flat/ Upslope	8 m

4.2.4 Vehicular access

Proposed Structure Plan design in Figure 1 depicts extension of Parnaa View from south to north. This will provide through access for the project area between David Brand Drive in the southeast to Babbage Island Road in the north; therefore providing two access routes for the project area.

A no-through road greater than 200 m in length is proposed in the southwest of the project area; however, this is temporary subject to future staged connection with adjacent residential development to the southeast subject to Scheme Amendment 4, which will ultimately deliver through access (as depicted in Figure 1).

The existing and future road network will largely provide perimeter access to the surrounding bushfire hazards. For the three residential cells in the western portion of the project area that will not have a public perimeter road, the adjacent low threat POS areas will provide a separation from classified vegetation sufficient to achieve BAL-29 or lower.

4.2.5 Implications of staged development

As the project area currently contains classified vegetation, staged clearance and construction is to consider the BAL impacts from adjacent future stages that have not yet been developed. Low threat staging buffers may need to be implemented around the current stage of development to ensure there is no residual impact from vegetation that has not yet been cleared or landscaped to achieve a low threat state.

If development within the project area is staged, design is to ensure that at least two publicly available vehicular access routes to two different suitable destinations are provided. This may require provision of temporary staging measures such as temporary compliant no-through roads and/or Emergency Access Ways (EAWs) to deliver compliant access outcomes for individual stages.

4.2.6 Fire water supply

The Structure Plan area will need to be provided with a firefighting water supply that is suitable for the scale of the development. The local area is currently provided with a reticulated hydrant system that will be extended around the development in accordance with the proposed road network and Water Corporation design standards.

4.2.7 Conclusion

On the basis of the above information, JBS&G considers the bushfire hazards within and adjacent to the project area and the associated bushfire risks are readily manageable through standard bushfire management responses outlined under Guideline acceptable solutions, as reinforced through the strategic level bushfire management strategies outlined in this BMP. These responses have been factored in to proposed development early in the planning process to ensure a suitable, compliant and effective bushfire management outcome is achieved for protection of future life and property assets.

5. Assessment against the bushfire protection criteria

5.1 Compliance with Elements 1–4

Compliance with Elements 1–4 of the bushfire protection criteria of the Guidelines (Version 1.4) will be demonstrated at future planning stages by meeting the acceptable solutions, as detailed in Table 5.

Table 5: Compliance with the bushfire protection criteria of the Guidelines (Elements 1–4)

Bushfire protection criteria	Performance Principle	Method of compliance Acceptable solutions	Statement of development compliance	Compliance achievable at future planning stages
Element 1: Location	**P1** – The strategic planning proposal, subdivision and development application is located in an area where the bushfire hazard assessment is or will, on completion, be moderate or low, or a BAL–29 or below, and the risk can be managed. For unavoidable development in areas where BAL–40 or BAL–FZ applies, demonstrating that the risk can be managed to the satisfaction of the decision-maker.	**A1.1 Development location** The strategic planning proposal, subdivision and development application is located in an area that is or will, on completion, be subject to either a moderate or low bushfire hazard level, or BAL–29 or below.	The pre-development BHL assessment (Figure 5) identifies that the project area currently contains land with Low, Moderate and Extreme BHLs. However, on completion of development, it is expected that the on-site classified vegetation extent will be modified to a non-vegetated/low threat managed state (as per Figure 6). Therefore, post-development BHLs are expected to be reduced to Low or Moderate in locations of proposed habitable development. Consideration will need to be given at the subdivision stage to external classified vegetation and the appropriate setbacks for habitable development to achieve a maximum of BAL-29. The proposed road and low threat POS interfaces proposed between areas of habitable development and external classified vegetation are considered sufficient to ensure that all future habitable development can achieve BAL-29 or lower. This will be confirmed through detailed BAL contour analysis at the subdivision stage.	✓
Element 2: Siting and design	**P2** – The siting and design of the strategic planning proposal, subdivision or development application, including roads, paths and landscaping, is appropriate to the level of bushfire threat that applies to the site. The proposal incorporates a defendable space and significantly reduces the heat intensities at the building surface thereby minimising the bushfire risk to people, property and infrastructure, including compliance with AS 3959 if appropriate.	**A2.1 Asset Protection Zone** Every habitable building is surrounded by, and every proposed lot can achieve, an APZ depicted on submitted plans, which meets the requirements set out in Schedule 1.	Low threat separation required for future habitable development to achieve BAL—29 or lower is to be implemented for all relevant lots through the proposed perimeter road and low threat POS interfaces. The required low threat separation will be identified at future planning stages based on future subdivision/development design and following a BAL contour assessment. Low threat separation is to be implemented and maintained in accordance with Schedule 1 of the Guidelines (Appendix C).	✓
Element 3: Vehicular access	**P3i** – The design and capacity of vehicular access and egress is to provide for the community to evacuate to a suitable destination before a bushfire arrives at the site, allowing emergency services personnel to attend the site and/or hazard vegetation.	**A3.1 Public roads** *The minimum requirements under this acceptable solution are applicable to all proposed and existing public roads.* Public roads are to meet the minimum technical requirements in Table 6, Column 1. The trafficable (carriageway/pavement) width is to be in accordance with the relevant class of road in the Local Government Guidelines for Subdivisional Development (IPWEA Subdivision Guidelines), Liveable Neighbourhoods, Austroad	Provisions for the construction of future public roads to relevant technical requirements under the Guidelines (refer to A3.1 and Appendix D) are to be made at the subdivision stage of planning.	✓

Bushfire protection criteria	Performance Principle	Method of compliance Acceptable solutions	Statement of development compliance	Compliance achievable at future planning stages
		standards and/or any applicable standards for the local government area.		
		A3.2a Multiple access routes Public road access is to be provided in two different directions to at least two different suitable destinations with an all-weather surface (two-way access). If the public road access to the subject site is via a no-through road which cannot be avoided due to demonstrated site constraints, the road access is to be a maximum of 200 metres from the subject lot(s) boundary to an intersection where two-way access is provided. The no-through road may exceed 200 metres if it is demonstrated that an alternative access, including an emergency access way, cannot be provided due to site constraints and the following requirements are met: • the no-through road travels towards a suitable destination; and • the balance of the no-through road, that is greater than 200 metres from the subject site, is wholly within BAL-LOW, or is within a residential built-out area – Figure 23.	On completion of the development, the existing and future public road network will provide all occupants with the option of travelling to multiple suitable destinations as detailed below: • Parnaa View heading north to Babbage Island Road, leading east via Robinson Street to the North West Coastal Highway and roads heading north and east • access via David Brand Drive to central Carnarvon and via Carnarvon Road and HMAS Sydney II Memorial Ave to the North West Coastal Highway southwards.	✓
		A3.2b Emergency access way *Where it is demonstrated that A3.2a cannot be achieved due to site constraints, or where an alternative design option does not exist, an emergency access way can be considered as an acceptable solution.* An emergency access way is to meet all the following requirements: • requirements in Table 6, Column 2; • provides a through connection to a public road; • be no more than 500 metres in length; and • must be signposted and if gated, gates must open the whole trafficable width and remain unlocked.	No permanent EAWs are proposed as part of the development. Any temporary EAWs required as a result of staged development are to be constructed to the relevant technical requirements of the Guidelines (see A3.2b and Appendix D).	✓
		A3.3 Through-roads All public roads should be through-roads. No-through roads should be avoided and should only be considered as an acceptable solution where: • it is demonstrated that no alternative road layout exists due to site constraints; and • the no-through road is a maximum length of 200 metres to an intersection providing two-way access, unless it satisfies the exemption provisions in A3.2a of this table.	Conceptual development design indicates that all roads in the project area will be through roads in accordance with provisions of Appendix D, noting that the temporary no-through road proposed in the southwest of the project area will be resolved following connection with the broader road network to the south subject to Scheme Amendment 4.	✓

Bushfire protection criteria	Performance Principle	Method of compliance Acceptable solutions	Statement of development compliance	Compliance achievable at future planning stages
		A no-through road is to meet all the following requirements: • requirements of a public road (Table 6, Column 1); and • turn-around area as shown in Figure 24.		
	P3ii – The design of vehicular access and egress provides: • access and egress for emergency service vehicles while allowing the community to evacuate; • a defendable space for emergency services personnel on the interface; • between classified vegetation and development site; and • hazard separation between classified vegetation and the subject site to reduce the potential radiant heat that may impact a lot(s).	**A3.4a Perimeter roads** A perimeter road is a public road and should be provided for greenfield or infill development where 10 or more lots are being proposed (including as part of a staged subdivision) with the aim of: • separating areas of classified vegetation under AS3959, which adjoin the subject site, from the proposed lot(s); and • removing the need for battle-axe lots that back onto areas of classified vegetation. A perimeter road is to meet the requirements contained in Table 6, Column 1. A perimeter road may not be required where: • the adjoining classified vegetation is Class G Grassland; • lots are zoned for rural living or equivalent; • it is demonstrated that it cannot be provided due to site constraints; or • all lots have frontage to an existing public road.	The existing and future road network will largely provide perimeter access to the surrounding bushfire hazards in accordance with Appendix D. For the three residential cells in the western portion of the project area that will not have a public perimeter road, the adjacent low threat POS areas will provide a separation from classified vegetation sufficient to achieve BAL-29 or lower.	✓
	P3iii – Vehicular access is provided which allows: • access and egress for emergency service vehicles; • defendable space for emergency services; • personnel on the interface between classified vegetation and development; and • hazard separation between classified vegetation and the site to reduce the potential radiant heat that may impact a lot(s).	**A3.4b Fire service access route** *Where proposed lots adjoin classified vegetation under AS3959 (excluding Class G Grassland), and a perimeter road is not required in accordance with A3.4a, a fire service access route can be considered as an acceptable solution to provide firefighter access, where access is not available, to the classified vegetation.* A fire service access route is to meet all the following requirements: • requirements in Table 6, Column 3; • be through-routes with no dead-ends; • linked to the internal road system at regular intervals, every 500 metres; • must be signposted; • no further than 500 metres from a public road; • if gated, gates must open the required horizontal clearance and can be locked by the local government and/or emergency services, if keys are provided for each gate; and • turn-around areas designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres.	FSARs are not required as proposed lots will not adjoin classified vegetation.	N/A

Bushfire protection criteria	Performance Principle	Method of compliance Acceptable solutions	Statement of development compliance	Compliance achievable at future planning stages
	P3iv – Vehicular access is provided which allows emergency service vehicles to directly access all habitable buildings and water supplies and exit the lot without entrapment.	**A3.5 Battle-axe access legs** *Where it is demonstrated that a battle-axe cannot be avoided due to site constraints, it can be considered as an acceptable solution.* There are no battle-axe technical requirements where the point the battle-axe access leg joins the effective area of the lot, is less than 50 metres from a public road in a reticulated area. In circumstances where the above condition is not met, or the battle-axe is in a non-reticulated water area, the battle-axe is to meet all the following requirements: • requirements in Table 6, Column 4; and • passing bays every 200 metres with a minimum length of 20 metres and a minimum additional trafficable width of two metres (i.e. the combined trafficable width of the passing bay and constructed private driveway to be a minimum six metres).	N/A - Battle-axe access legs are a subdivision stage consideration.	N/A
		A3.6 Private driveways There are no private driveway technical requirements where the private driveway is: • within a lot serviced by reticulated water; • no greater than 70 metres in length between the most distant external part of the development site and the public road measured as a hose lay; and • accessed by a public road where the road speed limit is not greater than 70 km/h. In circumstances where all of the above conditions are not met, or the private driveway is in a non-reticulated water area, the private driveway is to meet all the following requirements: • requirements in Table 6, Column 4; • passing bays every 200 metres with a minimum length of 20 metres and a minimum • additional trafficable width of two metres (i.e. the combined trafficable width of the passing bay and constructed private driveway to be a minimum six metres); and • turn-around area as shown in Figure 28 and within 30 metres of the habitable building.	N/A – Private driveways are a DA stage consideration.	N/A
Element 4: Water	No performance principle applies	**A4.1 Identification of future water supply** Evidence that a reticulated or sufficient non-reticulated water supply for bushfire fighting can be provided at the subdivision and/or development application stage, in accordance with the specifications of the relevant water supply authority or the requirements of Schedule 2. Where the provision of a strategic water tank(s) is required a suitable area within a road reserve or a dedicated lot the location	Reticulated water supply services are expected to be extended throughout the project area from services currently present within surrounding areas of development, which will result in provision of a reticulated mains water supply for future habitable development consistent with Water Corporation Design Standard 63 requirements.	✓

Bushfire protection criteria	Performance Principle	Method of compliance Acceptable solutions	Statement of development compliance	Compliance achievable at future planning stages
		should be identified, should be identified on the structure plan, to the satisfaction of the local government.		
	P4 – Provide a permanent water supply that is: • sufficient and available for firefighting purposes; • constructed from non-combustible materials (e.g. steel), or able to maintain its integrity throughout a bushfire; and • accessible, with legal access for maintenance and re-filling by tankers and emergency service vehicles.	**A4.2 Provision of water for firefighting purposes** Where a reticulated water supply is existing or proposed, hydrant connection(s) should be provided in accordance with the specifications of the relevant water supply authority. Where these specifications cannot be met, then the following applies: • The provision of a water tank(s), in accordance with the requirements of Schedule 2; and • Where the provision of a strategic water tank(s) is applicable, then the following requirements apply: – land to be ceded free of cost to the local government for the placement of the tank(s); – the lot or road reserve where the tank is to be located is identified on the plan of subdivision; – tank capacity, construction, and fittings, provided in accordance with the requirements of Schedule 2; and – a strategic water tank is to be located no more than 10 minutes from the subject site (at legal road speeds). Where a subdivision includes an existing habitable building(s) that is to be retained, a water supply should be provided to this existing habitable building(s), in accordance with the requirements listed above.	N/A – Provision of water for fire-fighting services is a subdivision and DA stage consideration.	N/A

5.2 Compliance with Element 5

Element 5 relates specifically to vulnerable tourism land uses and is therefore not applicable to the proposed Structure Plan application.

6. Responsibilities for implementation and management of the bushfire measures

This BMP has been prepared as a strategic guide to demonstrate how development compliance will be delivered at future planning stages in accordance with the Guidelines, where required. Aside from the preparation of future BMPs to accompany future subdivision applications where required, there are no further items to implement, enforce or review at this strategic stage of the planning process. The preparation of a further BMP will not be required for subsequent subdivision and development stages except where the application area is designated as bushfire prone as per the state map of bushfire prone areas.

Future BMPs prepared for subsequent subdivision applications are to meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measure 6.4) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions or meet the performance requirements of the Guidelines. Future BMPs are to include the following detailed information:

- proposed lot layout, including any public open space (POS) areas
- detailed landscaping plans in regard to POS areas to demonstrate the expected low threat vegetation outcomes under Clause 2.2.3.2
- confirmation of post-development classified vegetation extent, effective slope and separation distances to proposed habitable development
- BAL contour map demonstrating that proposed development areas will achieve a rating of BAL–29 or lower
- width and alignment of compliant APZs, including any APZ setback requirements into proposed lots
- confirmation of how bushfire management will be addressed regarding temporary bushfire hazards on adjacent future development stages, including low threat staging buffers or temporary quarantining of lots where required, if development is staged
- vehicular access provisions, including demonstration that a minimum of two access routes will be achieved for each stage of development in accordance with acceptable solution A3.1 (may require consideration of temporary compliant access provisions such as no-through roads/EAWs)
- provisions for bushfire notification on Title for any future lots with a rating of BAL-12.5 or greater as a condition of subdivision
- compliance requirements with the annual Shire of Carnarvon firebreak notice (see Appendix E)
- assessment against the bushfire protection criteria of the Guidelines
- proposed implementation and audit program outlining all measures requiring implementation and the appropriate timing and responsibilities for implementation.

On the basis of the information contained in this BMP, JBS&G considers the bushfire hazards within and adjacent to the project area and the associated bushfire risks are readily manageable through application of standard acceptable solutions outlined in the Guidelines, which will be implemented as required throughout future planning stages. JBS&G considers that on implementation of the proposed management measures, the site will be able to be developed with a manageable level of bushfire risk whilst maintaining full compliance with the Guidelines.

7. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquires.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

8. References

Department of Fire and Emergency Services (DFES) 2021, *Map of Bush Fire Prone Areas*, [Online], Government of Western Australia, available from: https://maps.slip.wa.gov.au/landgate/bushfireprone/, [19/09/2023].

Department of Planning (DoP) 2016, *Visual guide for bushfire risk assessment in Western Australia*, Department of Planning, Perth.

Standards Australia (SA) 2018, *Australian Standard AS 3959–2018 Construction of Buildings in Bushfire-prone Areas*, Standards Australia, Sydney.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC) 2021, *Guidelines for Planning in Bushfire Prone Areas*, Version 1.4 December 2021, Western Australian Planning Commission, Perth.

Appendix A Landscape Masterplan

NOTE:
FOR AREAS PROPOSED TO BE LANDSCAPED WITH 'SHADE TREES & COASTAL PLANTING TO LOT BOUNDARY', LANDSCAPING WILL NEED TO ACHIEVE A 'LOW THREAT VEGETATION' OUTCOME AS PER CLAUSE 2.2.3.2 OF AS3959 AND/OR THE ASSET PROTECTION ZONE (APZ) REQUIREMENTS OUTLINED UNDER ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT OF THE GUIDELINES FOR PLANNING IN BUSHFIRE PRONE AREAS (2021).

CARNARVON NORTHWATER
STAGE 4 & 5 MASTERPLAN

DWG **CARN-01-01**
REV **B**
DATE **APRIL 23**

0 10 20 30 40 50 m

SCALE **1 : 1000 @ A1**

emerge ASSOCIATES

LEGEND

- EXTENT OF WORKS
- CONCRETE PATH
- SHRUB PLANTING
- TURF
- COLOURED CONCRETE
- STONE PITCHING
- PROPOSED STREET TREES
- PROPOSED TREES
- GRAVEL BANDING

GROUND COVER SPECIES

Acacia gregorii
Gregory's Wattle

Ptilotus exaltatus
Pink Mula Mula

Eremophila glabra
'Kalbarri Carpet'

Swansonia formosa
Sturt Desert Pea

SHRUB SPECIES

Marsdenia australia
'Silky Pear'

Gomphrena canescens
Batchelors Buttons

Grevillea crithmifolia
'Green Carpet'

Lomandra longifolia
'Tanika'

Senna artemisoides
Silver Cassia

Scaevola crassifolia
Thick Leaved Fan Flower

Triodia pungens
Soft Spinifex

Westringia fruticosa
Coastal Rosemary

TREE SPECIES

Corymbia hamersleyana
'Pilbara bloodwood'

Melaleuca argentea
'Silver-leaved paper-bark'

Eucalyptus victrix
Coolibah

Allocasuarina decaisneana
'Desert Oak'

NOTE:
FOR AREAS PROPOSED TO BE LANDSCAPED WITH 'SHADE TREES & COASTAL PLANTING TO LOT BOUNDARY', LANDSCAPING WILL NEED TO ACHIEVE A 'LOW THREAT VEGETATION' OUTCOME AS PER CLAUSE 2.2.3.2 OF AS3959 AND/OR THE ASSET PROTECTION ZONE (APZ) REQUIREMENTS OUTLINED UNDER ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT OF THE GUIDELINES FOR PLANNING IN BUSHFIRE PRONE AREAS (2021).

CARNARVON NORTHWATER
STAGE 4 & 5 MASTERPLAN

DWG **CARN-01-02**
REV **B**
DATE **APRIL 23**
SCALE **1 : 1000 @ A1**
0 10 20 30 40 50 m

emerge ASSOCIATES

Appendix B Georeferenced site photos and descriptions

Plot 1	
Vegetation classification	Class D Scrub (Downslope >0–5°)
Description / justification	Scrub vegetation 2–6 m in height with a continuous horizontal fuel profile

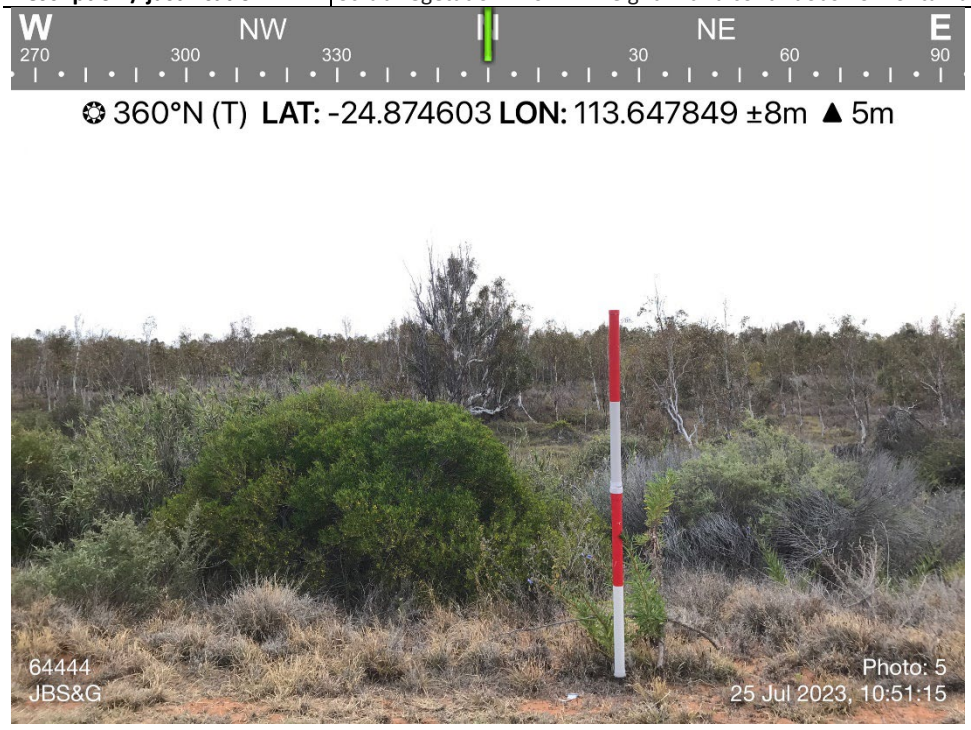
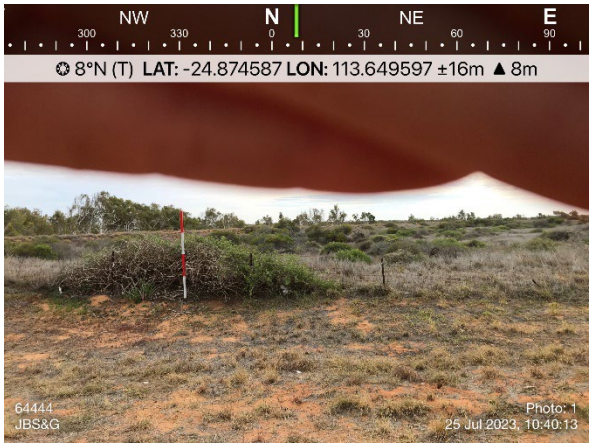


Photo ID: 1a

Plot 2	
Vegetation classification	Class D Scrub (Flat/Upslope)
Description / justification	Scrub vegetation 2–6 m in height with a continuous horizontal fuel profile



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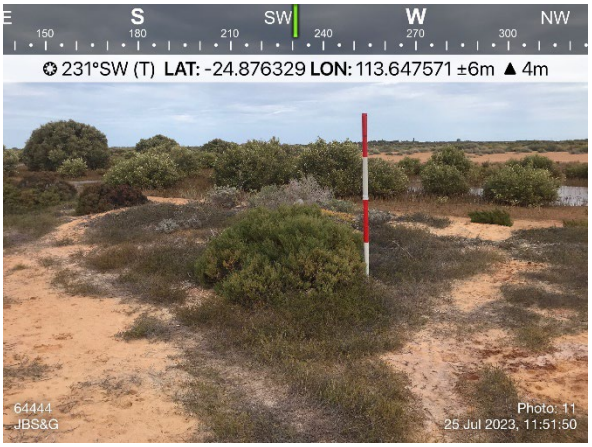

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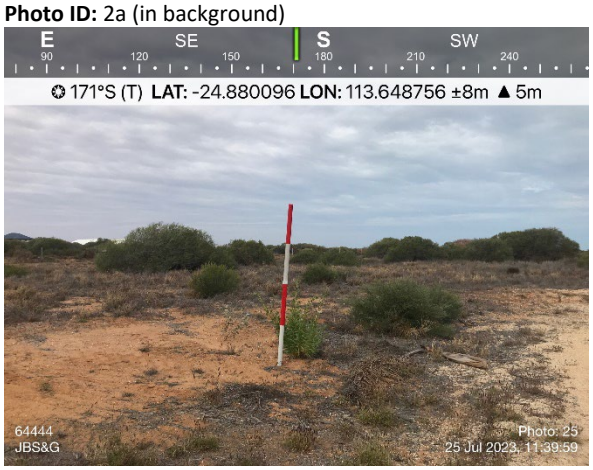

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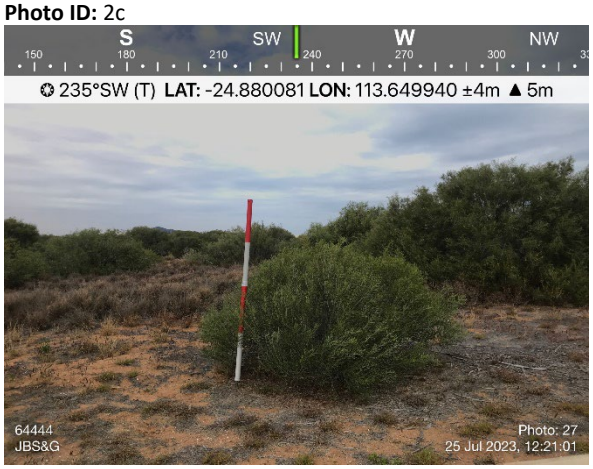

Photo ID: 2e

Photo ID: 2f

Plot 2	
 **Photo ID:** 2g	

Plot 3	
Vegetation classification	Class C Shrubland (Downslope >0–5°)
Description / justification	Shrub vegetation less than 2 m in height with a continuous horizontal fuel profile

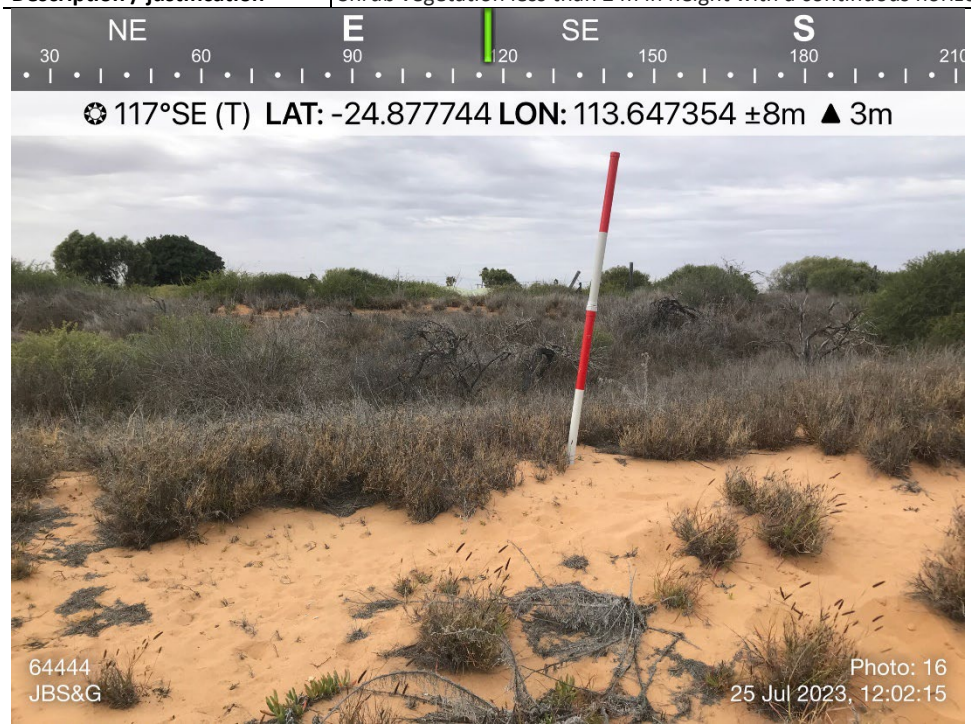

Photo ID: 3a

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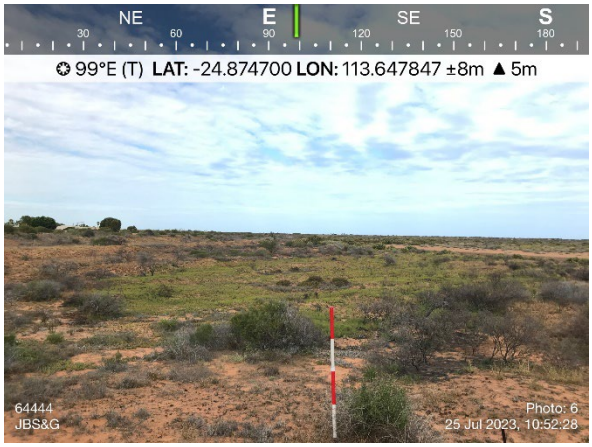
Vegetation classification	Class C Shrubland (Flat/Upslope)
Description / justification	Shrub vegetation less than 2 m in height with a continuous horizontal fuel profile



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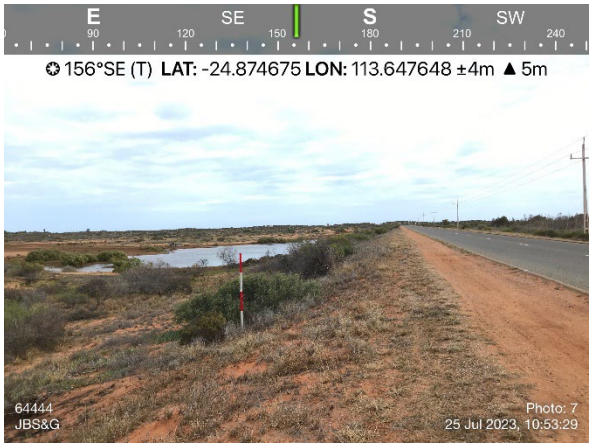

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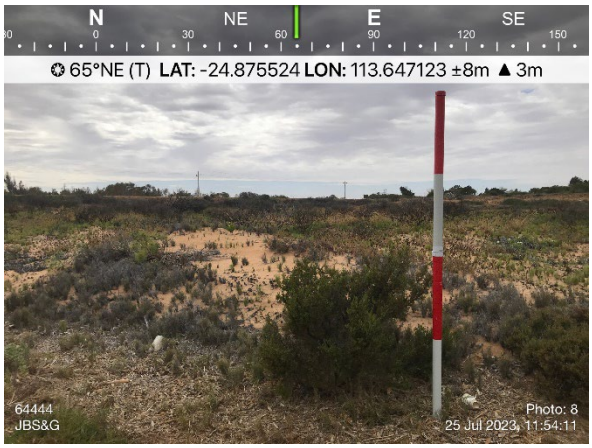

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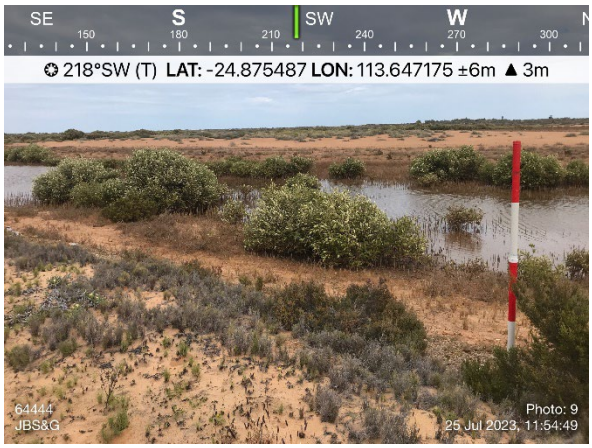

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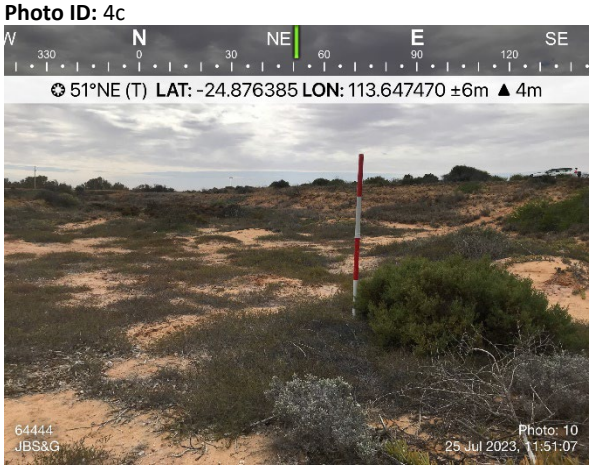

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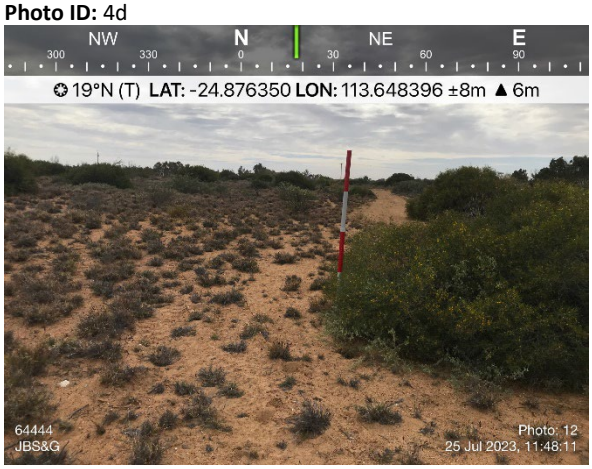

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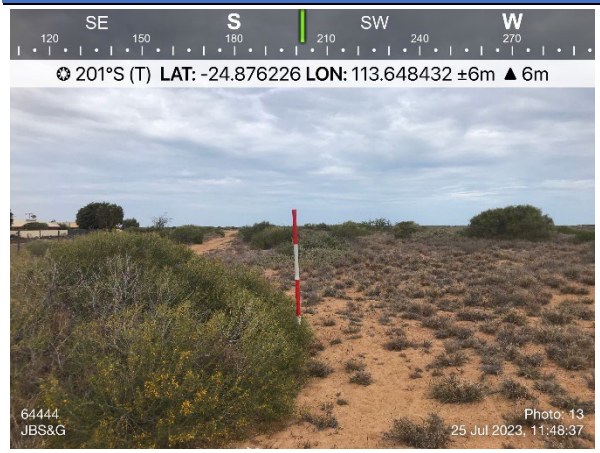
Plot 4



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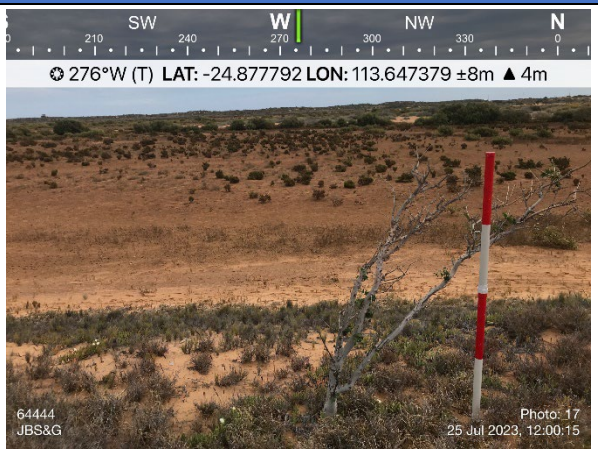

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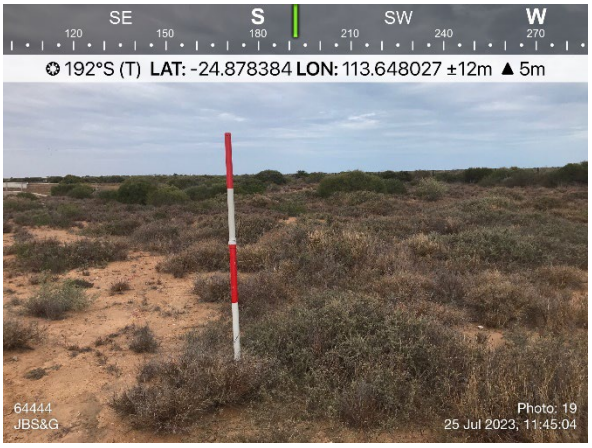

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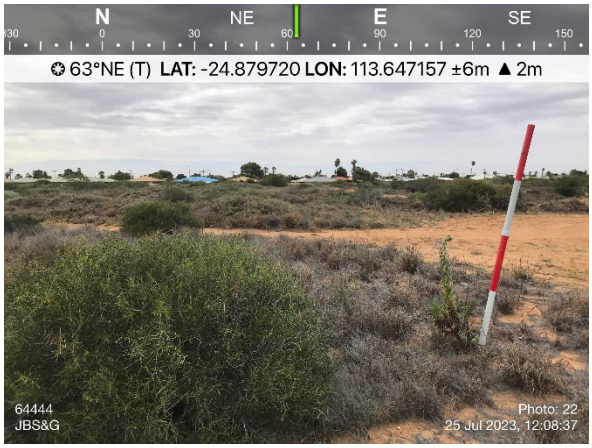

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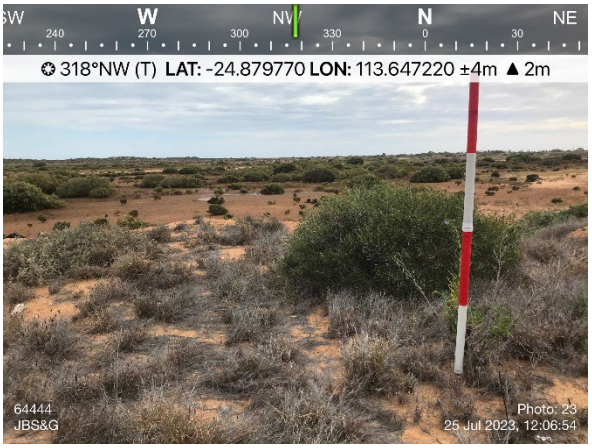

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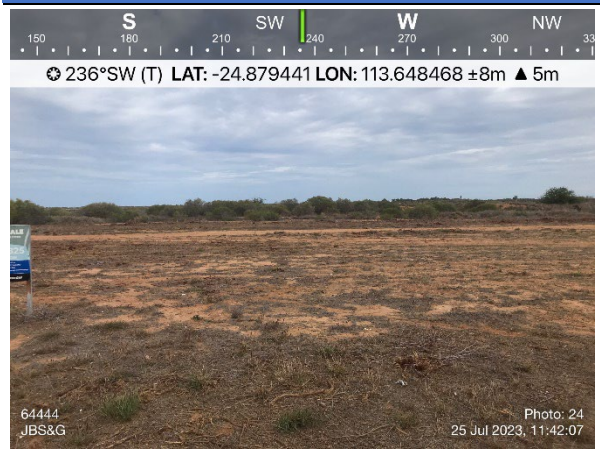
 **Photo ID:** 4m	

Plot 5	
Vegetation classification	Class G Grassland (Flat/Upslope)
Description / justification	Grasses and weeds greater than 100 mm in height at maturity

Photo ID: 5a

Photo ID: 5b

Plot 6	
Vegetation classification	Excluded – Non-vegetated and Low threat (Clause 2.2.3.2 [e] and [f])
Description / justification	Existing non-vegetated areas (i.e. buildings, roads, tracks, water bodies, footpaths, driveways, etc) and low threat managed vegetation (i.e. existing urban street verges, managed gardens, floodplains devoid of vegetation, etc)

Photo ID: 6a

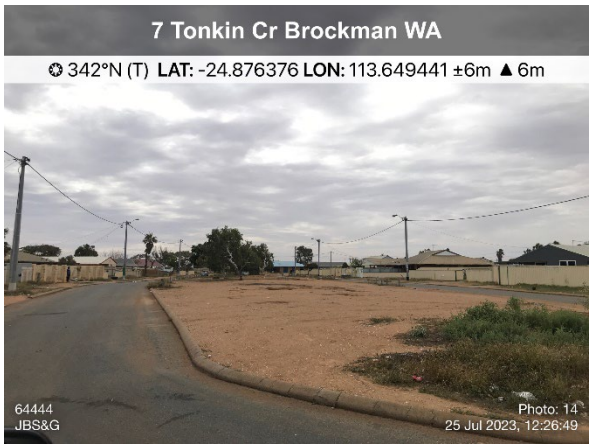
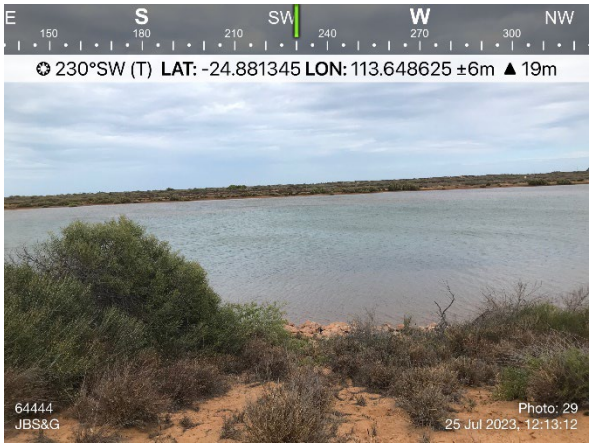


Photo ID: 6b

Photo ID: 6c

Photo ID: 6d

Photo ID: 6e



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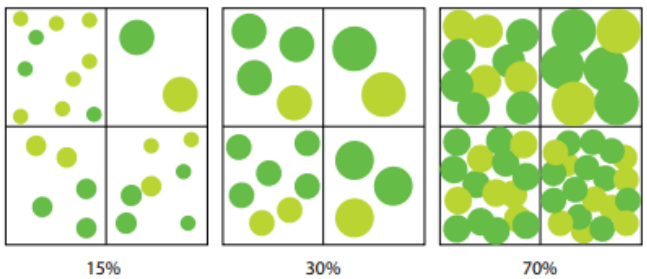
Plot 6	
 **Photo ID:** 6g	

Appendix C Asset Protection Zone standards and explanatory notes

Schedule 1: Standards for Asset Protection Zones	
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 <6 millimetres in thickness)	• Should be managed and removed on a regular basis to maintain a low threat state. • Should be maintained at <2 tonnes per hectare (on average). • Mulches should be non-combustible such as stone, gravel or crushed mineral earth or wood mulch >6 millimetres in thickness.
Trees* (>6 metres 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 <15 per cent of the total APZ area. • Tree canopies at maturity should be at least five metres apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided that the total canopy cover within the APZ will not exceed 15 per cent and are not connected to the tree canopy outside the APZ. **Figure 19:** Tree canopy cover – ranging from 15 to 70 per cent at maturity 
Shrub* and scrub* (0.5 metres to six metres in height). Shrub and scrub >6 metres 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 >5 square metres in area. • Clumps should be separated from each other and any exposed window or door by at least 10 metres.
Ground covers* (<0.5 metres in height. Ground covers >0.5 metres in height are to be treated as shrubs)	• 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 >100 millimetres in height.

Schedule 1: Standards for Asset Protection Zones	
Grass	• Grass should be maintained at a height of 100 millimetres 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 covers, grass and non-combustible mulches as prescribed above.
LP Gas Cylinders	Should be located on the side of a building furthest 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*

Source: *Guidelines for Planning in Bushfire Prone Areas (WAPC 2021)*

Element 2 Explanatory Notes

E2 Managing an Asset Protection Zone (APZ) to a low threat state

An APZ is a low fuel area maintained around a habitable building to increase the likelihood that it will survive a bushfire, by providing a defendable space and reducing the potential for direct flame contact, radiant heat exposure and ember attack.

Vegetation management within an APZ should provide defendable space and be maintained to a low threat state, in perpetuity, in accordance with the requirements outlined in Schedule 1.

The width of an APZ varies with slope and vegetation type, however it should only be as wide as needed to ensure the potential radiant heat impact of a bushfire does not exceed 29kW/m² (BAL-29), or 10kW/m² where a building is identified for use as an on-site shelter. An APZ is generally not required where a building or development site achieves 29kW/m² (BAL-29) or lower in its pre-development state (prior to any vegetation clearing or modification).

An APZ should include an area of defendable space immediately adjoining a building, that is kept free from combustible items and obstructions, within which firefighting operations can be undertaken to defend the structure. Where a lot contains a building envelope, it may not be necessary for the entire building envelope to achieve 29kW/m² (BAL-29) as this may result in significant unnecessary clearing. It is recommended that the BMP identifies that a sufficient APZ can be accommodated within the building envelope, with the development site and associated APZ to be determined at the development approval stage.

An APZ should be contained within the boundaries of the lot on which the building is situated, except in instances where it is demonstrated that the vegetation on the adjoining land is managed in a low threat state, as per cl. 2.2.3.2 of AS 3959, such as a road, managed park, rocky outcrop or a water body.

The siting of a habitable building and associated APZ should aim to minimise the clearing of vegetation. The BMP should demonstrate that the proposed APZ has minimised the unnecessary loss of vegetation or potential for conflict with landscape or environmental objectives; and complies with environmental approvals/exemptions (where necessary). A re-design or reduction in lot yield may be necessary to minimise the removal and modification of remnant vegetation.

It is recommended that development be located on flat areas or slopes less than 20 degrees (especially where classified vegetation is located downslope to a building) and away from ridge tops, crests or narrow gullies, as bushfire can spread rapidly in these areas. Circumstances where these locations may be suitable for development to occur include where the land is already cleared, and 29kW/m² (BAL-29) or lower can be achieved for the whole development site without the use of an APZ. To ensure soil stability within an APZ, vegetation removal on slopes exceeding 18 degrees is discouraged.

Fine fuel load should be maintained to less than two tonnes per hectare, however this is often a subjective assessment. Reducing fuel load levels does not necessarily require the removal of existing vegetation. A combination of methods can be utilised to reduce fuel load such as raking, weed removal, pruning, mulching and/or the removal of plant material.

A simple method to estimate fuel load is to roughly equate one tonne of fuel load per hectare as 100 grams per square metre. For example, two tonnes per hectare of leaf litter is roughly 200 grams of leaf litter per square metre and eight tonnes per hectare is roughly 800 grams. Eucalyptus leaf litter is approximately 100 grams per handful, so two handfuls of litter per square metre will roughly equate to two tonnes per hectare. Different types of fine fuel, like mulch or pine needles may be more or less than a handful, however the 100 grams per square metre rule of thumb can still be used.

The landowner or proponent is responsible for maintaining an APZ in accordance with Schedule 1 - Standards for Asset Protection Zones. Ongoing maintenance of an APZ is usually enforced through the local government firebreak notice issued under section 33 of the Bushfires Act 1954, and/or through a condition of a development approval, which requires the implementation of measures identified within a BMP.

A copy of the firebreak notice and Schedule 1 should be included in a BMP specifically as a how-to guide for the landowner, and to demonstrate to decision-makers that the measures outlined in the BMP to achieve the appropriate BAL rating through provision and ongoing management of an APZ, can be implemented.

Element 2 Explanatory Notes

E2 Landscaping and design of an Asset Protection Zone

Landscaping, design, and maintenance of an APZ in a bushfire prone area can significantly improve the bushfire resilience of a building. An APZ should not be seen as an area entirely cleared of vegetation, but as a strategically designed space that gives holistic consideration to how existing or proposed vegetation or non-combustible features interact with, or affect the building's bushfire resilience.

A well designed APZ provides a greater level of vegetation management within the first few metres of a building with, for example, less vegetation or inclusion of non-combustible materials. The vegetation within the remainder of an APZ can increase further away from the building with carefully considered plant selection and landscaping techniques.

Strategic landscaping measures can be applied, such as replacing weeds with low flammability vegetation (refer to E2 Plant Flammability) to create horizontal and vertical separations between the retained vegetation. The accumulation of fine fuel load from different plants is an important consideration for ongoing maintenance in accordance with Schedule 1. For example, when planting ground covers under deciduous trees within an APZ, the total fine fuel load prescribed in Schedule 1 will include any dead plant material from ground covers and leaf litter from the trees.

Plant density and final structure and form of mature vegetation should be considered in the initial landscaping stages. For example, clumps of sapling shrubs planted at a density without consideration of future growth, may increase the bushfire risk as a clump will quickly grow to exceed $5m^2$. It should be noted that in some cases, a single shrub in a mature state may be so dense as to fill a $5m^2$ clump alone.

The location of plants within an APZ is a key design technique. Separation of garden beds with areas of low fuel or non-combustible material, will break up fuel continuity and reduce the likelihood of a bushfire running through an APZ and subjecting a dwelling to radiant heat or direct flame contact. It is important to note, where mature trees are separated from a building by six metres, but the canopy has grown to extend or overhang a building, maintenance and pruning to remove the overhanging branches should be undertaken without the entirety of the tree being removed.

Mulches used within the APZ should be non-combustible. The use of stone, gravel, rock and crushed mineral earth is encouraged. Wood mulch >6mm in thickness may be used, however it is recommended that it is used in garden beds or areas where the moisture level is higher by regular irrigation. These materials could be sourced from non-toxic construction and demolition waste giving the added benefit of reducing the environmental impact of any 'hard landscaping' actions.

Combustible objects, plants, garden supplies such as mulches, fences made from combustible material, should be avoided within 10 metres of a building. Vines or climbing plants on pergolas, posts or beams, should be located away from vulnerable parts of the building, such as windows and doors. Non-flammable features can be used to provide hazard separation from classified vegetation, such as tennis courts, pools, lawns and driveways or paths that use inorganic mulches (gravel or crushed rock). Consider locating firewood stacks away from trees and habitable buildings.

Incorporation of landscaping features, such as masonry feature walls can provide habitable buildings with barriers to wind, radiant heat and embers. These features can include noise walls or wind breaks. Use of Appendix F of AS 3959 for bushfire resistant timber selection within areas of $29kW/m^2$ (BAL-29) or below, or the use of non-combustible fencing materials such as iron, brick, limestone, metal post and wire is encouraged.

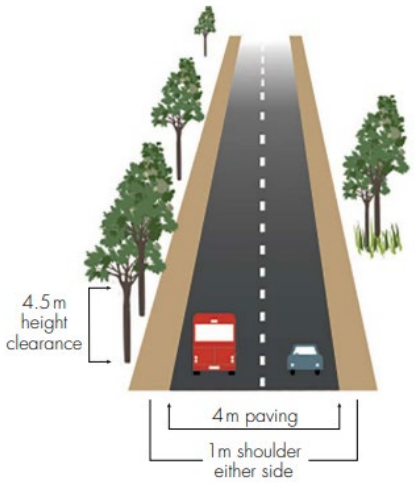
In addition to regular maintenance of an APZ, further bushfire protection can be provided at any time by:

- ensuring gutters are free from vegetation;
- installing gutter guards or plugs;
- regular cleaning of underfloor spaces, or enclosing them to prevent gaps;
- trimming and removing dead plants or leaf litter;
- pruning climbing vegetation (such as vines) on a trellis, to ensure it does not connect to a building, particularly near windows and doors;
- removing vegetation in close proximity to a water tank to ensure it is not touching the sides of a tank; and/or
- following the requirements of the relevant local government section 33 fire break notice, which may include additional provisions such as locating wood piles more than 10 metres from a building.

Element 2 Explanatory Notes
Preparation of a property prior to the bushfire season and/or in anticipation of a bushfire is beneficial even if your plan is to evacuate. As embers can travel up to several kilometres from a bushfire and fall into small spaces and crevices or land against the external walls of a building, best practice recommends that objects within the APZ are moved away from the building prior to any bushfire event. Objects may include, but are not limited to: • door mats; • outdoor furniture; • potted plants; • shade sails or umbrellas; • plastic garbage bins; • firewood stacks; • flammable sculptures; and/or • playground equipment and children's toys.
E2 Plant flammability
There are certain plant characteristics that are known to influence flammability, such as moisture or oil content and the presence and type of bark. Plants with lower flammability properties may still burn during a bushfire event, but may be more resistant to burning and some may regenerate faster post-bushfire. There are many terms for plant flammability that should not be confused, including: • Fire resistant – plant species that survive being burnt and will regrow after a bushfire and therefore may be highly flammable and inappropriate for a garden in areas of high bushfire risk. • Fire retardant – plants that may not burn readily or may slow the passage of a bushfire. • Fire wise – plants that have been identified and selected based on their flammability properties and linked to maintenance advice and planting location within a garden. Although not a requirement of these Guidelines, local governments may develop their own list of fire wise or fire retardant plant species that suit the environmental characteristics of an area. When developing a recommended plant species list, local governments should consult with ecologists, land care officers or environmental authorities to ensure the plants do not present a risk to endangered ecological communities, threatened, or endangered species or their habitat. When selecting plants, private landholders and developers should aim for plants within the APZ that have the following characteristics: • grow in a predicted structure, shape and height; • are open and loose branching with leaves that are thinly spread; • have a coarse texture and low surface-area-to-volume ratio; • will not drop large amounts of leaves or limbs, that require regular maintenance; • have wide, flat, and thick or succulent leaves; • trees that have bark attached tightly to their trunk or have smooth bark; • have low amounts of oils, waxes, and resins (which will often have a strong scent when crushed); • do not produce or hold large amounts of fine dead material in their crowns; and/or • will not become a weed in the area. Refer to the WAPC Bushfire and Vegetation Fact Sheet for further information on clearing and vegetation management and APZ landscaping, design and plant selection reference material.

Source: *Guidelines for Planning in Bushfire Prone Areas (WAPC 2021)*

Appendix D Vehicular access explanatory notes

Acceptable Solution A3.1 – Public Roads
Explanatory Note E3.1
These Guidelines do not prescribe values for the trafficable (carriageway/pavement) width of public roads as they should be in accordance with the class of road as specified in the IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Austroad Standards and/or any applicable standard in the local government area. The IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Austroad Standards do not prescribe a horizontal clearance. However, it is recommended that a traversable verge is provided to allow for emergency services vehicles to stop and operate on the side of the public road, specifically where the public road may traverse large areas of classified vegetation. Where local government roads are proposed to be widened by the proponent, they must obtain approval from the local government.    Figure 20: Example of a public road

Source: *Guidelines for Planning in Bushfire Prone Areas (WAPC 2021)*

Acceptable Solution A3.2a – Multiple access routes

Explanatory Note E3.2a

Two-way public road access is public road access from a lot in at least two different directions to two suitable destinations, and provides residents and the community, as well as emergency services, with access and egress from both the subdivision and individual habitable buildings/development in the event of a bushfire emergency. A single road provides no alternative route if the access becomes congested or is unable to be traversed due to smoke and/or fallen trees during a bushfire.

Two-way public road access applies to access/egress routes leading into a subdivision, as well as those within a subdivision. A road that loops back onto itself does not constitute the option of two different directions.

Two-way public road access should always be the first option. Where the site is not able to achieve two-way access within 200 metres of the lot boundary, due to demonstrated site or environmental constraints, the proponent should identify options for an emergency access way from the subject site to a suitable destination. Where an emergency access way cannot be provided, the proponent should demonstrate compliance with the performance principle.

Subject sites or proposed lots greater than 200 metres from an intersection, which provides two-way access, do not satisfy the requirement for two-way access unless they meet the provisions which allow for no-through roads greater than 200 metres in A3.2a.

To demonstrate compliance with the performance principle for two-way access, the bushfire planning practitioner may have regard to:

a. the extent of the bushfire hazard, location and vegetation classification, the likelihood, potential severity and impact of bushfire to the subject site and the road network;
b. time between fire detection and the onset of conditions in comparison to travel time for the community to evacuate to a suitable destination;
c. available access route(s) travelling towards a suitable destination; and
d. turn-around area for a fire appliance for no-through roads.

Figure 21: Example of compliant and non-compliant two-way

Source: *Guidelines for Planning in Bushfire Prone Areas (WAPC 2021)*

Acceptable Solution A3.2b – Emergency access way
Explanatory Note E3.2b
An emergency access way is not a preferred alternative to through public road access and should only be considered acceptable where it has been demonstrated that it will provide the safety and performance needs of emergency services and the community, including consideration for future needs, and that public road access to satisfy A3.2a cannot be achieved due to site constraints, such as an established road network with no opportunity to provide a public road for secondary access. Acceptance of an emergency access way should also consider the ability to accommodate reasonable worst-case vehicle volumes. The principle function of the emergency access way is to provide a contingency (second) community evacuation route and simultaneously provide access for emergency services, in the event of a bushfire emergency. Where an emergency access way traverses classified vegetation, which has the potential to create a bushfire hazard, an emergency access way performs the secondary function of providing access by emergency services to this vegetation. Emergency access ways should connect to a public road to allow alternative two-way through access. An emergency access way should not exceed 500 metres in length as they may not be as safe for road-use due to not being designed or constructed to the full requirements of a public road and may present uncertainties to emergency service personnel and the public as they are not part of the daily road network and not identified on Maps. **Permanent public emergency access way** An emergency access way can be provided as either a public easement in gross or a right-of-way. In both approaches, the management of the emergency access way is by the local government as the grantee of the easement or management body of the right-of-way. The proponent must obtain written consent from the local government that the local government will accept care, control and management of the easement or right-of-way; this must be provided to the decision-maker prior to granting planning approval. The approach taken is at the discretion of the decision-maker and/ or the local government and is also dependent on whether the land is to remain in private ownership or be ceded to the Crown. Consultation with Land Use Management at the Department of Planning, Lands and Heritage should also be considered if the land is to be ceded to the Crown or if the local government is uncertain of which approach to take. If the emergency access way is provided as an easement, it should be provided as a public easement in gross under sections 195 and 196 of the Land Administration Act 1997 in favour of the local government and/or public authority, to ensure accessibility for emergency services and the public at all times. To be provided as a right-of-way the emergency access way should be vested in the Crown under section 152 of the Planning and Development Act 2005 as a right-of-way and such land to be ceded free of cost and without any payment or compensation by the Crown. If gates are used to control traffic flow during non-emergency periods, these will be managed by the local government and must not be locked. Gates should be double gates wide enough to access the full pavement width and accommodate Type 3.4 fire appliances with the design and construction to be approved by the relevant local government. **Temporary public emergency access way** A temporary emergency access way may be proposed to facilitate the staging arrangements of a subdivision. The provision of two public roads may not be possible in the first stage of the subdivision and an emergency access way can be provided as an interim access route until the second public road is developed and gazetted in a subsequent stage of the subdivision (see figure

Acceptable Solution A3.2b – Emergency access way
Explanatory Note E3.2b
22). The emergency access way should be provided in the same manner as a permanent emergency access way, but it should be removed from the certificate of title once the public road is developed and gazetted. Where an emergency access way is proposed as an alternative to a public road, the Bushfire Management Plan should provide thorough justification for its use. **Restricted public emergency access way** There may be some instances where a restricted emergency access way is proposed as a performance principle based solution where access is only available to the public in the event of a bushfire emergency. This option can only be considered where the local government or Main Roads WA have advised that vehicular access on the emergency access way is not allowed during non-emergency periods, as it provides an additional thoroughfare and entry point on a local or State road. In this scenario, the emergency access way can be provided as an easement under section 195 of the Land Administration Act 1997, as public access in the event of a bushfire emergency or vested in the Crown as a reserve under section 152 of the Planning and Development Act 2005. Such land is to be ceded free of cost without any payment or compensation by the Crown. The proponent must obtain written consent from the local government that the local government will accept care, control and management of the proposed reserve and agree to the terms of the Management Order Conditions (if applicable); this must be provided to the decision-maker prior to granting planning approval. The purpose of the reserve should be for a public purpose specified in the condition related to the subdivision, for example for emergency access only, or for emergency access and recreation. A reserve for emergency access and recreation can optimise the land-use as a dual purpose where it provides vehicular access in the event of a bushfire emergency, but can be accessed by the public (on foot) on a day-to-day basis as a recreation link. Appropriate signage can ensure the general public is aware of the purpose of the reserve. The approach taken is at the discretion of the decision-maker and/or local government. **Right-of-carriageway emergency access way** There may be some instances where a right-of-carriageway easement is proposed as a performance principle-based solution. This may be where particular landowner(s) and emergency services, but not the public, require access over a neighbouring lot(s). A right-of-carriageway easement should be provided under section 195 of the Land Administration Act 1997. The easement is to provide alternative access for the particular landowner(s) in the event of a bushfire emergency and not for use by the public. In this scenario, support will be necessary from the adjoining lot owner(s). The easement is to be granted to the local government and it is to agree with the landowner on the arrangements of the management of the easement area by deed. These management arrangements will be at the discretion of the local government. If gated, the easement area can be locked to restrict day-to-day vehicular access.

Acceptable Solution A3.2b – Emergency access way
Explanatory Note E3.2b

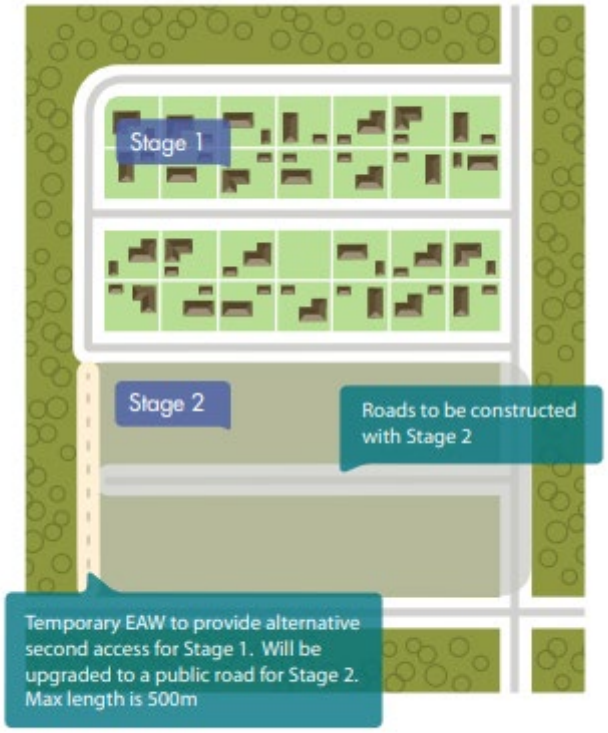


Figure 22: Example of an emergency access way

Source: *Guidelines for Planning in Bushfire Prone Areas (WAPC 2021)*

Acceptable Solution A3.3 – Through roads

Explanatory Note E3.3

In bushfire prone areas, a proposed structure plan or subdivision that incorporates no-through roads should be avoided because they do not provide a connected and legible design that allows for easy access and egress by the community, residents and emergency services in the event of a bushfire. No-through roads also reduce the options available for access and egress in the event of a bushfire emergency.

There will however be situations where a subject site is accessed via an existing or proposed no-through road and alternative access cannot be provided. In these situations, the proponent should demonstrate to the decision-maker, that all efforts have been made with the local government and/or adjoining landowners to secure alternative public road access or an emergency access way and that a redesign has been explored. The bushfire planning practitioner may need to develop a performance principle-based solution or address the non-compliance and demonstrate to the decisionmaker why discretion should be exercised in accordance with section 2.6 of these Guidelines.

No-through roads will only be considered an acceptable solution where it is demonstrated by the proponent, to the satisfaction of the decision maker, that a no through-road cannot be avoided due to site constraints. For example, the internal road design of a structure plan or subdivision where site constraints, such as a water body or Bush Forever, prevent the ability to create a through-road and a no through road may be a more appropriate road layout.

No-through roads should be a maximum of 200 metres from the lot(s) boundary to an intersection where two-way access is provided and may only exceed 200 metres if it meets the provisions which allow for no-through roads greater than 200 metres in A3.2a.

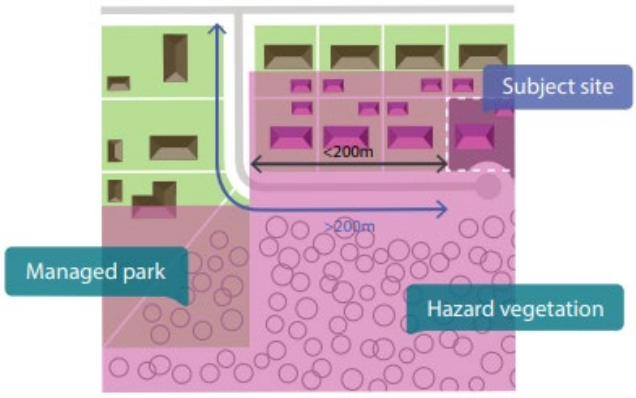


Figure 23: Example of a site on a no-through road greater than 200 metres from the intersection, but within 200 metres of BAL-LOW

Acceptable Solution A3.3 – Through roads

Explanatory Note E3.3

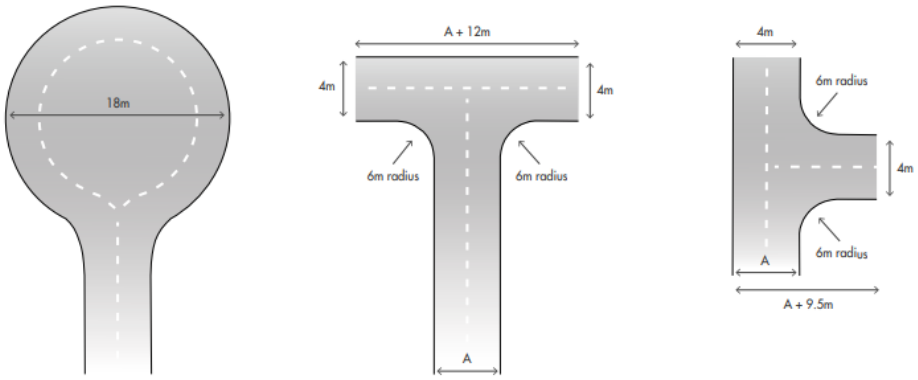


Figure 24: Turn-around area dimensions for a no-through road

Source: *Guidelines for Planning in Bushfire Prone Areas (WAPC 2021)*

Acceptable Solution A3.4a – Perimeter roads
Explanatory Note E3.4a
Where a planning proposal includes the creation of 10 or more lots adjacent to each other, which adjoin classified vegetation under AS 3959 with the exception of Class G Grassland, as part of a greenfield development or large urban infill site, hazard separation and defendable space should be provided in the form of a perimeter road. Greenfield is 'undeveloped or minimally developed areas that have been identified for urban development'; and urban infill is 'the redevelopment of existing urban areas at a higher density than currently exists'. The creation of 10 or more lots includes cumulative subdivision applications where the subdivision application may be part of a staged subdivision. A perimeter road should be in accordance with the class of road as specified in the IPWEA Subdivision Guidelines, Liveable Neighbourhoods, Austroad Standards and/or any applicable standard in the local government area as per the requirements of a public road in Table 6, Column 1. As the road is likely to function as a key neighbourhood distributor, or similar, consideration should be given to the provision of additional width to allow for emergency services vehicles to stop and operate on the side of the perimeter road, whilst simultaneously proving for the evacuation of the community (Figure 20). When designing a strategic planning proposal and/or subdivision, creating a large setback between classified vegetation and proposed lots with a perimeter road, and orientating habitable buildings to front onto (rather than back onto) areas of vegetation has many benefits, including: • passive surveillance; • defendable space for firefighting and emergency management purposes; • reducing the potential radiant heat that may impact a habitable building in a bushfire event; • reducing the need for battle-axe lots; and • unconstrained public access/egress for the community in the event of a bushfire. In developments where no perimeter road exists, property defence in a bushfire event is difficult and can be impossible. Where proposed lots have frontage to an existing public road and abut the hazard at the rear or side, it may be an undesirable planning outcome to create lots which front the existing public road and back onto a perimeter road. In this instance, consideration should be given to a fire service access route. Refer to E3.4b below.

Acceptable Solution A3.4a – Perimeter roads
Explanatory Note E3.4a

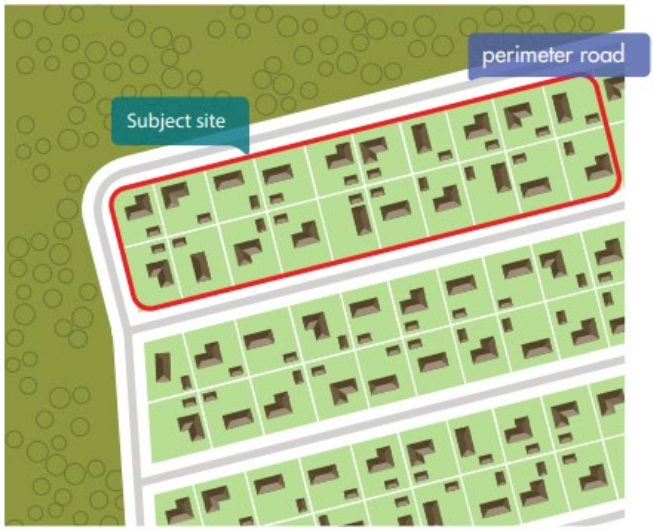


Figure 25: Example of a perimeter road

Source: *Guidelines for Planning in Bushfire Prone Areas (WAPC 2021)*

Technical requirement	1	2	3	4
	Public road	Emergency access way[1]	Fire service access route[1]	Battle-axe and private driveways[2]
Minimum trafficable surface (m)	In accordance with A3.1	6	6	4
Minimum horizontal clearance (m)	N/A	6	6	6
Minimum vertical clearance (m)	4.5	4.5	4.5	4.5
Minimum weight capacity (t)	15	15	15	15
Maximum grade unsealed road[3]	As outlined in the IPWEA Subdivision Guidelines	1:10 (10%, 6°)	1:10 (10%, 6°)	1:10 (10%, 6°)
Maximum grade sealed road[3]		1:7 (14.3%, 8°)	1:7 (14.3%, 8°)	1:7 (14.3%, 8°)
Maximum average grade sealed road		1:10 (10%, 6°)	1:10 (10%, 6°)	1:10 (10%, 6°)
Minimum inner radius of road curves (m)		8.5	8.5	8.5

[1] To have crossfalls between 3 and 6%

[2] Where driveways and battle-axe legs are not required to comply with the widths in A3.5 or A3.6, they are to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision

[3] Dips must have no more than a 1 in 8 (12.5% -7.1 degree) entry and exit angle.

Appendix E Shire of Carnarvon Annual Firebreak Notice

BUSH FIRE NOTICE AND REQUIREMENTS

NOTICE TO ALL OWNERS AND/OR OCCUPIERS OF LAND IN THE SHIRE OF CARNARVON

In accordance with Section 33 of the Bush Fires Act 1954, you are required to carry out fire prevention work on land owned or occupied by you as set out in this Notice by the dates specified. If the requirements of this Notice are not met by the due date or are not completed to the satisfaction of an inspecting officer, an on-the-spot fine of $250 will be issued. The maximum fine for failure to comply is $5,000 or a modified penalty of $250 per day. Council can also enter the land and carry out required works at the owner/occupier's expense. *(Section 33 Bush Fires Act 1954).*

All landowners and occupiers of land within the Shire of Carnarvon shall before the 1st day of November in each year (or within 14 days of becoming the owner or occupier of land if after that date) clear firebreaks and maintain them up to and including the 30th day of April the following year, in accordance with this notice. Where a property is affected by an approved bushfire management plan, the property owner and/or occupier must still comply with all requirements in this notice and with ALL additional requirements outlined within that plan.

FIRE BREAK NOTICE 2023/2024

FIRE BREAKS

Must be installed before 1 November and maintained to 30 April inclusive.

TOWNSITE LAND

Refers to all land within the gazetted town site of Carnarvon and Coral Bay

Where the land is 2,000 square metres or less:

- Maintain all dry grass on the land to a height no greater than 50mm.
- Ensure no tree crowns overhang buildings.
- Prune trees and shrubs and remove dead flammable material within 1.5m around all buildings.
- Ensure the roofs, gutters, and walls of all buildings on the land are free of flammable matter.

Where the land is greater than 2,000 square metres:

- Install or upgrade a minimum 3-metre-wide by 4-metre-high clearance, bare earth, continuous (no dead ends) trafficable fire break as close as possible inside the entire perimeter of the land.
- Keep a 20m low fuel asset protection zone, clear of all flammable material, around all buildings.

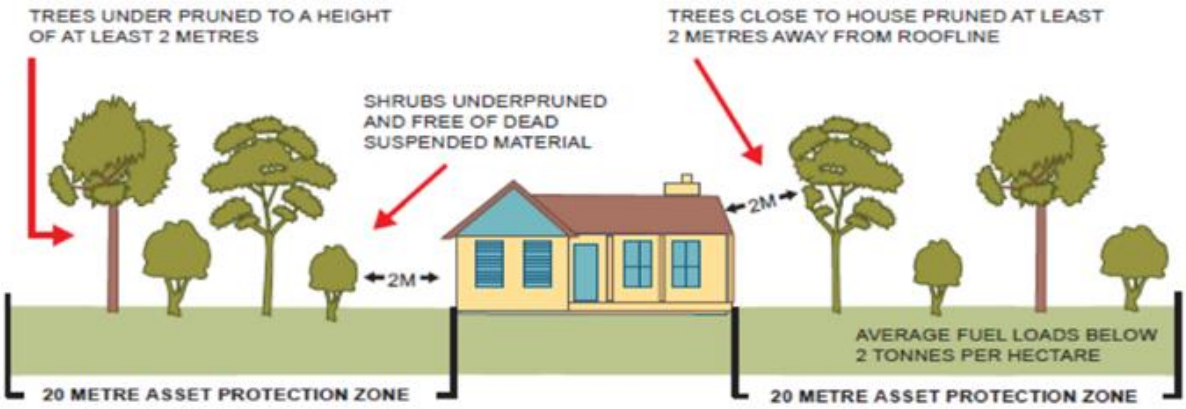
RURAL, PASTORAL, AND PLANTATION LAND

Refers to all land outside the gazetted town site of Carnarvon and Coral Bay.

- Install or upgrade a minimum 3-metre-wide by 4-metre-high clearance (for pastoral lands recommended 6-20m break be installed dependent on fuel loading and vegetation), bare earth, continuous (no dead ends) trafficable fire break as close as possible inside the entire perimeter of the land.

Asset Protection Zone

Asset Protection Zone, maintain a fuel-reduced zone around all buildings and assets which extends 20 metres from the outermost point of all buildings and assets.
Gutters, roofs, and walls of all buildings are to be free of flammable matter and maintained.
Fuel load within the 20-metre zone is reduced and maintained to no more than 2 tonnes per hectare. Trees over 5 meters in height within the 20-metre zone to be under-pruned up to 2 metres. Trees or shrubs within 2 metres of a building/asset shall be pruned to a height no greater than 2 metres and/or pruned away from the building/asset to a distance greater than 2 metres.



ALTERNATE STYLE FIREBREAK

If you consider it impracticable or environmentally damaging to carry out the requirements set out in this notice, you can apply to the Shire by 1 October for permission to provide alternative firebreaks or other fire prevention measures. In the absence of written approval for alternative measures, the owner/occupier must adhere to the requirements of this Notice. For further information, contact the Shire of Carnarvon on 9941 0000.

RUBBISH SITES

Refers to all rubbish sites for pastoral stations, town sites, and community use.
Install or upgrade a minimum 3-metre-wide by 4-metre-high clearance, bare earth, continuous (no dead ends) trafficable fire break as close as possible inside the entire perimeter of the rubbish site.

ADDITIONAL WORKS

In addition to the requirements of this Notice, regardless of land size and location, you may be required to carry out further fire prevention works to reduce hazards considered necessary by an Authorised Officer. Any further requirement would be specified by way of a "work order" forwarded to the address of the owner(s) and/or occupier(s). Some examples of these could be:

- Remove accumulated fuel such as leaf litter, twigs, dead bush, and dead trees capable of carrying a running fire.
- Reduce unmanaged grasses/weeds by slashing, mowing, or other means.
- Reduce long grasses in areas not being grazed or cultivated by slashing, mowing, bailing, or by other means.
- Reduce vegetation to a low-threat state from the outer edge of the firebreak through to the property boundary (e.g., no long grass or overhanging branches).

FIREBREAKS

A strip of land free of all flammable material with the intention of minimizing the spread or extension of a bushfire and providing safe access on the property for emergency vehicles and other firefighting operations.

Such firebreaks may be constructed by one or more of the following methods:

- Ploughing
- Cultivating
- Raking
- Burning
- Chemical spraying

Picture: Example of required firebreak and dimension of fire units

DATES YOU MUST REMEMBER

RESTRICTED BURNING

1 October to 30 April Every Year

During this period:

- A permit is required to burn.
- Burning is prohibited on any day when the Fire Danger Rating reaches High, Extreme, or Catastrophic.
- Burning is prohibited when a Total Fire Ban has been declared.
- NO PERMITS will be issued for burning on public holidays.

During the Restricted Burning Periods:

You are only allowed to burn on days that are Moderate. There are signs located on Northwest Coast Highway north and south of Carnarvon townsite.

You can also look on the BOM website:

http://www.bom.gov.au/wa/forecasts/fire-danger-ratings.shtml

PERMITS TO BURN

Can be obtained by contacting a Local Fire Control Officer or the Shire of Carnarvon Ph: 9941 0000 Email: shire@carnarvon.wa.gov.au

BUSH FIRE BRIGADE MEMBERSHIP

If you are interested in joining your local Volunteer Bush Fire Brigade, contact the Fire Control Officer for your area or the Shire's Community Emergency Services Manager on 0448 081 637.

CONTACTS INFORMATION

ALL FIRES OR LIFE-THREATENING EMERGENCIES

000

Gascoyne River Bush Fire Brigade:	000
Hospital:	9941 0555
SES:	132 500
Police:	131 444
DFES information line:	13 33 37
Shire Office:	9941 0000
Visitors Centre	9941 1146
Shire Ranger:	9941 0019

FIRE CONTROL OFFICERS

Community Emergency Services Manager:	0448 081 637

Document Status

Rev No.	Purpose	Author	Reviewed and approved for Issue	
			Name	Date
Rev A	Draft for review by client	Michelle Gellender	Zac Cockerill (BPAD 37803, Level 2)	13 November 2023
Rev 0	**Issued for use: to accompany Structure Plan submission**	**Zac Cockerill (BPAD 37803, Level 2)**	**Zac Cockerill (BPAD 37803, Level 2)**	**13 December 2023**

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Wardandi Noongar Country | 177
Spencer Street Bunbury, WA 6230
T: 08 9792 4797

Canberra
Ngunnawal Country | Level 1, The Realm
18 National Circuit Barton, ACT 2600
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Larrakia Country | Suite G1, Level 1
48-50 Smith Street, Darwin NT 0800
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Hobart
Muwununa/Nuenon Country | Level 6,
111 Macquarie Street Hobart, TAS 7000
T: 03 6108 9054

Melbourne
Kulin Country | Level 5, 10 Queen
Street, Melbourne, VIC 3000
T: 03 9642 0599

Newcastle
Awabakal/Worimi Country | 61 / 63
Parry Street Newcastle West, NSW 2302
T: 02 8245 0300

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Whadjuk Nyoongar Country | Allendale Square,
Level 9, 77 St Georges Terrace, WA 6000
T: 08 9380 3100

Sydney
Gadigal Country | Level 1, 50
Margaret Street, Sydney, NSW 2000
T: 02 8245 0300

Wollongong
Dharawal Country | Suite 1A, 280 - 286
Keira Street, Wollongong, NSW 2500
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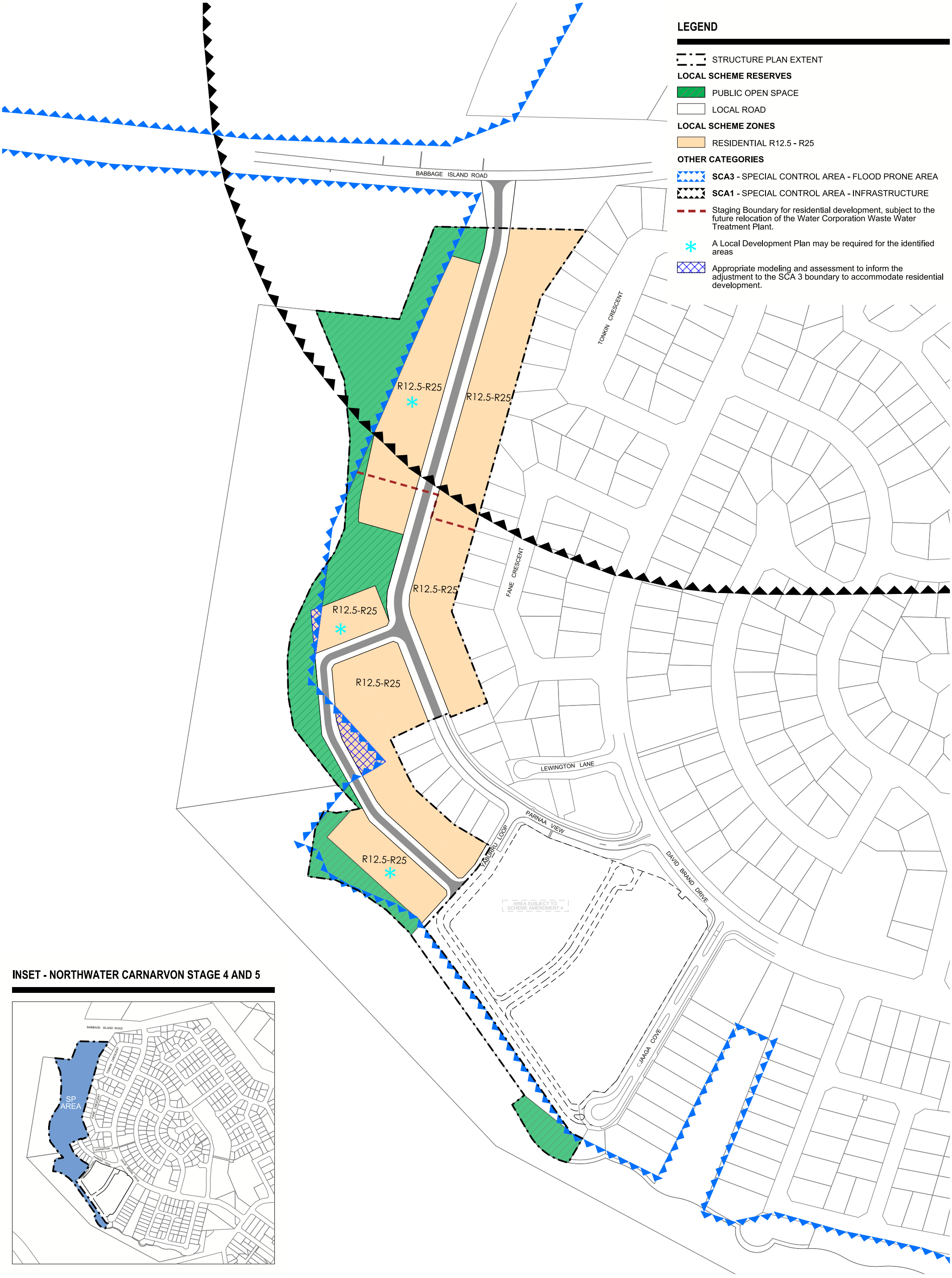

LEGEND

- STRUCTURE PLAN EXTENT

LOCAL SCHEME RESERVES

- PUBLIC OPEN SPACE
- LOCAL ROAD

LOCAL SCHEME ZONES

- RESIDENTIAL R12.5 - R25

OTHER CATEGORIES

- **SCA3** - SPECIAL CONTROL AREA - FLOOD PRONE AREA
- **SCA1** - SPECIAL CONTROL AREA - INFRASTRUCTURE
- Staging Boundary for residential development, subject to the future relocation of the Water Corporation Waste Water Treatment Plant.
- * A Local Development Plan may be required for the identified areas
- Appropriate modeling and assessment to inform the adjustment to the SCA 3 boundary to accommodate residential development.

INSET - NORTHWATER CARNARVON STAGE 4 AND 5

Plan 1 - Structure Plan

LOT 9001 DAVID BRAND DRIVE, CARNARVON

A DevelopmentWA Project

scale: 1:3000@A3 | 1:1500@A1

0 30 60m

plan: 10/036/049D

date: 16/02/2024

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