LOT 173-177 BURSLEM DRIVE MADDINGTON OUTLINE DEVELOPMENT PLAN

CITY OF GOSNELLS

LOT 173-177 BURSLEM DRIVE OUTLINE DEVELOPMENT PLAN

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DOCUMENT STATUS

VERSION	COMMENT	PREPARED BY	REVIEWED BY	REVIEW DATE	APPROVED BY	ISSUE DATE
Revision 1		CFM		31.03.2022		31.03.2022
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ENDORSEMENT

This Outline Development Plan is prepared under the provisions of the City of Gosnells Town Planning Scheme No. 6.

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

27 September 2005

In accordance with Schedule 2, Part 4, Clause 28 (2) and refer to Part 1, 2. (b) of the Planning and Development (Local Planning Schemes) Regulations 2015.

Date of Expiry: **19 October 2025**

Table 1: Table of Amendments

AMENDMENT NO.	SUMMARY OF THE AMENDMENT	AMENDMENT TYPE	DATE APPROVED BY WAPC
Amendment 1	• Amendment to Heritage designation • Introduction of Residential zone at R30 density code • Amendment to road network		18 March 2025

Table 2: Table of Density Plan

DENSITY PLAN NUMBER	AREA OF DENSITY PLAN APPLICATION	DATE ENDORSED BY WAPC

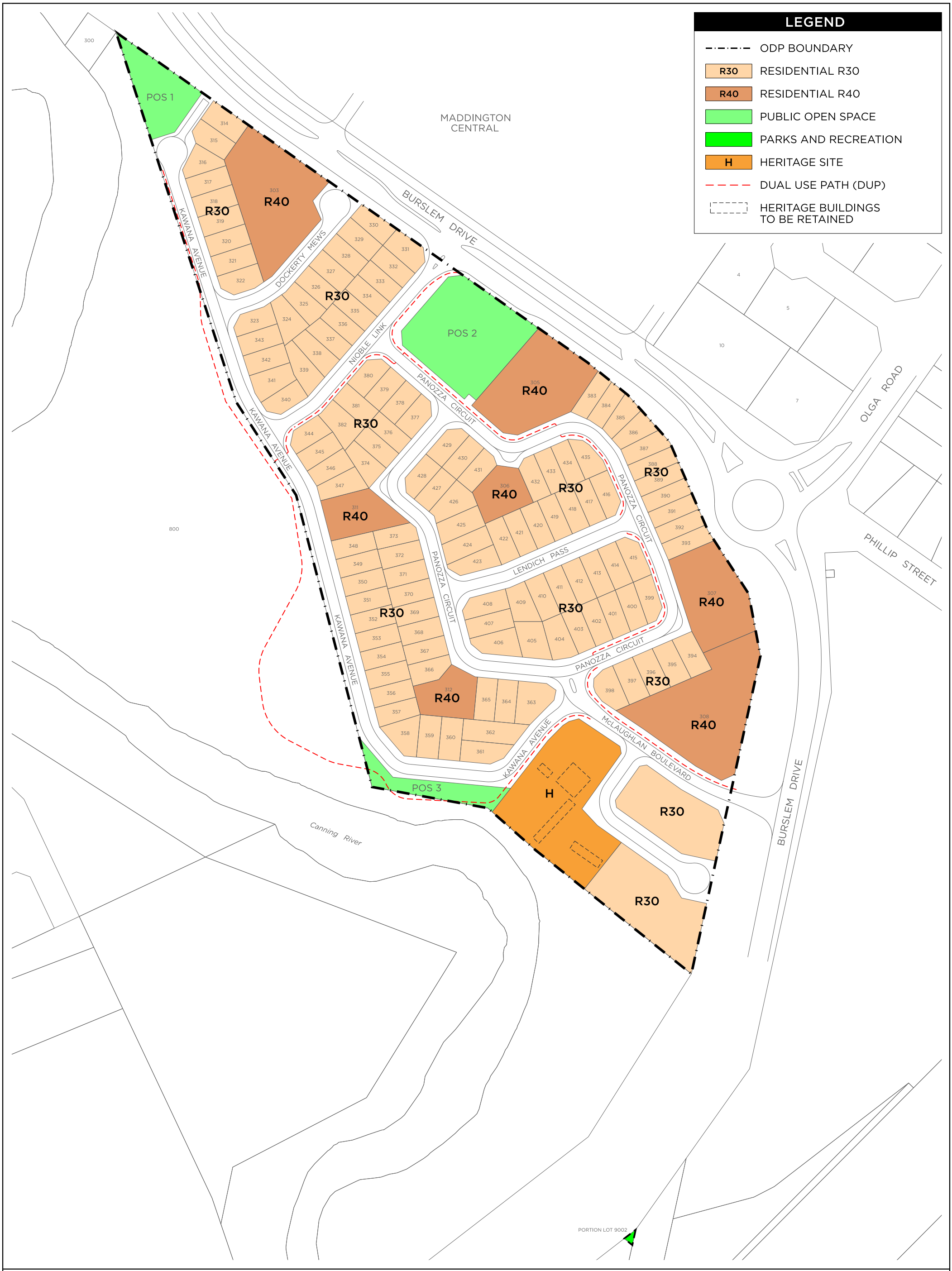
EXECUTIVE SUMMARY

This Outline Development Plan applies to land generally bound by Burslem Drive to the south and east and the Canning River to the west, being located within the inner edge of the line denoting the Outline Development Plan boundary on the Outline Development Plan Map.

A summary of all key statistics and planning outcome is provided in Table 3 below:

Table 3: Executive Summary

ITEM	DATA	REPORT REFERENCE
Total area covered by the structure plan	8.7 hectares	Section 1.2
Area of each land use proposed: - Residential - Industrial - Commercial	Hectares / Lot Yield 8.7 hectares 137 lots 0 hectares 0 lots 0 hectares 0 lots	Sections 2.5.3 and 4.3
Estimated lot yield	138 lots	Section 4.3
Estimated number of dwellings	178 dwellings	Section 4.3
Estimated residential site density	30 dwellings per site hectare 20 dwellings per gross urban hectare	Section 4.3
Estimated population	480 people	Section 4.3
Number of high schools	0 high schools	Section 2.5.4
Number of primary schools	0 primary schools	Section 2.5.4
Estimated commercial floor space (for activity centres if appropriate)	0 net lettable area	Section 2.5.3
Estimated number and % of public open space: - Regional open space - District open space	 0 hectares 0% 0 hectares 0%	
Estimated area and number: - neighbourhood parks - local parks	 0 hectares - 0 parks 0.559 hectares – 3 parks	Section 3.2.4.3
Estimated number and area of natural area and biodiversity assets	0 hectares 0 sites	



OUTLINE DEVELOPMENT PLAN

Maddington Homestead

FIGURE 6

NORTH

Scale: 1:2000 @ A3

0 20 40 60m

PLAN: GOGMA-5-007 REVISION:

DATE: 24/03/2022 DRAWN: JP

PROJECTION: PCG 94 PLANNER: CM

DATUM: AHD CHECK: CM

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APPENDICES

1 INTRODUCTION

1.1 Introduction & Purpose

StudioCFM acts on behalf of Wellington Parkland Pty Ltd, the owner of Lot 9002 Panozza Circle, Maddington (the 'subject site'). This report has been prepared in support of an amendment request to the *Lot 173-177 Burslem Drive Outline Development Plan (ODP)* which seeks to reduce the area of the Maddington Homestead curtilage.

Wellington Parkland has established a consultant team comprising experts across the following disciplines.

Discipline	**Consultant**
Town Planning and Urban Design	studioCFM
Engineering	JDSi
Hydrology	Pentium Water
Bushfire Consultant	Emerge Associates

StudioCFM is the principal point of contact for all enquiries relating to this application.

1.2 Land Description

1.2.1 Location

The subject site is in the municipality of the City of Gosnells. The site is situated approximately 16 kilometres south-east of the Perth Central Area and 2.5 kilometres north-west of Gosnells town centre (refer Figure 1 – Location Plan).

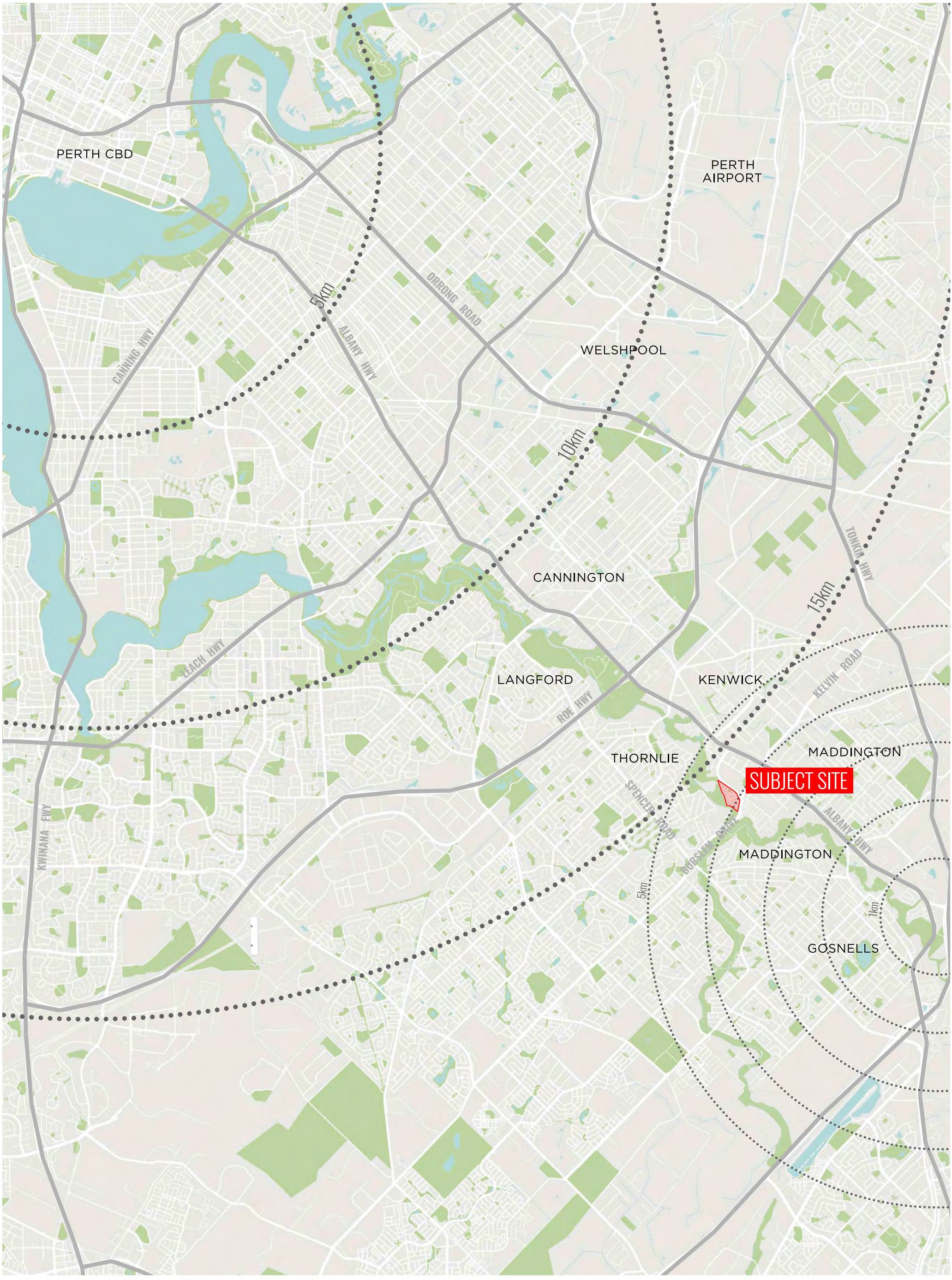
The site is bounded by Burslem Drive to the south and east and the Canning River on the west. It is located approximately 0.5 kilometres south of Maddington Secondary Activity Centre.

1.2.2 Legal Description and Ownership

The original ODP covers Lot 173 – 177 Burslem Drive in the suburb of Maddington. The original land holdings were owned by Wellington Parkland Pty Ltd.

1.2.3 Land Area

The ODP area is originally 8.7 hectares. The subject site has been developed for single residential lots since the approval and adoption of the ODP in 2005. Today, the balance undeveloped land being Lot 9002 Panozza (P07768) is approximately 2.39 hectares.



LOCATION PLAN

Maddington Homestead

FIGURE 1

NORTH

Not to Scale @ A3

0 600 1200 1800m

PLAN: GOGMA-5-006 REVISION: A

DATE: 24/03/2022 DRAWN: JP

PROJECTION: PCG 94 PLANNER: CM

DATUM: AHD CHECK: CM

2 SITE CONDITIONS & CONSTRAINTS

2.1 Biodiversity & Natural Area Asset

The site does not contain any areas of native vegetation nor natural area and biodiversity asset. The site has been historically used as a market garden. Figure 2 is a recent aerial photograph of the subject site and it shows the balance undeveloped portion of the estate. The site was historically cleared of native vegetation and now contains only a few remnant native trees, self-sown garden escapes such as Jacaranda and Plumbago, and overgrown weeds.

2.2 Site Characteristics

2.2.1 Site Elevation

The site has an elevation range from RL5.2 metres to RL9.2 metres. The site slopes down in a north-westerly direction from Burslem Drive down towards the Canning River (refer Figure 2 – Aerial Photo).

2.2.2 Soil Typology

The geology of the site is:

- Soil System: Pinjarra System
- Sub Soil System: Envgeol Cms Phase – Sandy Silty Clay – Pale Brown

2.2.3 Acid Sulphate Soils

In accordance with WAPC's *Acid Sulphate Soils Planning Guidelines*, September 2010, the ODP area is generally classified as 'Moderate to Low Risk'.

An assessment conducted by ENV Australia (2004) indicates that the potential for acid sulphate soils does not appear to be an environmental risk at the site. (refer to Appendix 2 – Drainage and Nutrient Management Plan)

2.2.4 Groundwater & Surface Water

The groundwater is recorded at RL 3m. As the site is generally above RL5.2m no surface water has been recorded on site.

2.2.5 Wetland and Foreshores

The ODP area is classified as 'Multiple use'.

The adjacent Canning River is classified as 'Conservation Category Wetland'. No further buffers are required to be provided within the ODP.

2.3 Bushfire Hazard

The Department of Fire and Emergency Service – Map of Bushfire Prone Area online mapping tool identifies the site as being 'bushfire prone' due to its proximity to the Canning River (Bush Forever No 246). A bushfire management plan has been previously prepared.

Recently a Bushfire Attack Level (BAL) Contour Plan has been prepared for the southern portion of the site and is included in Appendix 1 and is based on:

- Assessment of vegetation within 100 metres of the adjacent public reserve and the Canning River (Bush Forever Site No 246).
- Identification of pre-development and post-development vegetation. Existing public open spaces have been developed and maintained as 'low threat vegetation'.
- Determination of effective slope under classified vegetation in the post-development scenario.

The remaining stage of this ODP can achieve the bushfire protection criteria outlined within Appendix 1.

AERIAL PHOTO

Maddington Homestead

FIGURE 2

NORTH

Scale: 1:2000 @ A3

0 20 40 60m

PLAN: GOGMA-5-008 REVISION:
DATE: 24/03/2022 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CM
DATUM: AHD CHECK: CM

2.4 Heritage

2.4.1 Aboriginal Heritage

A search of the Department of Aboriginal Affairs' Aboriginal Heritage Inquiry System identifies three sites within close proximity to the ODP site being:

- Place ID 22009 – which has been lodged as a Mythological Site, Camp Site and Hunting Place.
- Place ID 3511 – a registered site for Mythological, Camp and Hunting Place;
- Place ID 22886 – stored data and not a registered site for Mythological, Meeting Place, Natural Features and Plant Resource.

2.4.2 Non-Aboriginal Heritage

Several heritage listed buildings are located within the 'Register of Heritage Places Curtilage' (RHP) on the subject site, being the Maddington Homestead building, and associated outbuildings, which includes adapted brick laundry, Wattle and Daub Timber Shed and Blacksmith's Machinery Shed.

The buildings within the RHP Curtilage Site are listed in the following public registers:

- Heritage Council of Western Australia – Register of Heritage Places (under which statutory 'Heritage Curtilage' is created);
- City of Gosnells – Municipal heritage Inventory (Management Category A); and
- City of Gosnells – Town Planning Scheme No. 6 Heritage List.

The following statement of significance is taken from the Permanent Entry and states the following:

The place is extremely rare, intact example of a substantial settler's house constructed in Western Australia prior to the convict era.

The place is the oldest extant residence in the district and is highly valued by the community.

The place contributes to the community's sense of place by providing a link with the colonial development of the area.

The place is associated with prominent figures in the history of Western Australia and the Canning district such as John Randall Philips, Major William Nairn, Surveyor General John Septimus Roe, Richard and Jabez White, John Liddelow and Joseph Harris and his descendants.

The place is associated with the earliest phases of rural development along the Canning River and with a subsequent gardening enterprise.

The place illustrates the innovative and creative use of local materials to imitate those used for houses in England at the time.

The 'Heritage Curtilage' identified on *Lots 173-177 Burslem Drive ODP* was determined by the Heritage Council that the building could be substantiated without detriment to the Homestead site. This was on the basis that future residential development within the Curtilage will be designed so to be complementary to the Homestead building.

Pursuant to the ODP, future proposed subdivision within the 'Heritage Curtilage' will require approval from the Heritage Council of Western Australia.

2.5 Context & Other Land Constraints

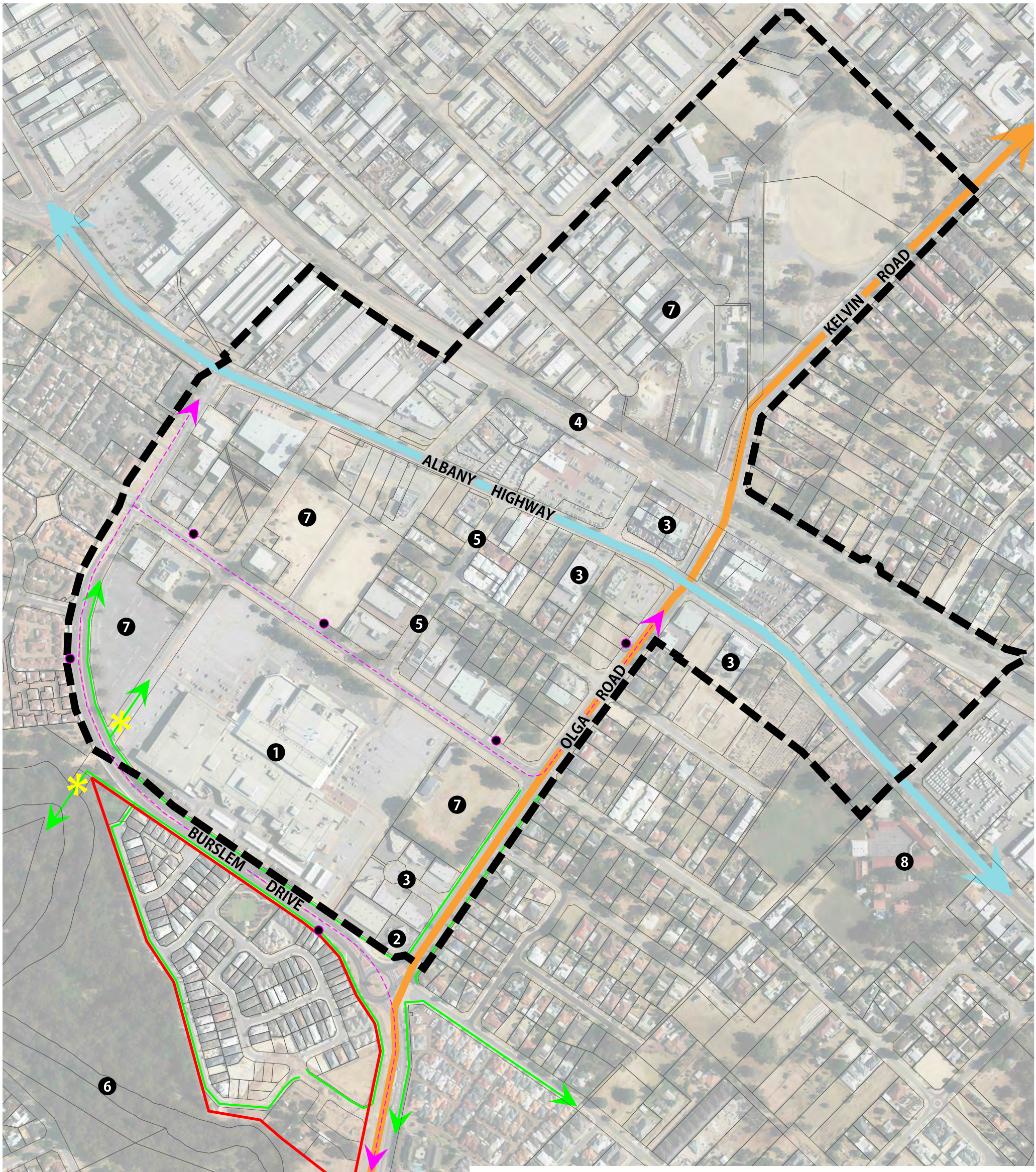
The local context plan shows the ODP within the context of the Maddington Secondary Activity Centre (refer to Figure 3).

2.5.1 Movement Network

2.5.1.1 BURSLEM DRIVE

Burslem Drive is reserved as *Other Regional Road* under the MRS. This road is also classified as a 'District Distributor A' and is an important connection between Albany Highway, Spencer Road, Warton Road and beyond. This transport corridor may generate high transport noise which may affect the adjacent future residential lots.

Burslem Drive is currently a two-lane, two way undivided road with a median at the entrance into Arcadia Waters Retirement Village. Burslem Drive is a 40 metres wide road reserve. The southern side of the Canning River, Burslem Drive has been upgraded to a dual carriageway.



LEGEND

- SUBJECT SITE
- MADDINGTON TOWN CENTRE AREA BOUNDARY
- PRIMARY REGIONAL ROAD
- OTHER REGIONAL ROAD
- EXISTING PEDESTRIAN + CYCLIST PATHS
- EXISTING PEDESTRIAN + CYCLIST UNDERPASS
- BUS ROUTE
- BUS STOP

EXISTING AMENITY

1. CENTRO MADDINGTON SHOPPING CENTRE
2. SERVICE STATION
3. SERVICE COMMERCIAL
4. MADDINGTON RAILWAY STATION
5. FUTURE MAIN STREET
6. CANNING RIVER
7. FUTURE COMMERCIAL, MIXED USE + HIGH DENSITY RESIDENTIAL
8. MADDINGTON PRIMARY SCHOOL

SITE CONTEXT PLAN

Maddington Homestead

FIGURE 3

NORTH

Scale: 1:5000 @ A3

0 50 100 150m

PLAN: GOGMA-1-009 REVISION: A
DATE: 24/03/2022 DRAWN: JP
PROJECTION: PCG 94 PLANNER: CM
DATUM: AHD CHECK: CM

2.5.1.2 PUBLIC TRANSPORT

Transperth bus route number 204/205 and 228 operates along this road on route to Maddington Secondary Activity Centre and other employment and transport nodes. Bus route number 220, 850 and 851 services the Maddington Secondary Activity Centre.

The Maddington Train Station is approximately 800 metres north-east of the ODP along Sampson Street.

2.5.2 Services and Infrastructure

No major services and infrastructure are currently being planned on the subject site.

2.5.3 Maddington Secondary Activity Centre

Maddington has been identified as a Secondary Activity Centre. The area measures approximately 33.1 hectares and has approximately 52,000sqm NLA. This ODP is located along the southern boundary of the Maddington Secondary Activity Centre.

The Maddington Secondary Activity Centre consists of:

- A traditional 'big box' style shopping mall surrounded by large areas of car park.
- A group of retail and office uses including a petrol station is located on the corner of Burslem Drive and Olga Road.
- A mix of commercial and low density residential uses are located between Attfield Street and Albany Highway. There are also some vacant lots and the bulk of the land is underutilised.

The Maddington Secondary Activity Centre is well serviced by the surrounding roads and existing paths.

Given the proximity of the Maddington Secondary Activity Centre, the ODP does not provide for any additional commercial or retail land uses.

2.5.4 Government Schools

Maddington Primary School is located along Albany Highway. Access to the existing Maddington Primary School can also be achieved from Attfield Street. The primary school is approximately 600 metres from the ODP area. The ODP does not provide for a Primary School nor a High School site.

3 PLANNING FRAMEWORK

3.1 Zoning & Reservations

3.1.1.1 METROPOLITAN REGION SCHEME

The subject site is zoned 'Urban' under the provisions of the Metropolitan Region Scheme (MRS) (refer to Figure 4).

3.1.1.2 CITY OF GOSNELLS TOWN PLANNING SCHEME NO 6

The subject site is zoned 'Residential Development' under the City of Gosnells Town Planning Scheme No. 6 (TPS6) (refer to Figure 5).

3.1.1.3 LOT 173-177 BURSLEM DRIVE OUTLINE DEVELOPMENT PLAN

The Lot 173-177 Burslem Drive Outline Development Plan (ODP) (refer to Figure 6) was adopted by Council in 2005 and identifies the site as being zoned "Residential" with an applicable density code of R20-R40 with a Heritage Site.

This ODP amendment is generally consistent with the existing Lot 173-177 Burslem Drive ODP (refer to Figure 7) except for the proposed consolidation of the Maddington Park Homestead and Ancillary Buildings into a 'Special Use' Zone (refer to Section 3.2.4.3).

3.2 Planning Strategies

3.2.1 DIRECTIONS 2031 AND BEYOND

Directions 2031 and Beyond provides a broad strategic framework defining he overall visions for the Perth and Peel Regions for the next 20 years. It sets out the planning framework for the delivery of housing, infrastructure and service to accommodate future projected population growth within both regions. A key element of the overall visions identified by *Directions 2031 and Beyond* is the consolidation of existing urbanised areas to ensure the efficient use of land and infrastructure.

Directions 2031 and Beyond identifies potential urban expansion and investigation areas within the Perth and Peel Regions. The subject site is within the 'South-East Sub-region' and has been identified as 'Urban'.

In accordance with the findings of the report, the population of the South-East Sub-Region is expected to increase from between 65,000 to 100,000 dwellings from 2008 to 2031. The population is projected to grow from 170,000 to 228,000 people over the same period.

Maddington is the closest activity centre to the subject ODP. This centre has been identified as a 'Secondary Centre'.

The proposed ODP amendment and ultimate subdivision of the site will assist the City of Gosnells and Western Australian Planning Commission in meeting these density targets.

The ODP satisfies the objectives of *Directions 2031 and Beyond* in the following ways:

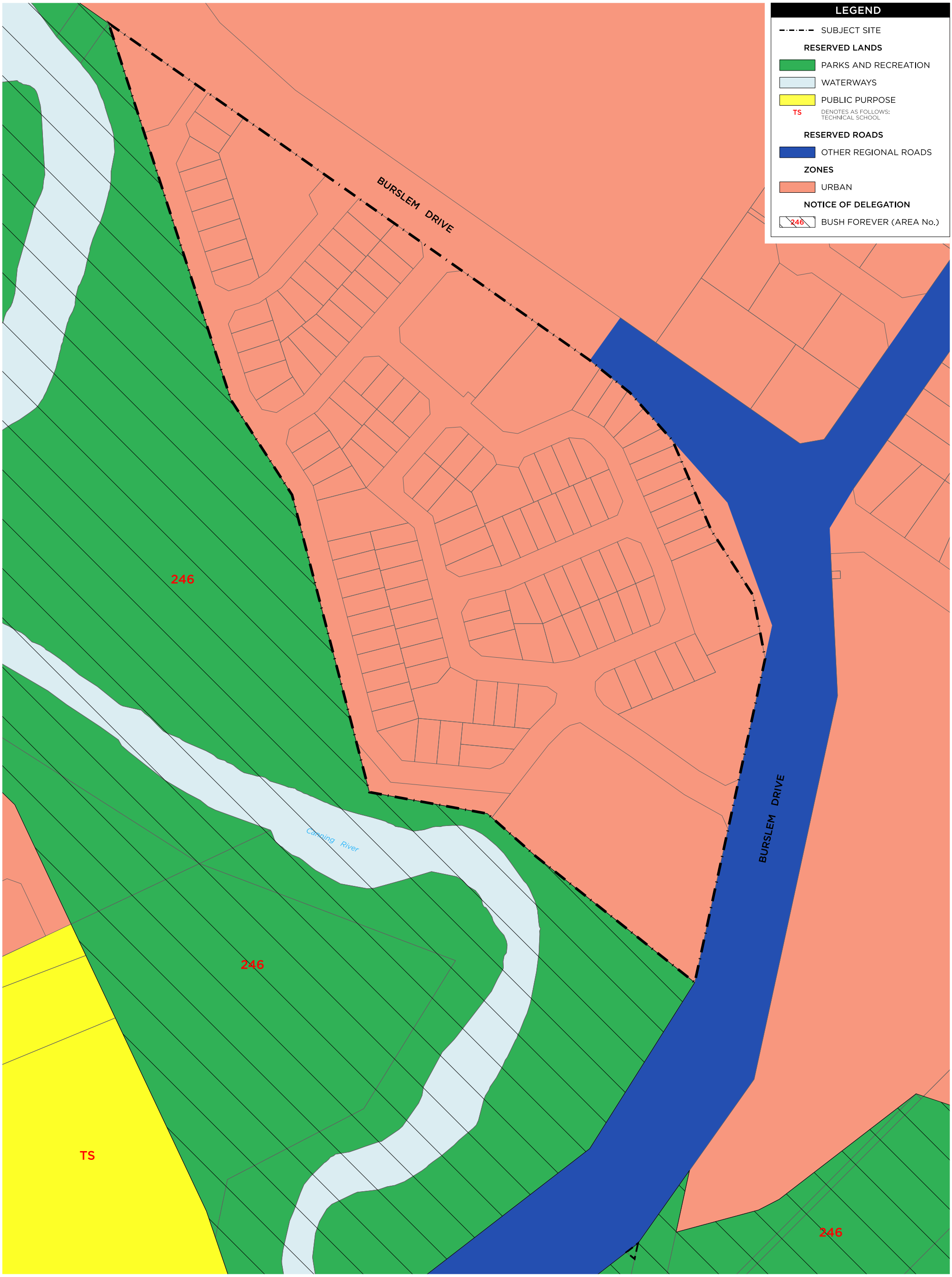
- The ODP facilitates urban development that is efficient in its design and use of resources;
- The ODP satisfies the density target of 15 dwellings per gross urban zone hectare;
- The development will help support the neighbouring Maddington Secondary Centre and the patronage of major public transport and road infrastructure in the area.

3.2.2 PERTH AND PEEL @ 3.5 MILLION

Perth and Peel @ 3.5 Million provides a framework for the development of the Perth and Peel Region to the year 2050. The document provides a strategic guidance to government agencies and local governments on land use, land supply, land development, environmental protection, infrastructure investment and the delivery of physical and community/social infrastructure for the Perth and Peel Region. The document seeks to meet the targets identified under *Directions 2031 and Beyond* and the *State Planning Strategy 2050*. *Perth and Peel @ 3.5 Million* also includes four Sub-Regional planning frameworks.

The subject site is situated within the *South Metropolitan Peel Sub-Regional Planning Framework* and is identified for Urban use consistent with the MRS zoning.

Several of the Framework's key principles are relevant to the Outline Development Plan including:



METROPOLITAN REGION SCHEME ZONING

Maddington Homestead

FIGURE 4

NORTH

Scale: 1:2000 @ A3

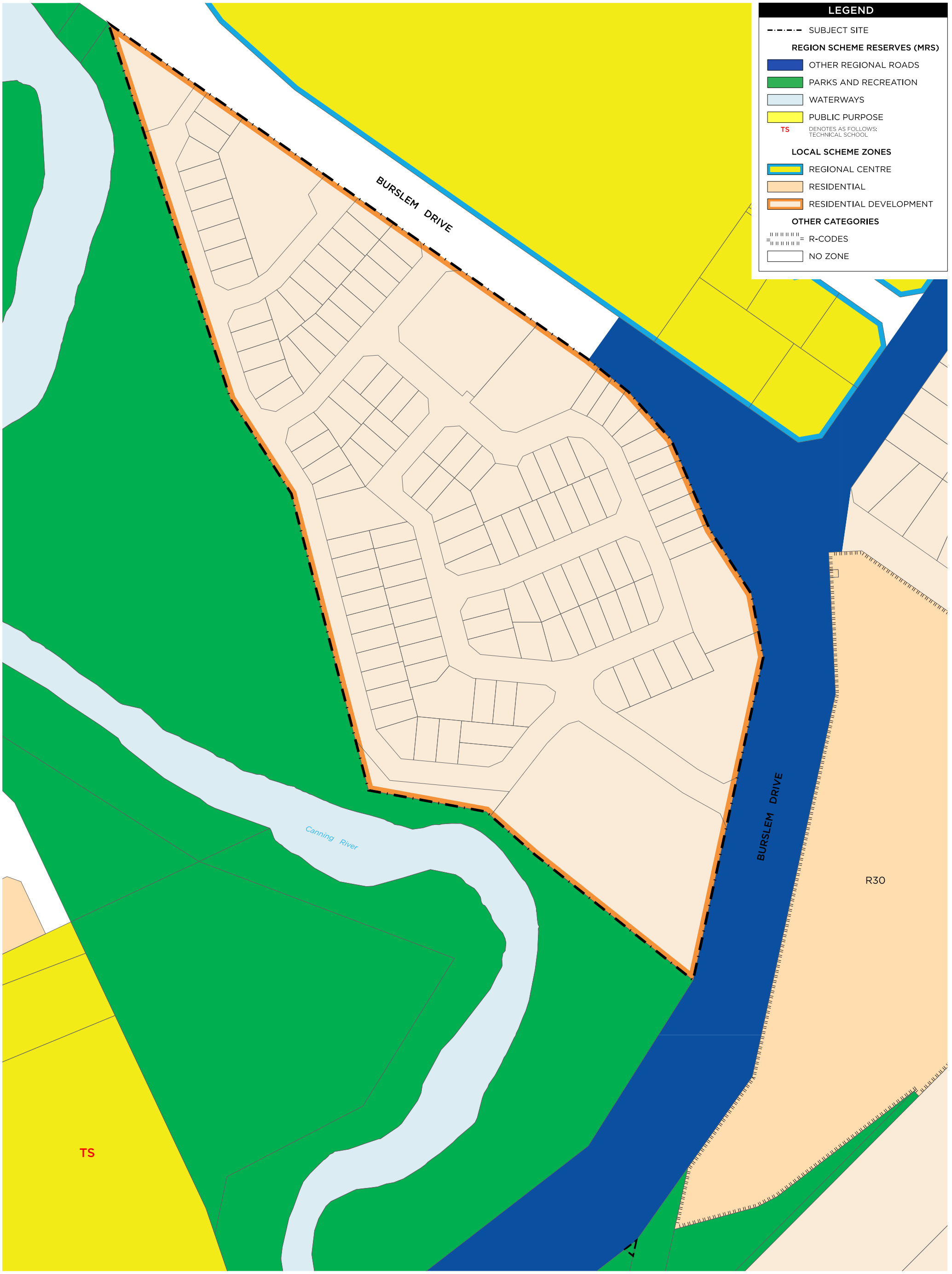
0 20 40 60m

PLAN: GOGMA-5-003 REVISION: A

DATE: 24/03/2022 DRAWN: JP

PROJECTION: PCG 94 PLANNER: CM

DATUM: AHD CHECK: CM



TOWN PLANNING SCHEME No.6

Maddington Homestead

FIGURE 5

NORTH

Scale: 1:2000 @ A3

0 20 40 60m

PLAN: GOGMA-5-004 REVISION: A

DATE: 24/03/2022 DRAWN: JP

PROJECTION: PCG 94 PLANNER: CM

DATUM: AHD CHECK: CM

APPROVED ODP - May 2005

Figure 6

N

0 25 50 75m

Scale: 1:2500@A4 Date: 26/8/15 Plan: GOGMA-5-005

studio CFM TOWN PLANNING URBAN DESIGN

- Develop a consolidated urban form that limits the identification of new greenfield areas to where they provide a logical extension to the urban form, and that places a greater emphasis on urban infill and increased residential density.
- Maximise the use of and add value to existing infrastructure including transport, community/social and service infrastructure where there is a concentration of urban and employment opportunities.

Under the document's Urban Consolidation Principles, the relevant principles includes:

- Housing – Provide well-designed higher density housing that considers local context, siting, form, amenity, and the natural environment, with diverse dwelling types to meet the changing needs of the changing demographics.
- Character and Heritage – Ensure the attractive character and heritage values within suburbs are retained and minimise changes to the existing urban fabric, where appropriate.
- Activity Centres – Support urban and economic development of the activity centres network as places that attract people to live and work by optimising land use and transport linkages between centres; protecting identified employment land from residential encroachment, where appropriate; and avoiding contiguous linear or ribbon development of commercial activities beyond activity centres.

The Outline Development Plan proposes a density of approximately 15 dwellings per gross urban hectare, which will contribute to meeting the forecasted dwelling target of 12,801 in the City of Gosnells and wider Southern Sub-Region.

3.2.3 Policies

3.2.3.1 State Planning Policy 2.10 – Swan-Canning River System

State Planning Policy 2.10 – Swan-Canning River System (SPP 2.10) is the overarching Policy which drives land use and planning decision making in proximity to the Swan and Canning River system. The Policy sets out a vision statement supported by guiding principles such as securing public access to the river, encouraging appropriate development in the context of the river, and protection of the river's natural environment.

SPP 2.10 is further broken down into statements of Policy for individual sections of the river system; i.e. Upper Swan, Perth water, Blackwall Reach etcetera which sets out specific objectives for those portions of the river system.

The Homestead ODP area is located within the 'Upper Canning and Southern rivers' section. According to the provisions of the Policy, planning decisions in this area should 'improve public access to the river' and 'protect places of cultural significance, in particular places on the State Heritage Register'.

3.2.3.2 State Planning Policy 3.5 – Historical Heritage Conservation

State Planning Policy 3.5 – Historic Heritage Conservation (SPP 3.5) is the overarching Policy which seeks to guide the preservation of areas of heritage significance throughout Western Australia.

The Policy makes the Heritage Council of Western Australia responsible for the identification, assessment, and registration of places of State significance, permits heritage areas to be designated by Local Planning Schemes, allows Local Governments to establish heritage lists, and sets out the relevant considerations for development assessment.

Importantly, the Policy sets out development control principles to be applied in relation to heritage areas, including a general presumption against demolition of heritage sites

3.2.3.3 State Planning Policy 3.7 – Planning In Bushfire Prone Area

State Planning Policy 3.7 – Planning in Bushfire Prone Area (SPP 3.7) seeks to guide he implementation of effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure. The subject site is identified by the Department of Fire and Emergency Services Map of Bushfire Prone Areas as being 'bushfire prone' with the mapped bushfire risk coming from the adjacent Canning River (Bush Forever Site No. 246).

Due to the site being identified as being 'bushfire prone', consideration of the principles and objectives of SPP 3.7 need to be considered as part of an application for subdivision approval. A Bushfire Management Plan has been prepared around the balance undeveloped portion of the ODP and is included in Appendix 1 to this report.

3.2.3.4 State Planning Policy 5.4 - Road And Rail Noise

The general objectives of *State Planning Policy 5.4 – Road and Rail Noise* (SPP 5.4) are to ensure people are protected from unreasonable levels of transport noise and to ensure new development is compatible with existing transport corridors and freight operations. It is noted the subject site abuts Burslem Drive on the southern portion of its eastern boundary which is an 'Other Regional Road' under the *Metropolitan Region Scheme*. A portion of the site will therefore be subject to impact from traffic noise because of future residential development.

As Burslem Drive is an 'Other Regional Road' which has the capacity of accommodating a high volume of traffic, it has the potential to exceed the 'noise target' requirements of SPP 5.4. In this regard, the ODP concludes that a number of noise amelioration measures may be required as a result of the urban development of the site to satisfy the principles and objectives of SPP 5.4, including:

- Notification on Title to be provided over the affected lots to state:

  "This lot is situated in the vicinity of Burslem Drive and is currently affected, and/or may in the future be affected by transport noise."

- Implementation of specified quite house package in accordance with the requirements of SPP 5.4.

3.2.3.5 WAPC Planning Bulletin – Historic Heritage Conservation

The Western Australian's Planning Bulletin 88 – Historic Heritage Conservation introduces and sets out the major aims, guiding principles and the background of State Planning Policy (SPP) 3.5 – Historic Heritage Conservation.

An important consideration of the bulletin is that it sets out how Local Planning Scheme and Strategies relate to the new SPP and the Model Scheme Text (MST).

3.2.3.6 Heritage Council Of Western Australia – Register Of Heritage Places

The Register of Heritage Places (RHP) is a statutory list of the State's most important and valuable heritage sites prepared by the Heritage Council of WA. The RHP entry records heritage sites significance, rarity, condition, location and other heritage listings. Sites listed on the Register are to be referred to the Heritage Council for comment during any development application or structure planning/ODP process prior to determination being made.

Maddington Park Homestead is listed on the Heritage Council's Register of Heritage Places (Permanent).

The 'Maddington Park Conservation Plan' was prepared for the RHP curtilage site by Considine & Griffiths Architects in conjunction with historian Robin Chinnery in June 2004. The upgrading of the homestead and significant outbuildings is to be undertaken in accordance with the recommendations of the conservation plan endorsed by the Heritage Council of WA.

The site remains the subject to a Conservation Order and that Ministerial approval will be required as part of the planning process.

At the completion of the conservation works for the homestead and outbuildings, Wellington Parkland seeks to have the curtilage of the Registered Place reduced to the lot on which the heritage place stands, removing the curtilage from road reserves and partial inclusion of approved subdivided lots.

3.2.4 Local Planning Framework

3.2.4.1 TOWN PLANNING SCHEME NO 6

The subject site is zoned 'Residential Development' under the City of Gosnells Town Planning Scheme No. 6 (TPS No6) (see 'Figure 5: Town Planning Scheme Map). Development within the 'Residential Development' zone must generally be in accordance with the approved ODP (Figure 6).

The objectives of the 'Residential Development' zone are:

- *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 generally in accordance with an Outline Development Plan adopted pursuant to Clause 7.4.*

Clause 5.7.1 Non-Residential Development in the Residential Zone provides for the following:

- *Non Residential Development in the Residential zone shall conform with the provisions of Section 1.5 – Setback Requirements and the maximum plot ratios prescribed in Table 1 of the Residential Design Codes, applicable to the density code afforded to the lot by the Scheme.*

3.2.4.2 CITY OF GOSNELLS MUNICIPAL HERITAGE INVENTORY 2016

The *City of Gosnells Municipal Heritage Inventory* identifies sites of heritage value within the City of Gosnells. It is prepared under the provisions of the Heritage Act 1990 and builds upon the City's original Heritage Inventory prepared in 1998. Sites of historical significance are divided in to 'A' 'B' and 'C' management categories indicating the highest to lowest levels heritage significance.

'Maddington Park Homestead', is identified as 'Category A' place, indicating the site's high heritage value not only to the City of Gosnells, but the State of Western Australia. There are only three other 'Category A' heritage sites within the City of Gosnells.

The *Municipal Heritage Inventory* has encouraged the Maddington Park Homestead for retention and conservation of place.

3.2.4.3 EXISTING LOT 173-177 BURSLEM DRIVE OUTLINE DEVELOPMENT PLAN (MAY 2005)

Residential

The existing *Lot 173-177 Burslem Drive ODP* currently provides for single residential development at R-Code R30 and grouped housing sites at R-Code R40. The ODP provides for the following residential yields:

- 122 single residential lots
- 6 Grouped Housing sites. 5 of these sites have been developed and yields 35 dwellings. The remaining 2 sites are located within the final stage of subdivision. These two sites have the capacity of yielding an additional 16 dwellings.

The ODP has an overall yield of 170 dwellings. This equates to a density of approximately:

- 19.5 dwellings per gross urban area; and
- 30 dwellings per site hectare.

These dwelling yields exceeds the minimum density prescribed by *Directions 2031 and Beyond* as well as Liveable Neighbourhoods.

Proposed interface along Burslem Drive to meet the requirements of the City of Gosnells Safe City Urban Design Strategy.

Public Open Space

The ODP provides for 0.5782 hectares of public open space. This equates to 6.58% POS contribution (including the heritage site) and 7.47% POS contribution (excluding the heritage site).

Local Development Plan (Detailed Area Plan)

The following are to be addressed in a Local Development Plan (Detailed Area Plan):

- A Local Development Plan (Detailed Area Plan) over lots that directly abuts Burslem Drive and/or Public Open Space will be prepared & implemented in consultation with City of Gosnells, prior to subdivision being finalised.

Homestead Curtilage

- Residential Development Zone shall be used when determining land use permissibility for the heritage site.
- Development within the heritage curtilage is to be approved by the Heritage Council prior to subdivision.

Dual Use Paths

- Location and development of the Dual Use Path (D.U.P) along the foreshore reserve to be finalised in consultation with Swan River Trust.
- Pedestrian crossing point in Burslem Drive to Maddington Secondary Activity Centre – location to be resolved in consultation with City of Gosnells.

3.2.5 Other Approvals & Decisions

Future development application will need to fulfill relevant condition of the subdivision approval granted by the WAPC on 12 September 2017 (WAPC Application Number 155668).

Lot 173 - 177 Burslem Drive, Maddington Development Schedule (GOGMA-5-007)	23-Mar-22
GROSS SITE AREA (hectares)	**8.700**
Minus Deductions (MRS ZONES)	
Total Non Urban Areas	**0.000**
Gross Urban Zone Area (ha)	**8.7000**

Less Uncreditable Open Space	
Total Uncreditable Open Space	**0.000**
Net Urban Zone (NUZ) Area (ha)	**8.700**

Deductions	
Total Deductions	**0.000**
Gross Subdivisible Area (GSA)	**8.7000**

Public Open Space Contribution (To be Provided)		**10%**	**0.8700**
2%	*Maximum Percentage of Restricted Public Open Space Permitted*	0.1740	
8%	*Minimum Percentage of Unrestricted Public Open Space to be provided*	0.696	
Minimum Public Open Space Contribution Required			**0.870**

PARKS						
POS Reference	**Location**	**Gross Area**	**First 15mm Drainage Area**	**Flood Storage Area (First 15mm to 1:5y ARI @ 1.25% of NUZ)**	**Flood Storage Area (1:5y to 1:100y ARI)**	**Unrestricted POS Area**
1		0.1345	0.0000	0.000	0.0000	0.1345
2		0.3318	0.0000	0.000	0.0000	0.3318
3		0.0934	0.0000	0.000	0.0000	0.0934
Total POS & Drainage		**0.560**	**0.000**	**0.000**	**0.000**	**0.560**

4 LAND USE & SUBDIVISION REQUIREMENTS

4.1 Land Use

The Lot 173-177 Burslem Drive Outline Development Plan (ODP) sets out land use, residential densities, public open space, vehicle and pedestrian/cyclist access within the broader locality.

The ODP amendment seeks to reduce the size of the heritage curtilage as reflected on the ODP amendment map. Further justification in support of this is provided in the following sections of this report (Refer Figure 6 – Outline Development Plan Amendment Map.

4.2 Maddington Homestead

The Maddington Homestead was built by Major William Nairn (c1836) for use as a private residence and consists of a two-storey rough rendered stone residence with a corrugated iron clad double hipped roof. The house has nine rooms in all and a cellar. Adjacent are a wattle and daub tack room, a detached kitchen and dairy, and two corrugated iron sheds. The site was historically surrounded by 60.7 hectares of established market garden and orchard. For five generations, the property has been the focal point of one of the most agriculturally successful families in the Canning District, the Harris family.

A fire in 1983 caused by a heater damaged the ground floor sitting room and was boarded up to prevent vandalism.

The Harris family continued to operate the land as a small market garden and orchard, but the house remained vacant.

4.2.1 Statement of Significance

The statement of significance is taken from the Permanent Entry.

The place is an extremely rare, intact example of a substantial settler's house constructed in Western Australia prior to the convict era.

The place is the oldest extant residence in the district and is highly valued by the community.

The place contributes to the community's sense of place by providing a link with the colonial development of the area.

The place is associated with prominent figures in the history of Western Australia and the Canning District such as John Randall Phillips, Major William Nairn, Surveyor General John Septimus Roe, Richard and Jabez White, John Liddelow and Joseph Harris and his descendants.

The place is associated with the earliest phases of rural development along the Canning River and with a subsequent market gardening enterprise.

The place illustrates the innovative and creative use of local materials to imitate those used for houses in England at the time.

4.2.2 The Proposed Maddington Park Homestead Site Design

The proposed amendment rationalises the Maddington Park Homestead Site and introduces residential development into the balance area.

The Maddington Park Homestead Lot is 'Heritage Site'.

The Maddington Park Homestead Lot is proposed to be approximately 4024sqm. This site will contain the existing Maddington Park Homestead building, the detached kitchen and dairy, the Blacksmith Shed, the Long Shed and the existing Well.

The Homestead Lot provides for the opportunity to interpretate 'a casual rural landscape adjacent to the Canning River'.

The Homestead Lot will have a primary street frontage onto McLaughlin Boulevard and a secondary street frontage onto Kawana Avenue.

The Maddington Park Homestead and associated outbuildings will have uninterrupted views from Burslem Drive after the bridge crossing. Views from multiple points along the Canning River reserve can also be achieved to promote the 'sense of place'.

4.3 Residential

The existing ODP has the capacity to yield 122 green titled lots and 7 grouped housing sites. To date, 110 green titled lots have been created. 5 Grouped Housing Sites with 35 dwellings are also developed. At 2.7 people per household, the ODP area will have approximately 460 people.

The proposed ODP amendment seeks to add an additional area for Residential R30 allotments. This will add to the housing diversity and choice within the ODP as these future dwellings can be developed as Specialist Disability Accommodation (SDA) and provide Supported Independent Living (SIL) services to 3-4 NDIS participants per dwelling.

The balance undeveloped land has approximately 20 lots and 2 grouped housing sites. The 2 remaining grouped housing sites has the potential to yield 16 dwellings.

The revised overall yield is 130 green titled lots and 48 grouped housing dwellings. The gross urban area of 8.7 hectare achieves the following density of approximately:

- 20 dwellings per gross urban hectare.
- 30 dwellings per site hectare.

The 178 total dwellings are estimated to have a population of 480 people.

4.4 Movement Networks

The proposed road network is consistent with the existing road network and provisions of the existing ODP. The ODP amendment does not provide for any direct vehicular access onto Burslem Drive from the future residential lots.

The amendment to the ODP which results in a smaller homestead curtilage lot and the additional R30 single residential dwellings is less intense as the abovementioned approved Development Area Plan (2016). The proposed residential development will not significantly increase the local traffic volumes to justify a change in the current road hierarchy and movement network. Thus, the existing road network and reserve widths proposed under the current ODP is considered sufficient.

The proposed additional 'Access Street D' will be consistent with Liveable Neighbourhoods. It will transition seamlessly to McLaughlin Boulevard and the existing movement network. McLaughlin Boulevard remains unchanged and will be the southern access point into the ODP from Burslem Drive.

The proposed additional 'Access Street D' has also been designed to provide another view corridor from Burslem Drive towards the existing Maddington Homestead. This is consistent with the urban design principles which safeguards the presence and prominence of the existing homestead within the context of the surrounding urban development and the Canning River.

The Dual Use Path within the foreshore area has been delivered.

Pedestrian crossing point in Burslem Drive to Maddington Secondary Activity Centre has been determined with consultation with City of Gosnells.

4.5 Water Management

VDM Environmental has prepared a Drainage and Nutrient Management Plan for the ODP. The main design philosophy of the design is based on the 'living stream concept' and has proposed the following:

- Provide an integrated treatment train that addresses nutrients, flood attenuation, sediment control and regulates catchment outflow to ensure existing outfalls and flows into the Canning River are maintained.
- Establish a wetland interface by incorporating a 'living stream' and swale system that defines the edge between rehabilitated/restored foreshore and the proposed development.
- Ensure volume and flow requirements of the treatment train have been calculated to take up a 1:1 year ARI storm event.

A wide range of structural Water Sensitive Urban Design (WSUD) Best Management Practices for stormwater quantity control have been considered for inclusion within the development layout of the site. These, coupled with On-Site Detention systems contribute to mitigate the increases in flows because of urban development. These structural BMP are elaborated (see Appendix 2 Chapter 3) as follows:

- 3 Gross Pollutant Traps to collect any floating debris and litter prior to entering the treatment train.
- Utilising of landscape areas as detention and treatment areas within the wetland area, i.e. grassed V-drains and vegetation swales.

- Incorporating into the 'living stream' a series of 2 nutrient stripping ponds and 1 compensating basin that are interconnected by the swales within the wetland area.

4.6 Local Development Plan

A new Local Development Plan will be prepared for the site in accordance with the Regulation for the orderly and proper planning of the Maddington Park Homestead and the future residential allotments within the heritage curtilage.

4.6.1 The Maddington Park Homestead

The Maddington Park Homestead development application will address the adaptive reuse of the Maddington Park Homestead. The following are key design elements to be addressed:

- the Maddington Park Homestead's rural and domestic context within the Canning River environment.
- The retention of existing significant trees and establishing a heritage landscape.
- Provide details of proposed fencing and impact on views from the north, river and adjacent estate.
- Multiple view lines to the Maddington Park homestead from Burslem Drive whilst addressing noise attenuation to the adjacent future residential development. View lines to the Maddington Park homestead from McLaughlin Boulevard, Kawana Avenue and from the Canning River.

4.6.2 Future Residential

The balance undeveloped residential lots shall have regard to the existing provisions of the ODP.

The Local Development Plan for the residential lots within the heritage curtilage will:

- Guide the ultimate build out of the residential sites with regard to the existing Maddington Park Homestead and out buildings.
- Guide the development of houses with a Bushfire Attack Level of 12.5 or higher. Variations sought may seek to maximise areas of useable development area inside the BAL 29 contour.

4.7 Infrastructure Coordination, Servicing & Staging

4.7.1 Earthworks

The location of the proposed subdivision is on a clay site and thus will require remediation works as per Stage 3. Imported sand material will then be mixed in with the clay material on site to a ratio acceptable by Geotechnical engineers. This mixed material known as Modified Sand/Clay material will be used throughout the subject site, and compacted and tested prior to commencement of civil works. This process is required to ensure the site earthworks and drainage works are as per the drainage strategy for flowing into the Canning River.

The complete earthworks will need to ensure that an overall site classification of 'S' is achieved.

4.7.2 Road Infrastructure and Drainage

Roads and drainage will be required to comply with the City of Gosnells requirements and provide an appropriate interface to existing Stage 3. In accordance with the ODP, construction of Panozza Circle will require completion; Kawana Avenue will be extended to meet up with Burslem Drive via McLaughlan Boulevard, and thus requiring an additional intersection to be introduced as part of future subdivision development. The proposed drainage strategy will ensure run off is captured in a pit and pipe arrangement and outflows into the Canning River catchment in line with the previous Stage.

4.7.3 Sewerage Reticulation

The ODP is located within the existing catchment for scheme wastewater. A 300mm dia sewer main is already reticulated throughout the proposed Stage 4 subdivision area and connects into existing sewer networks. This pipe has capacity to accommodate the undeveloped Stage 4 outflows and only lot connections will be required as part of Stage 4 civil works. The sewer connection points are off Kawana Avenue, Burslem Drive and Panozza Circle respectively. The sewer network functions as a 'gravity sewer.'

4.7.4 Water Supply

The proposed subdivision is located within the existing catchment for scheme water reticulation. The proposed Stage 4 subdivision area will be serviced by existing water reticulation mains and future lots will require connections into these mains. There is currently a 150mm diameter and a 100mm diameter main running through the proposed Stage 4 subdivision area. The existing WaterCorp network has the capacity to meet the demands for proposed subdivision.

4.7.5 Natural Gas

The proposed subdivision will be supplied with reticulated gas via the existing network from Stage 3 off Panozza Circle and Kawana Avenue. ATCO Gas has indicated there is sufficient capacity to service the future demands of the balance undeveloped land.

4.7.6 Western Power

Power supply to the balance undeveloped area will be via an extension of the existing end points at Panozza Circle and Kawana Avenue. The transformer located on Lot 307 has sufficient capacity to service the balance area. Should additional power supply be required, it is likely that an upgrade by Western Power to the transformer at Lot 307.

4.7.7 Telstra

The proposed ODP is located within the catchment of the existing Telstra network. Services will be extended via pit and pipe design to service the balance undeveloped area.

5 CONCLUSION

This report has been prepared to support the rationalisation of the existing heritage site for the Maddington Homestead and the creation of additional residential development land and public open space. This amendment will facilitate the restoration of the existing Maddington Park Homestead and associated outbuildings.

As demonstrated in this report, the proposed amendment is considered justified and appropriate for the following reasons:

- To consolidate the Maddington Park Homestead heritage site and allotment to enable the future conservation and adaptive reuse of the building and its associated outbuildings.
- To ensure the refurbished Blacksmith's Shed and Long Shed are retained in public open space and is accessible to the public.
- To provide an appropriate rural and colonial setting for the existing Maddington Park Homestead and its associated outbuildings.
- Provides housing diversity and choice within the Maddington Secondary Activity Centre.
- The increase in yield within the ODP amendment is minimal and does not have significant traffic implications on the surrounding road network.
- Future developments will be guided by a Local Development Plan to ensure future residential dwellings adequately address the existing Maddington Park Homestead.
- Risk associated with bushfire and mitigation measures for acoustic noise will be appropriately addressed through the Local Development Plan.

The proposed Outline Development Plan amendment is consistent with the relevant State and Local Planning Framework and it is therefore requested the City of Gosnells and Western Australian Planning Commission support the amendment request.

Table 5: Technical Appendices Index

APPENDIX NO	DOCUMENT TITLE	NATURE OF DOCUMENT	REFERRAL/APPROVAL AGENCY	SUMMARY OF DOCUMENT MODIFICATIONS
1	Bushfire Management Plan			
2	Drainage and Nutrient Management Plan			
3	Civil Engineering			

APPENDICES

Appendix 1
BUSHFIRE MANAGEMENT PLAN

Bushfire management plan/Statement addressing the Bushfire Protection Criteria coversheet

Site address: Lot 9002 Burslem Drive, Maddington

Site visit: Yes ☑ No ☐

Date of site visit (if applicable): Day 9 Month August Year 2017

Report author or reviewer: Kirsten Knox (Emerge Associates) and Rohan Carboon (Bushfire Safety Consulting) - see below.

WA BPAD accreditation level (please circle): * See below for information regarding qualifications.

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

If accredited please provide the following.

BPAD accreditation number: Accreditation expiry: Month Year

Bushfire management plan version number: EP17-077(01)--001

Bushfire management plan date: Day 8 Month September Year 2017

Client/business name: Wellington Parkland Pty Ltd

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

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

None of the above ☑

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

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

* Note: Bushfire Safety Consulting is owned and operated by Rohan Carboon, an experienced bushfire consultant to the urban planning industry. Rohan has undergraduate degrees in Environmental Management and postgraduate qualifications in Bushfire Protection and has over 20 years experience. He is currently finalising BPAD Level 3 accreditation. Emerge Associates has been providing bushfire consulting services jointly with Bushfire Safety Consulting for more than four years and have completed BPAD Level 2 training and are in the process of finalising accreditation.

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

Signature of report author or reviewer (Kirsten Knox)

Date 8 September 2017

emerge ASSOCIATES
Integrated Science & Design

Bushfire Safety CONSULTING

Bushfire Management Plan

Lot 9002 Burslem Drive, Maddington

Project No: EP17-077(01)

Prepared for Wellington Parkland Pty Ltd
September 2017

Document Control

Doc name:	**Bushfire Management Plan Lot 9002 Burslem Drive, Maddington**				
Doc no.:	**EP17-077(01)--001**				
Version	**Date**	**Author**		**Reviewer**	
1	September 2017	Andreas Biddiscombe	ADB	Kirsten Knox	KK
				Rohan Carboon	RC
	Report issued to client.				

Disclaimer:

This document has been prepared in good faith and is derived from information sources believed to be reliable and accurate at the time of publication. Nevertheless, it is distributed on the terms and understanding that the author is not liable for any error or omission in the information sources available or provided to us, or responsible for the outcomes of any actions taken based on the recommendations contained herein. It is also expected that our recommendations will be implemented in their entirety, and we cannot be held responsible for any consequences arising from partial or incorrect implementation of the recommendations provided.

This document has been prepared primarily to consider the layout of development and/or the appropriate building construction standards applicable to development, where relevant. The measures outlined are considered to be prudent minimum standards only based on the standards prescribed by the relevant authorities. The level of bushfire risk mitigation achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. The relevant local government and fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions recommended in this document, it should always be remembered that bushfires burn under a wide range of conditions which can be unpredictable. An element of risk, no matter how small, will always remain. The objective of the Australian Standard AS 3959-2009 is to “prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the front passes” (Standards Australia 2009). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be lost.

Executive Summary

Wellington Parkland Pty Ltd (the proponent) propose to develop Lot 9002 Burslem Drive, Maddington (herein referred to as "the site") for residential purposes in accordance with the proposed plan of subdivision attached as **Appendix A**. The site is approximately 2.4 hectares (ha) in area and is located approximately 16 km south-east of the Perth Central Business District, within the City of Gosnells, as shown in **Figure 1**.

The site is currently identified as a "Bushfire Prone Area" under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2017). This Bushfire Management Plan (BMP) has been prepared to support the proposed residential subdivision of the site. It includes an assessment of bushfire hazard levels in the vicinity of the site (within 150 metres), in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015), the *Guidelines for Planning in Bushfire Prone Areas Version 1.2* (the Guidelines) (WAPC and DFES 2017) and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009), and consideration of potential radiant heat impacts. This BMP has also been prepared to ensure that any bushfire risk is appropriately managed through the implementation of appropriate mitigation measures (such as increased construction standards) where necessary.

Existing bushfire hazards identified within 150 m of the site include Woodland (Class B) and Grassland (Class G) vegetation within the adjacent Swan Canning Riverpark. In the assumed post development scenario for the site, all vegetation will be removed or managed as low threat within the site to support future residential development. Vegetation outside of the site is assumed to be retained in its current state, and will therefore pose a long term bushfire risk to the site.

A method 1 Bushfire Attack Level (BAL) assessment has been undertaken as part of the BMP to determine the maximum heat flux to which proposed residential lots within the site will be exposed to in the assumed post development scenario. A BAL contour plan has been prepared based on the outcomes of the BAL assessment and is shown in **Figure 6**.

The results of the BAL assessment within this BMP show that all future dwellings within the site can achieve appropriate separation from bushfire hazards. Indicative BAL ratings (and associated construction standards in accordance with AS 3959) for each subdivided lot within the site are specified within this document, including any in-lot setback (internal APZ) requirements. These indicative BAL ratings and associated internal APZ distances will require certification prior to or as part of the lot title clearance process and can then be used to support the future building licence process.

Overall this BMP has been prepared in line with Appendix Four of the Guidelines and demonstrates that as development progresses, an acceptable solution can be adopted for each bushfire hazard management issue, as summarised below:

- **Location:** The BAL assessment indicates that the development (i.e. future dwellings) is located in an area that can or will, on completion, be subject to a BAL rating of BAL-29 or below.

- **Siting and Design:** Future dwellings will not be exposed to an unacceptable level of radiant flux, without appropriate mitigation measures, such as APZs and/or increased construction standards in accordance with AS 3959 where applicable. Separation will be provided between dwellings and post development classified vegetation through the location of public open space, public roads, and internal lot setbacks (where necessary).
- **Vehicular Access:** The internal layout, design and construction of public vehicular access and egress in the development will be in accordance with the Guidelines, and will allow vehicles to move through the site easily and safely at all times. The proposed subdivision design provides multiple connections to the existing public road network and allows residents to move away from the main source of bushfire risk, located south-west of the site.
- **Water:** The development will be provided with a permanent and secure reticulated water supply and will be installed in accordance with the specifications of the Water Corporation, including the installation of fire hydrants. This is a typical requirement of urban development.

This BMP sets out the roles and responsibilities of the developer, future residents and the City of Gosnells to ensure the bushfire risk to the site is appropriately mitigated. It is important that the measures and procedures outlined in this BMP are adopted across the subdivision and dwelling construction approvals processes.

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Appendices

1 Introduction

1.1 Background

Wellington Parkland Pty Ltd (the proponent) propose to develop Lot 9002 Burslem Drive, Maddington (herein referred to as "the site") for residential purposes in accordance with the proposed plan of subdivision attached as **Appendix A**. The site is approximately 2.4 hectares (ha) in area and is located approximately 16 km south-east of the Perth Central Business District, within the City of Gosnells, as shown in **Figure 1**.

The site comprises the final stage of the approved *Maddington Homestead Outline Development Plan* and the proposed subdivision design provides for the creation of 11 residential lots (including two grouped housing sites), internal roads and a 'heritage site'.

Part of the site is currently identified as a "Bushfire Prone Area" under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2017), as shown in **Plate 1** below. The identification of Bushfire Prone Areas within any portion of the site requires further assessment of the bushfire hazard implications on proposed development to be undertaken in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.2* (the Guidelines) (WAPC and DFES 2017).

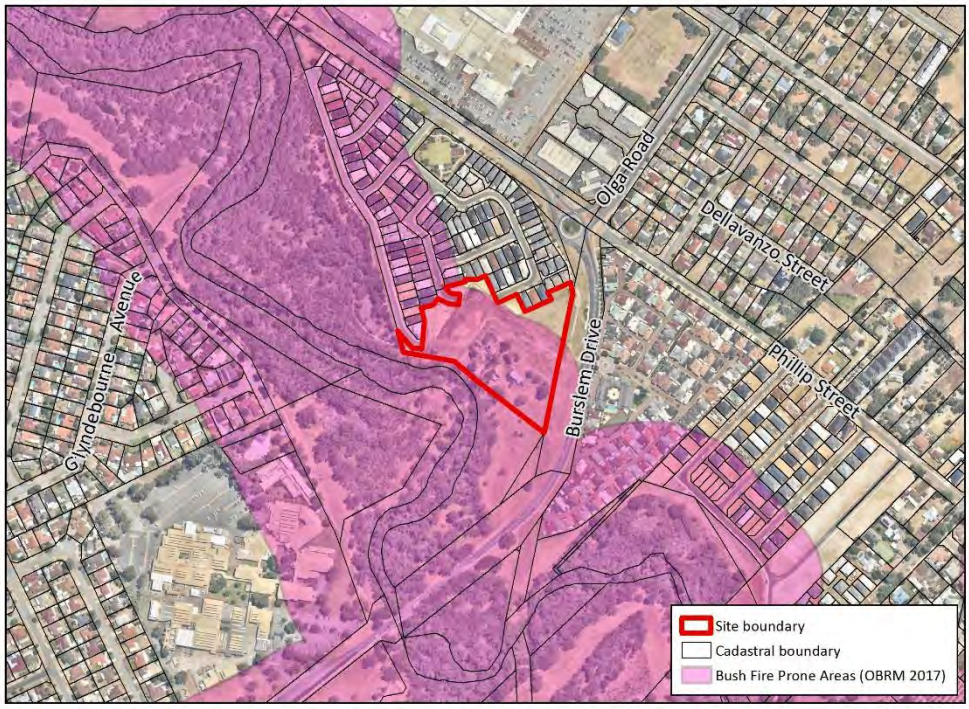

Plate 1: Areas within and surrounding the site identified as "Bushfire Prone Areas" (OBRM 2017).

1.2 Aim of this document

The objective of this BMP is to support the proposed residential subdivision of the site, in accordance with the plan of subdivision provided in **Appendix A**, and to enable bushfire management issues (such as location, siting, vehicle access and water supply) to be addressed as part of the planning process and also through future development approval (if required) and building licence processes. This BMP addresses the requirements of SPP 3.7, the Guidelines and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009) and includes:

- An assessment of classified vegetation and associated bushfire hazard levels in the vicinity of the site (within 150 m) and consideration of hazards that will exist in the post development scenario.
- Identification of how the development will achieve the performance principles of the Guidelines by ensuring:
  - Development can be located, sited and designed to ensure that any bushfire hazard does not present an unreasonable level of risk to life and property (i.e. BAL-29 is not exceeded), supported by a Bushfire Attack Level (BAL) assessment. Where applicable, this includes consideration of Asset Protection Zone requirements.
  - Vehicular access to and egress from the development is safe if a bushfire occurs.
  - Water is available to the development, so that life and property can be protected from bushfire.
- An outline of the roles and responsibilities associated with implementing this BMP (**Section 4**).

With regard to the proposed heritage site, this BMP is applicable only to the subdivision application to establish the parent lot. Any future development within the heritage site will likely require standalone bushfire planning documentation, discussed further in **Section 3.2.4**.

1.3 Accreditation

This BMP has been prepared jointly by Emerge Associates and Bushfire Safety Consulting.

Bushfire Safety Consulting is owned and operated by Rohan Carboon, an experienced bushfire consultant to the urban planning industry. Rohan has been providing bushfire risk and hazard assessment and mitigation advice to the urban planning and development industry for more than six years. He first worked professionally in community bushfire safety education in 1999 and has been involved in land management including bushfire suppression since 1993.

Bushfire Safety Consulting is a Corporate Bronze Member of the Fire Protection Association of Australia. Rohan has successfully completed the Graduate Diploma in Bushfire Protection at the University of Western Sydney and is in the process of finalising Bushfire Planning and Design (BPAD) Level 3 accreditation under the Fire Protection Association of Australia's new Western Australian accreditation scheme.

Emerge Associates has been working jointly with Bushfire Safety Consulting for more than five years to undertake detailed bushfire assessments to support the land use development industry. Emerge Associates' personnel have undertaken BPAD Level 2 training and are in the process of seeking accreditation.

1.4 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a bushfire management plan:

- *Fire and Emergency Services Act 1998*
- *Bush Fires Act 1954*
- Planning and Development (Local Planning Scheme Amendment) Regulations 2015
- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas Version 1.2* (WAPC and DFES 2017)
- *Australian Standard AS 3959 – 2009 Construction of buildings in bushfire prone areas* (Standards Australia 2009)

1.5 Description of Site and Adjacent Land Uses

The site is zoned 'urban' under the Metropolitan Region Scheme (MRS) (as shown in **Plate 2** below) and 'residential development' under the City of Gosnells Town Planning Scheme No. 6 (TPS No. 6). The site has been historically cleared, and supports some scattered trees over weedy grasses. There are also several derelict buildings/structures associated with historic land uses, as shown in **Figure 1**. The site is bound by the Burslem Drive MRS 'Other Regional Road' reserve to the east, the Swan Canning Riverpark (reserved as 'Parks and Recreation') to the south-west, and existing residential land uses to the north.

Natural topographical contours (DoW 2008) indicate that the site and surrounding residential areas are generally flat, with lower elevations occurring in the adjacent Swan Canning Riverpark. The elevation characteristics of the site and surrounding area are shown in **Figure 1**.

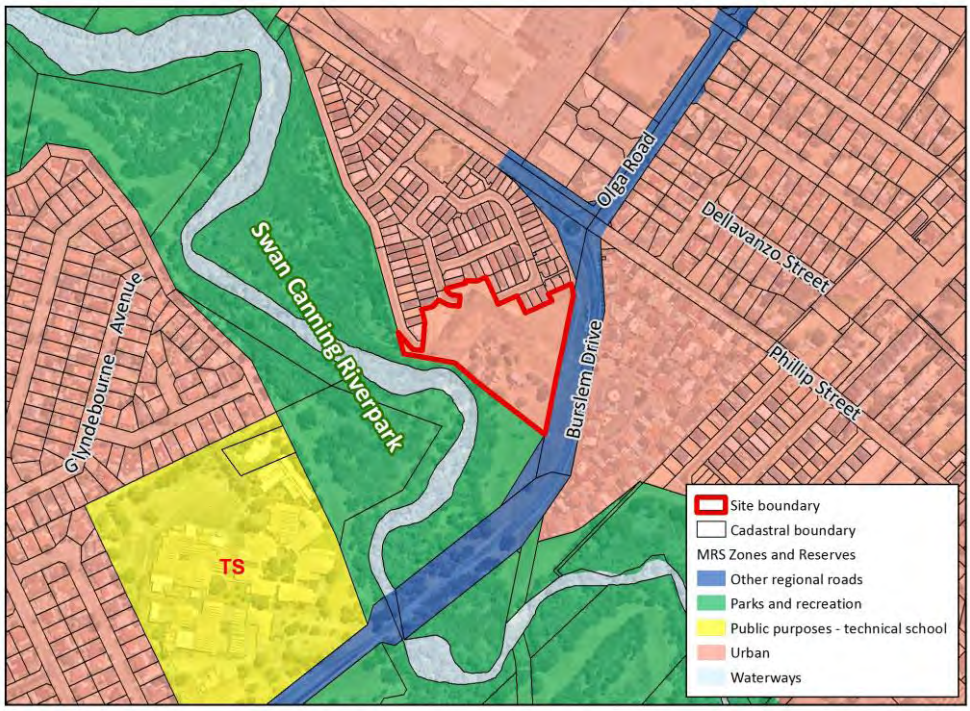

Plate 2: Land use zoning of the site and surrounding area, under the MRS

2 Bushfire Context

2.1 Bushfire risk

The risk management process described in AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines* is a systematic method for identifying, analysing, evaluating and treating emergency risks.

Bushfire risk is determined by assessing:

- Bushfire hazard (i.e. bushfire prone vegetation)
- Threat level (i.e. proximity of the hazard to assets and people)
- Vulnerability of the asset
- Consequence rating (i.e. a rating for the potential outcome once the 'incident' has occurred)
- Likelihood rating (i.e. the chance of an event).

It is not necessary to undertake a standalone site specific bushfire risk assessment in accordance with AS/NZS ISO 31000:2009 as part of this BMP, as risk has been appropriately considered in the specific context of the Guidelines (WAPC and DFES 2017) and AS 3959.

AS 3959 specifies requirements for the construction of buildings in bushfire prone areas in order to improve their resistance to bushfire attack from embers, radiant heat, flame contact, and combinations of these attack forms.

The objective of AS 3959 is to provide detailed methods for assessing bushfire attack and to prescribe specific construction details for buildings to reduce the risk of ignition from a bushfire, appropriate to the:

- Potential for ignition caused by burning embers, radiant heat or flame generated by a bushfire.
- Intensity of the bushfire attack on the building.

Two separate methods are outlined in AS 3959 for determining the impact of bushfire on dwellings and have been summarised below:

- **Method 1**, outlined in Section 2 and Appendix A of AS 3959, provides a basic assessment of radiant heat flux levels at various distances from classified vegetation (up to 100 m). This method assumes standard fuel loads for classified vegetation as outlined in AS 3959 and considers the effective slope beneath vegetation. This method can be used to determine appropriate setbacks to dwellings to achieve different levels of radiant heat exposure (i.e. BAL-12.5 to BAL-FZ, outlined in **Section 3.2.4** of this document).
- **Method 2**, outlined in Appendix B of AS 3959, provides a framework for a more rigorous and site specific assessment of radiant heat flux exposure for a site, involving bushfire engineering analysis and modelling using site specific data (e.g. climate/weather conditions during fire season, actual onsite fuel loads associated with classified vegetation etc.).

Vegetation that does not trigger a BAL assessment (i.e. low threat) according to Clause 2.2.3.2 of AS 3959 includes the following:

a) Vegetation of any type more than 100 m from the site.
b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site or each other.
d) Strips of vegetation less than 20 m wide (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
e) Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.
f) Low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses, maintained public reserves and parkland, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and wind breaks.

The vulnerability of assets such as dwellings is impacted by several factors. Some relate to the way a bushfire behaves at a site, others to the design and construction materials in the building and siting of surrounding elements. Infrastructure, utilities and human behaviour are also factors. Leondard (2009) identified the following factors as relevant considerations:

- Terrain (slope)
- Vegetation (overall fuel load, steady state litter load, bark fuels, etc.)
- Weather (temperature, relative humidity and wind speed)
- Distance of building from unmanaged vegetation
- Individual elements surrounding the building that are either a shield or an additional fuel source
- Proximity to surrounding infrastructure
- Building design and maintenance
- Human behaviour (ability to be present and capacity to fight the fire)
- Access to the building and how that influences human behaviour
- Water supply for active and/or passive defence
- Power supply.

The bushfire threat for the site has been determined by undertaking a method 1 BAL assessment to ensure no future dwellings are exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29), as outlined in **Section 3.2.3**.

Where buildings are lost, this is likely to occur as a result of their vulnerability to the mechanisms of bushfire attack. Buildings constructed to increased standards under AS 3959 are more likely to survive a bushfire than buildings that do not conform to these construction standards, although building survival is not guaranteed.

2.2 Vegetation classification and bushfire hazard assessment

Assessing bushfire hazards takes into account the classes of vegetation within the site and surrounding area for a minimum of 100 m, in accordance with AS 3959. The assignment of vegetation classifications is based on an assessment of vegetation structure, which includes consideration of the various fuel layers of different vegetation types. For example, fuel layers in a typical forest environment can be broken-down into five segments as illustrated in **Plate 3** below. These defined fuel layers are considered when determining the classification of vegetation and associated bushfire hazard levels.

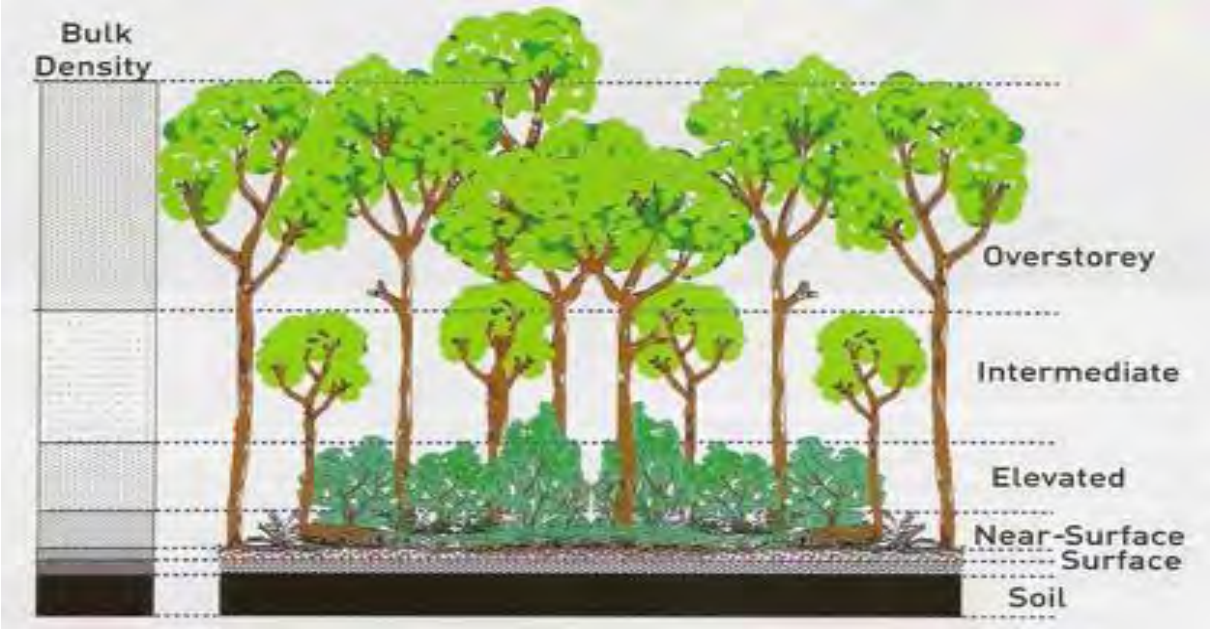

Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

An assessment of existing vegetation within and 150 m surrounding the site was undertaken in accordance with AS 3959 and the Guidelines on 9 August 2017. **Table 1** below outlines the type of vegetation within and surrounding the site, classification of this vegetation in accordance with Section 2.2.3.2 and Table 2.3 of AS 3959, and its assumed post development classification and ongoing management (where applicable).

The associated bushfire hazard assessment levels outlined in **Table 1** (based on existing conditions) were determined using Appendix Two of the Guidelines.

As outlined in **Table 1** below:

- Pre-development AS 3959 classifications are shown in **Figure 2**
- Pre-development bushfire hazard ratings are shown in **Figure 3**
- Post-development AS 3959 classifications are shown in **Figure 4**.

Table 1: Vegetation type and future management

Pre-development			Post-development	
Plot	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot**	**Post-development AS 3959 classification and assumptions**
Plot 1	**AS 3959 classification (Figure 2):** Woodland (Class B) **Bushfire hazard rating (Figure 3):** Extreme Woodland of *Eucalyptus* species over cleared understorey dominated by introduced weed species. This vegetation occurs within the Swan Canning Riverpark. This reserve incorporates the Canning River floodplain, which was observed to be inundated during the site assessment.	 *Photo location 1: Woodland (Class B) vegetation within Swan Canning Riverpark.*  *Photo location 2: Woodland (Class B) vegetation within Swan Canning Riverpark.*	Plot 1a	**AS3959 classification (Figure 4):** Woodland (Class B) Vegetation assumed to remain in existing unmanaged state.
			Plot 6	**AS3959 classification (Figure 4):** Exclusion 2.2.3.2 (a) Vegetation located greater than 100 m from the site.
Plot 2	**AS 3959 classification (Figure 2):** Woodland (Class B) **Bushfire hazard rating (Figure 3):** Extreme Woodland of *Eucalyptus* species over cleared understorey dominated by introduced weed species. This vegetation occurs within the Swan Canning Riverpark. This reserve incorporates the Canning River floodplain, which was observed to be inundated during the site assessment.	 *Photo location 3: Woodland (Class B) vegetation within Swan Canning Riverpark.*  *Photo location 4: Woodland (Class B) vegetation within Swan Canning Riverpark.*	Plot 6	**AS3959 classification (Figure 4):** Exclusion 2.2.3.2 (a) Vegetation located greater than 100 m from the site.

Table 1: Vegetation type and future management

Pre-development			Post-development	
Plot	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot**	**Post-development AS 3959 classification and assumptions**
Plot 3	**AS 3959 classification (Figure 2):** Grassland (Class G) **Bushfire hazard rating (Figure 3):** Moderate Grassland comprising introduced grass and weed species. Seasonal management (slashing of grass fuels) prior to bushfire season evident in historic aerial imagery. However, the formality, frequency or reliability of existing management regimes is unknown.	 *Photo location 5: Grassland (Class G) vegetation within the site.*  *Photo location 6: Grassland (Class G) vegetation within Lot 800.*  *Photo location 7: Grassland (Class G) vegetation within the site.*  *Photo location 8: Grassland (Class G) vegetation with and adjacent to the site.*	Plot 3a	**AS3959 classification (Figure 4):** Grassland (Class G) Vegetation assumed to remain in existing state. No management of vegetation has been assumed.
			Plot 4a	**AS3959 classification (Figure 4):** Exclusion 2.2.3.2 (f) Existing vegetation to be cleared and area to be landscaped as public open space. Ongoing maintenance has been assumed, discussed further in **Section 3.2.3**.
			Plot 5a	**AS3959 classification (Figure 4):** Exclusion 2.2.3.2 (e) Existing vegetation to be cleared and area to be developed for residential land uses or public roads.
			Plot 6	**AS3959 classification (Figure 4):** Exclusion 2.2.3.2 (a) Vegetation located greater than 100 m from the site.

Table 1: Vegetation type and future management

Pre-development			Post-development	
Plot	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot**	**Post-development AS 3959 classification and assumptions**
Plot 4	**AS 3959 classification (Figure 2):** Exclusion 2.2.3.2 (f) **Bushfire hazard rating (Figure 3):** Low, however where this plot occurs within 100 m of moderate or extreme hazards, a moderate hazard applies. Managed turf areas within the Burslem Drive MRS 'Other Regional Road' reserve and other median strips, currently maintained to a low threat standard by the City of Gosnells as part of the urban road network.	 *Photo location 9: Low threat vegetation (exclusion 2.2.3.2 (f)) within the Burslem Drive 'Other Regional Road' MRS reserve.*  *Photo location 10: Low threat vegetation (exclusion 2.2.3.2 (f)) within the Burslem Drive 'Other Regional Road' MRS reserve.*	Plot 4	**AS3959 classification (Figure 4):** Exclusion 2.2.3.2 (f) Assumed to remain in existing state. Existing management by City of Gosnells assumed to continue in the future.
Plot 5	**AS 3959 classification (Figure 2):** Exclusion 2.2.3.2 (e) **Bushfire hazard rating (Figure 3):** Low, however where this plot occurs within 100 m of moderate or extreme hazards, a moderate hazard applies. Constructed areas comprising roads, footpaths and buildings, in addition to areas of bare mineral earth.	 *Photo location 11: Non-vegetated area (exclusion 2.2.3.2(e)) within the site*  *Photo location 12: Non-vegetated area (exclusion 2.2.3.2(e)) associated with existing residential development.*	Plot 5	**AS3959 classification (Figure 4):** Exclusion 2.2.3.2 (e) Assumed to remain in existing state.

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2.3 Effective Slope

The applicable plots which pose a bushfire hazard to the site in the post-development scenario are Plot 1a and Plot 3a, as shown in **Figure 4**. The effective slope under areas of classified vegetation within these plots is downslope 0^{o} to 5^{o}, as shown in **Figure 5**.

The effective slope has been calculated based on a landscape assessment of fuels within the Swan Canning Riverpark, which is generally flat with some discrete areas of undulation associated with the narrow river embankment.

3 Bushfire Mitigation Strategy

This BMP provides an outline of the mitigation strategies that will ensure that as development progresses, an acceptable solution and/or performance-based system of control is adopted for each bushfire hazard management issue. As previously discussed, it is not necessary to undertake a standalone risk assessment as per AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines*. This approach is consistent with Appendix Four of the Guidelines.

The management issues addressed as part of this BMP are:

- Location of the development
- Siting and design of the development
- Vehicular access
- Water supply.

An 'acceptable solution' is proposed to address the intent of all four performance principles outlined in the Guidelines. An associated compliance checklist is attached as **Appendix B** and the applicable responses are detailed below.

3.1 Element 1: Location

3.1.1 Intent

To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.

3.1.2 Acceptable Solution A1.1 Development location

While development within the site is being progressed within 100 m of areas of moderate and extreme bushfire hazards (as shown in **Figure 3**), development has been sited and designed to manage or mitigate the associated bushfire risk by ensuring that no future dwellings within the site will be exposed to an unacceptable level of radiant heat flux (i.e. BAL-29 is not exceeded). This will be achieved through the provision of Asset Protection Zones (APZs) and increased building construction standards, where required. These measures are considered further in the following sections.

3.2 Element 2: Siting and design of development

3.2.1 Intent

To ensure the siting and design of development minimises the level of bushfire impact.

3.2.2 Background

AS 3959 provides six BAL ratings: BAL-LOW, BAL-12.5, BAL19, BAL-29, BAL-40 and BAL-FZ. These categories are based on heat flux exposure thresholds and are summarised in **Table 2**. The method for determining the BAL rating for any given site involves a specific assessment of vegetation and topographic slopes. Each BAL rating is associated with appropriate construction standards that apply as a minimum for buildings in bushfire-prone areas (as per AS 3959).

Table 2: Summary of BAL ratings, heat flux thresholds and associated construction standards, as outlined within AS 3959

Bushfire Attack Level (BAL)	Classified vegetation within 100 m of the subject building and heat flux exposure thresholds	Description of the predicted bushfire attack and levels of exposure	Construction section (within AS 3959)
BAL-LOW	See Section 2.2.3.2 of AS 3959	There is insufficient risk to warrant specific construction requirements	4
BAL-12.5	≤ 12.5 kW/m^2	Ember attack	3 & 5
BAL-19	> 12.5 kW/m^2 to ≤ 19 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers blown together with increasing heat flux	3 & 6
BAL-29	> 19 kW/m^2 to ≤ 29 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers blown together with increasing heat flux	3 & 7
BAL-40	> 29 kW/m^2 to ≤ 40 kW/m^2	Increasing levels of ember attack and burning debris ignited by windborne embers blown together with the increased likelihood of exposure to flame	3 & 8
BAL-FZ	≤ 40 kW/m^2	Direct exposure to flames from fire front in addition to heat flux and ember attack	3 & 9

The site will be subdivided into residential lots, public open space, public roads and a heritage site, in accordance with the proposed subdivision plan (see **Appendix A**). Future dwellings constructed within subdivided residential lots exposed to any bushfire hazard will be those located within 100 m of classified vegetation in the post-development scenario.

The extent of classified vegetation posing a bushfire risk to the site (within 100 m) in the post-development scenario (as shown in **Figure 4**) is restricted to Plot 1a (Woodland) and Plot 3a (Grassland) to the south-west of the site, within the Swan Canning Riverpark.

As outlined in **Section 2.2**, grassland vegetation associated with Plot 3a is understood to have been previously managed (slashed) prior to the bushfire season, based on a review of recent historical aerial imagery. However, no ongoing management of this vegetation has been assumed given there is no current understanding of the formality, frequency or reliability of such management continuing in the future. As such, a worst-case scenario assuming no ongoing management has been applied.

A method 1 BAL assessment has been undertaken as part of this BMP in order to demonstrate that with the provision of appropriate APZs (where applicable), no future dwellings constructed within the site will be exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29). This is outlined further below.

3.2.3 BAL assessment methodology and assumptions

The BAL assessment for the site has been undertaken in accordance with Method 1 of AS 3959 to determine the maximum heat flux to which future residential lots within the site will be exposed. The criteria to determine the BAL is outlined as follows:

- Designated FDI: 80
- Flame Temperature:1090
- Slope: Downslope 0° to 5° (**Figure 5**)
- Vegetation Class: Woodland and Grassland (**Figure 4**)
- Setback distances: As per Table 2.4.3 in AS 3959.

In addition to the above, the following key assumptions have informed this assessment:

- The site will be completely cleared of vegetation to support residential development in accordance with the proposed subdivision (**Appendix A**), or where vegetation is retained (i.e. remnant individual trees) will be maintained as low threat vegetation in accordance with Section 2.2.3.2 of AS 3959.
- Public open space areas to be established within the site (Plot 4a) will be constructed, landscaped and maintained as low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. Maintenance will be undertaken by the developer until handover to the City of Gosnells.
- Areas of classified vegetation or exclusion areas outside the site will remain in their existing condition and the current management regimes (where these occur) will continue to be implemented. The Burslem Drive MRS 'Other Regional Road' reserve and other median strips (Plot 4) are currently maintained to a low threat standard by the City of Gosnells as part of the urban road network and it is assumed this maintenance will continue.

3.2.4 BAL assessment outcome

Based on the outcomes of the method 1 BAL assessment undertaken for the site, no future dwellings are likely to be exposed to a BAL rating greater than BAL-29. The results of the BAL assessment are provided in **Table 3** below, and the associated BAL contour map is shown in **Figure 6**.

Table 3 details the setbacks required between future dwellings and classified vegetation within 100 m of the site, to achieve the various BAL ratings. The method 1 setbacks are based on the distances specified within Table 2.4.3 of AS 3959.

Table 3: Results of method 1 BAL assessment

Plot	Vegetation classification	Effective slope	Distance to vegetation	BAL Rating
Plot 1a	Woodland (Class B)	Downslope 0° to 5°	< 13 m	BAL-FZ
			13 - < 17 m	BAL-40
			17 - < 25 m	BAL-29
			25 - < 35 m	BAL-19
			35 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW

Plot	Vegetation classification	Effective slope	Distance to vegetation	BAL Rating
Plot 3a	Grassland (Class G)	Downslope 0° to 5°	< 7 m	BAL-FZ
			7 - < 9 m	BAL-40
			9 - < 14 m	BAL-29
			14 - < 20 m	BAL-19
			20 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW

The results of this BAL assessment are shown in **Figure 6**, and indicate that all future dwellings within the site can achieve appropriate separation from bushfire hazards, and BAL-29 is not exceeded. The indicative BAL ratings for each subdivided lot are detailed in **Table 4** and will require certification prior to or as part of the lot title clearance process and can then be used to support the future building licence process.

Those lots within the site exposed to a BAL rating greater than BAL-LOW will be subject to a notification pursuant to Section 165 of the *Planning and Development Act 2005* to be placed on the certificate(s) of title, indicating that the lot is subject to the requirements of a Bushfire Management Plan (i.e. increased construction standards to meet increased BAL ratings). Those lots requiring notification will be confirmed as part of the future BAL rating certification process.

With regard to the heritage site (subdivided lot 309), BAL-29 can be achieved and as such the subdivision application is compliant in this regard. However, some portions of the heritage site are exposed to BAL-40 and BAL-FZ and as such, if future residential dwellings are proposed to be constructed on this lot in the future, dwellings will be excluded from this area and instead the BAL-40 and BAL-FZ area will form an APZ, outlined further in **Section 3.2.5**.

It is understood that the future development of the heritage site will be progressed through a standalone development application, or similar. As the future development design of the heritage is finalised, bushfire risk mitigation will be considered through the preparation of a separate BMP to support the development application.

3.2.5 Acceptable solution A2.1: Asset Protection Zone

One of the most important bushfire protection measures influencing the safety of people and property is to create an APZ around buildings. The APZ is a low fuel area immediately surrounding a building comprised of non-flammable features such as irrigated landscapes, gardens, driveways and roads. As outlined in the Guidelines, an APZ must be wide enough to ensure that the maximum BAL rating for residential dwellings adjacent to classified vegetation will not exceed BAL-29.

Research into land management and house losses during the 'Black Saturday' Victorian bushfires concluded that the action of private landholders who managed fuel loads close to their houses was the single most important factor in determining house survival when compared with other land management practices, such as broad scale fuel reduction burning remote from residential areas (Gibbons *et al.* 2012).

Managing vegetation in the APZ has two main purposes:

- To reduce direct flame contact and radiant heat from igniting the building during the passage of a fire front.
- To reduce ember attack and provide a safer space for people to defend (if required) before, during and after a fire front passes.

APZs within the site are primarily provided through low threat vegetation within public open space (plot 4a), in addition to the continuation of the Kawana Avenue road reserve into the site. This provides suitable separation for subdivided lots within the site to nearby bushfire hazards. Notwithstanding this, some lots may implement an in-lot setback (internal APZ) to achieve a lower BAL rating, as detailed in **Table 4**.

Table 4: Indicative BAL ratings for subdivided lots

Subdivided lot no.	Indicative BAL rating	Notes/comment
308 (grouped housing)	BAL-12.5	Can achieve BAL-LOW with minimum 7 m front of lot setback (internal APZ).
309 (heritage site)	BAL-29	Up to 17 m setback required from south-western boundary to achieve BAL-29. Bushfire management and BAL ratings to be further considered through the development application process.
312 (grouped housing)	BAL-12.5	-
359	BAL-19	-
360	BAL-19	-
361	BAL-19	-
362	BAL-12.5	-
363	BAL-12.5	-
364	BAL-12.5	-
365	BAL-12.5	-
397	BAL-LOW	-
398	BAL-12.5	-
404	BAL-12.5	Can achieve BAL-LOW with minimum 1 m front of lot setback (internal APZ).
405	BAL-12.5	-
406	BAL-12.5	-

Note: *The above indicative BAL ratings are NOT certified. These indicative BAL ratings will require certification prior to or as part of the lot title clearance process and can then be used to support the future building licence process.*

As discussed above, the proposed heritage site (subdivided lot 309) requires an internal APZ along its south-western boundary to achieve BAL-29. The width of the APZ varies from 9 m up to 17 m along this interface. This BMP has been prepared to support the proposed subdivision application only and a separate BMP will be prepared to support the future development application process for the heritage site.

In addition to the above, it is recommended that all lots within the site that are exposed to a BAL rating greater than BAL-LOW (as detailed in this BMP or within further detailed BAL assessment/s) should be maintained to an APZ standard in order to protect dwellings from ember attack. The APZ/s should be established and maintained to the standards outlined in **Appendix C**, or as detailed in Appendix Four of the Guidelines and/or the City of Gosnells *Annual Fire Hazard Reduction Notice* (as published).

3.3 Element 3: Vehicular access

3.3.1 Intent

To ensure vehicular access serving a subdivision is available and safe during a bushfire event.

3.3.2 Background

As outlined within the Guidelines, to achieve the intent, all applicable 'acceptable solutions' must be addressed, or alternatively the performance principle achieved.

3.3.3 Acceptable solution A3.1: Two access routes

The site will form part of the broader Maddington Homestead development and will connect to the existing public road network surrounding the site. The internal road network of the site is shown in **Figure 6** and **Appendix A** and provides direct access to the existing public road network including the arterial Burslem Drive, in addition to two local roads Kawana Avenue and Panozza Circuit.

Access to and from the site allows residents to move away from the main source of bushfire risk, located south-west of the site. The existing and proposed future road network provides for at least two permanent access options at all times to future residents and emergency response personnel. This will achieve the acceptable solution, as outlined in Appendix Four of the Guidelines.

3.3.4 Acceptable solution A3.2: Public roads

Surrounding public roads and all new public roads within the site will comply with the minimum standards outlined in Appendix Four of the Guidelines. All public roads achieve a minimum 6 m width, as per the Guidelines.

3.4 Element 4: Water

3.4.1 Intent

To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.

3.4.2 Acceptable Solution A4.1: Reticulated water

The development is located within an Emergency Services Levy (ESL) Category 1 – Perth Metropolitan Fire District, which indicates that bushfire events are responded to by a network of metropolitan

career fire and rescue stations, in addition to the State Emergency Services (SES) as required. Fire response services require ready access to an adequate water supply during bushfire emergencies.

The development will be provided with a reticulated water supply, together with fire hydrants that will be installed by the developer to meet the standard specifications of Water Corporation (Design Standard DS 63) and DFES. Fire hydrants on land zoned for residential purposes are required to be sited at or within 200 m of residential dwellings (Class 1a). The Water Corporation would be responsible for all hydrant maintenance and repairs.

3.5 Public education and preparedness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The DFES publication '*Prepare. Act. Survive.'* (DFES 2014) provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx

The City of Gosnells also provides bushfire safety advice to residents available from their website http://www.gosnells.wa.gov.au/Your_property/Community_safety/Fire_prevention. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high risk areas.

Future residents of the site are able to access additional bushfire information via the above sources, or through contacting the City of Gosnells or DFES directly. In the case of a bushfire in the area, advice would be provided to residents by DFES, Department of Biodiversity, Conservation and Attractions and/or the City of Gosnells on any specific recommendations to responding to the bushfire, including evacuation if required. It is recommended that future residents should make themselves aware of their responsibilities with regard to responding to a potential bushfire.

4 Implementing the Bushfire Management Plan

Table 5 outlines the future responsibilities of the developer, future lot owners or residents, and the City of Gosnells associated with implementing this BMP and the proposed subdivision of the site. As discussed above, a separate BMP will be prepared to support the future development application for development of the heritage site.

The future owners/occupiers of lots within the site, as created through future subdivision stages, are responsible for maintaining a reduced level of risk from bushfire within their properties (where applicable), and will be responsible for undertaking, complying and implementing measures to protect their own assets (and people under their care) from the threat and risk of bushfire.

Table 5: Responsibilities for the implementation of the BMP

Management action	Timing
Developer/s	
Certify indicative BAL ratings for all lots subject to bushfire risk (i.e. greater than BAL-LOW) in accordance with the BAL Contour Plan (**Figure 6**)/**Table 4** and/or based on a subsequent BAL assessment if required. The assessment recommendations are to be submitted to the City of Gosnells and accommodated in the lot clearances.	As part of subdivision and development[2]
For each new lot created within areas exposed to a BAL rating exceeding BAL-LOW, lodge a Section 165 Notification on the Certificate of Title in order to alert purchasers and successors in title of the existence of the overarching BMP and specifically the requirements associated with meeting AS 3959 construction standards.	To support the creation of lot titles[1]
Install the public roads to standards outlined in Appendix Four of the Guidelines.	To support the creation of lot titles[1]
Reticulated water supply and hydrants to be installed as per standard Water Corporation requirements, unless otherwise agreed.	As part of subdivision and development[2]
Make a copy of the BMP and future certified BAL assessment available to each lot owner subject to AS 3959 construction standards.	During the lot sale process, and ongoing as required
Ensure the site is completely cleared of vegetation or, where vegetation is retained, maintained to a low threat standard (in accordance with Section 2.2.3.2 of AS 3959) as part of development to ensure no temporary bushfire fuels within the site impact on future dwellings.	Ongoing, where applicable
Property owner/occupier	
Ensuring construction of dwelling/s complies with AS 3959, as detailed within this BMP or a certified BAL assessment.	As part of building design and construction
If dwellings are subject to additional construction in the future, such as renovations, AS 3959 compliance is required.	As part of building design and construction
Ensuring that their property complies with the City of Gosnells *Annual Fire Hazard Reduction Notice* as published.	Ongoing, where applicable
Where subject to a BAL rating greater than BAL-LOW, maintaining their property in good order to minimise bushfire fuels in accordance with the APZ requirements outlined in **Appendix C** and/or Appendix Four of the Guidelines.	Ongoing, where applicable
Ensuring that where hydrants are located, they are not obstructed and remain visible at all times.	Ongoing, where applicable

Management action	Timing
City of Gosnells	
Providing fire prevention and preparedness advice to landowners upon request, including the *Homeowners Bush Fire Survival Manual: Prepare, Act, Survive* (or similar suitable documentation) and the latest City of Mandurah Fire Break Notice.	Ongoing, as required
Monitoring vegetation fuel loads in public reserves and liaising with relevant stakeholders to maintain fuel loads at minimal fuel levels. This includes areas of POS within the site following the developer handover period.	Ongoing, as required
Maintaining public road reserves to appropriate standards and ensuring compliance with the City of Gosnells *Annual Fire Hazard Reduction Notice* as published.	Ongoing, as required
Water Corporation	
The Water Corporation is responsible for the ongoing maintenance and repair of water hydrants.	The Water Corporation is responsible for the ongoing maintenance and repair of water hydrants.

[1] To support creation of lot titles, evidence will be provided that the action outlined has been addressed, or agreement on an appropriate alternative has been arranged with the City of Gosnells. This will generally be required to support the clearance of subdivision conditions.

[2] Where an action is to be undertaken 'as part of subdivision and development', this may occur before or after the creation of lot titles. The typical subdivision process will ensure this action will be addressed as part of development (regardless of whether it is before or after the creation of lot titles), through agreement with the City of Gosnells or other responsible authority. Evidence of these actions is not required to support the clearance of subdivision conditions.

5 Summary of Bushfire Management

The site is located within an area identified as bushfire prone within the state *Map of Bush Fire Prone Areas* (OBRM 2017). This BMP has been prepared consistent with Appendix Four of the Guidelines (WAPC and DFES 2017) and demonstrates that as development progresses, an acceptable solution system of control can be adopted for each bushfire hazard management issue, as summarised below:

- **Location:** The BAL assessment indicates that the development (i.e. future dwellings) is located in an area that can or will, on completion, be subject to a BAL rating of BAL-29 or below.
- **Siting and Design:** Future dwellings will not be exposed to an unacceptable level of radiant flux, without appropriate mitigation measures, such as APZs and/or increased construction standards in accordance with AS 3959 where applicable. Separation will be provided between dwellings and post development classified vegetation through the location of public open space, public roads, and internal lot setbacks (where necessary).
- **Vehicular Access:** The internal layout, design and construction of public vehicular access and egress in the development will be in accordance with the Guidelines, and will allow vehicles to move through the site easily and safely at all times. The proposed subdivision design provides multiple connections to the existing public road network and allows residents to move away from the main source of bushfire risk, located south-west of the site.
- **Water:** The development will be provided with a permanent and secure reticulated water supply and will be installed in accordance with the specifications of the Water Corporation, including the installation of fire hydrants. This is a typical requirement of urban development.

Table 4 specifies the indicative BAL ratings for each subdivided lot within the site and any required in-lot setback (internal APZ) requirements to achieve that BAL rating. These indicative BAL ratings and associated internal APZ distances will require certification prior to or as part of the lot title clearance process and can then be used to support the future building licence process.

Table 5 of this BMP outlines the actions which should be implemented, and the parties responsible for their implementation, to reduce the bushfire risk to future residents and the community.

Community bushfire safety is a shared responsibility between state and local governments, fire agencies, communities and individuals. The future owners/occupiers of lots within the site are responsible for maintaining a reduced level of risk from bushfire within their properties, and will be responsible for undertaking, complying and implementing measures to protect their own assets (and people under their care) from the threat and risk of bushfire. Further information on bushfire preparedness is available directly from the City of Gosnells and DFES.

6 Applicant Declaration

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

Signature:

Name: Rohan Carboon

Company: Emerge Associates

Date: 8 September 2017

Signature:

Name: Kirsten Knox

Company: Bushfire Safety Consulting

Date: 8 September 2017

7 References

7.1 General references

Department of Fire and Emergency Services (DFES) 2014, *Prepare. Act. Survive.*, Perth.

Gibbons, P., van Bommel, L., Gill, A., Cary, GJ, Driscoll, D., Bradstock, R., Knight, E., Moritz, M., Stephens, S. and Lindenmayer, D. 2012, *Land Management Practices Associated with House Loss in Wildfires*, PLoS One, 7(1).

Leondard, J. 2009, *Report to the 2009 Victorian Royal Comission Building Performance in Bushfires*, CSIRO.

Standards Australia 2009, *AS 3959-2009 Construction of buildings in bushfire-prone areas*, Sydney.

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

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.2*, Western Australia.

7.2 Online references

Office of Bushfire Risk management (OBRM) 2017, Map of Bush Fire Prone Areas, viewed September 2017, < https://maps.slip.wa.gov.au/landgate/bushfireprone/>

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Figures

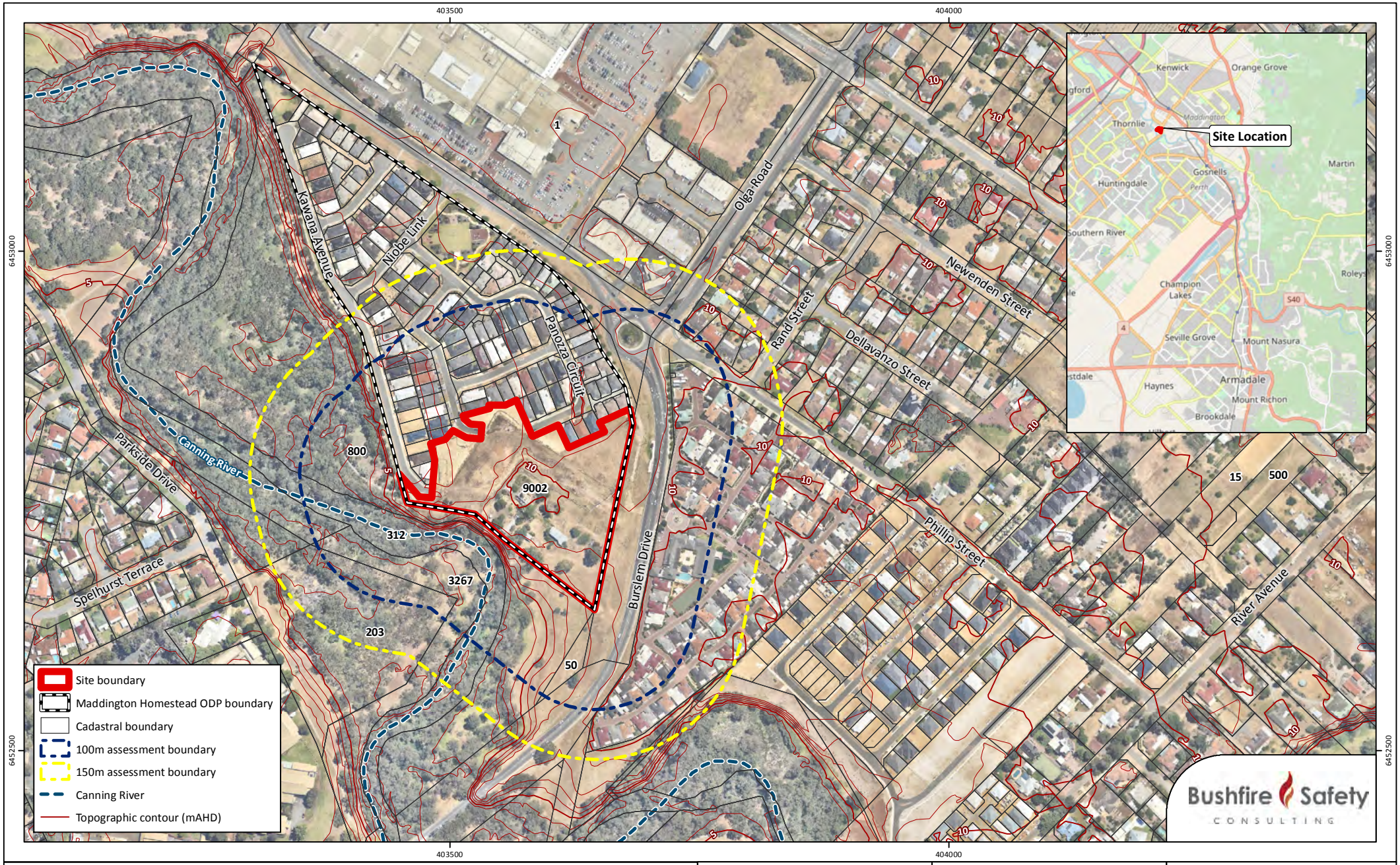

Figure 1: Site and Assessment Area

Project: Bushfire Management Plan
Lot 9002 Burslem Drive, Maddington
Client: Wellington Parkland Pty Ltd

Plan Number:
EP17-077(01)--F02
Drawn: KNM
Date: 29/08/2017
Checked: ADB
Approved: KK
Date: 08/09/2017

N

0 50 100 150
Metres
Scale: 1:5,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Figure 2: Existing Site Conditions – AS 3959 Vegetation Classification

Project: Bushfire Management Plan
Lot 9002 Burslem Drive, Maddington
Client: Wellington Parkland Pty Ltd

Plan Number:
EP17-077(01)--F03

Drawn:	KNM
Date:	29/08/2017
Checked:	ADB
Approved:	KK
Date:	08/09/2017

N

0 50 100
Metres
Scale: 1:3,500@A4
GDA 1994 MGA Zone 50

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Figure 3: Existing Site Conditions – Bushfire Hazard Assessment

Project: Bushfire Management Plan
Lot 9002 Burslem Drive, Maddington
Client: Wellington Parkland Pty Ltd

Plan Number:
EP17-077(01)--F04
Drawn: KNM
Date: 29/08/2017
Checked: ADB
Approved: KK
Date: 08/09/2017

N

0 50 100
Metres
Scale: 1:3,500@A4
GDA 1994 MGA Zone 50

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Figure 4: Post Development Site Conditions – AS 3959 Vegetation Classification

Project: Bushfire Management Plan
Lot 9002 Burslem Drive, Maddington
Client: Wellington Parkland Pty Ltd

Plan Number:
EP17-077(01)--F05
Drawn: KNM
Date: 29/08/2017
Checked: ADB
Approved: KK
Date: 08/09/2017

N

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Metres
Scale: 1:3,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

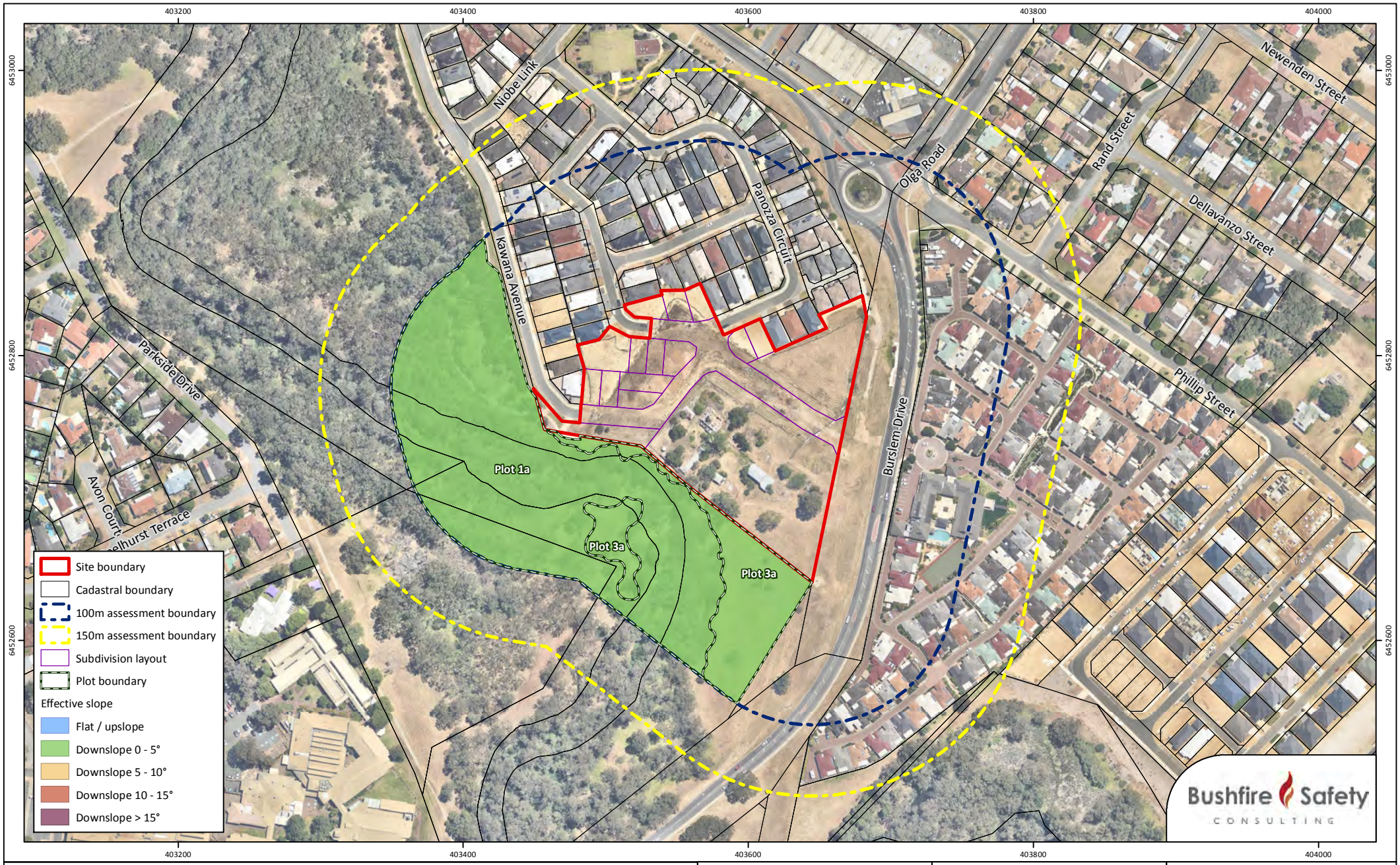

Figure 5: Effective Slope

Project: Bushfire Management Plan
Lot 9002 Burslem Drive, Maddington
Client: Wellington Parkland Pty Ltd

Plan Number:
EP17-077(01)--F06

Drawn:	KNM
Date:	29/08/2017
Checked:	ADB
Approved:	KK
Date:	08/09/2017

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Metres
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GDA 1994 MGA Zone 50

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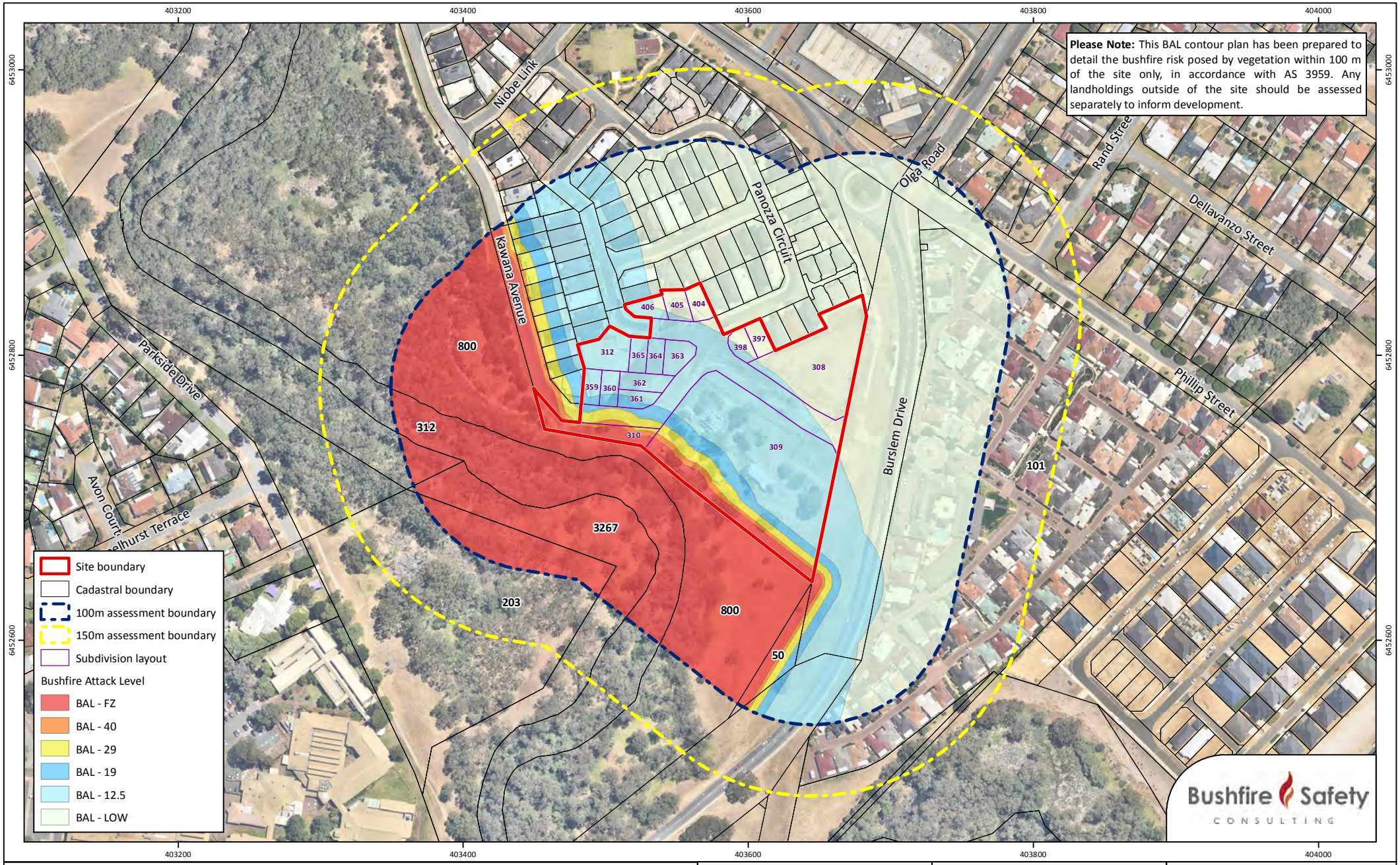

Figure 6: Bushfire Attack Level Contour Plan

Project: Bushfire Management Plan
Lot 9002 Burslem Drive, Maddington
Client: Wellington Parkland Pty Ltd

Plan Number:
EP17-077(01)--F07
Drawn: KNM
Date: 29/08/2017
Checked: ADB
Approved: KK
Date: 08/09/2017

N

0 50 100
Metres
Scale: 1:3,500@A4
GDA 1994 MGA Zone 50

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Appendix A

Subdivision Plan (Studio CFM 2017)

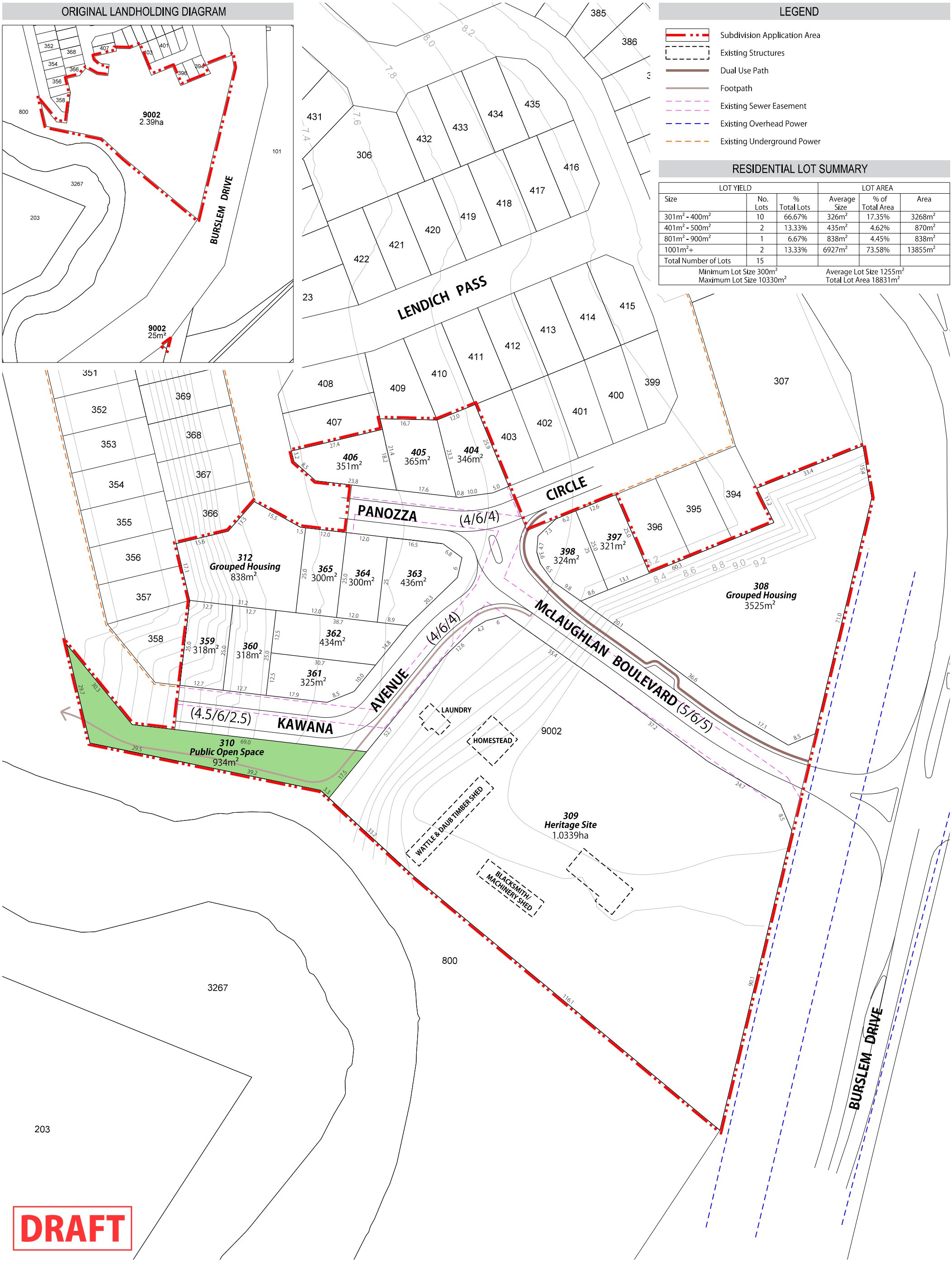
ORIGINAL LANDHOLDING DIAGRAM

LEGEND

- Subdivision Application Area
- Existing Structures
- Dual Use Path
- Footpath
- Existing Sewer Easement
- Existing Overhead Power
- Existing Underground Power

RESIDENTIAL LOT SUMMARY

LOT YIELD			LOT AREA		
Size	No. Lots	% Total Lots	Average Size	% of Total Area	Area
301m² - 400m²	10	66.67%	326m²	17.35%	3268m²
401m² - 500m²	2	13.33%	435m²	4.62%	870m²
801m² - 900m²	1	6.67%	838m²	4.45%	838m²
1001m²+	2	13.33%	6927m²	73.58%	13855m²
Total Number of Lots	15				
Minimum Lot Size 300m² Maximum Lot Size 10330m²			Average Lot Size 1255m² Total Lot Area 18831m²		



DRAFT

PLAN OF SUBDIVISION

Lot 9002 Burslem Dive, MADDINGTON

Date: 03/08/2017 Plan: GOGMA-3-002 Scale: 1:1000@A3

0 10 20 30m

studio CFM
TOWN PLANNING URBAN DESIGN
e chee.mok@studiocfm.com.au
t 0438 883 358
a 28 Brown St, East Perth WA 6004

Appendix B

Compliance Checklist

Appendix B: Compliance Checklist

Element/Question	Response	Applicable Section of BMP
1: Location		
Does the proposal comply with the performance criteria by applying acceptable solution A1.1?	Yes.	**Section 3.1.2**
2: Siting and design of the Development		
Does the proposal comply with the performance criteria by applying acceptable solution A2.1?	Yes.	**Section 3.2.4 and 3.2.5**
3: Vehicular access		
Does the proposal comply with the performance criteria by applying acceptable solution A3.1?	Yes.	**Section 3.3.3**
Does the proposal comply with the performance criteria by applying acceptable solution A3.2?	Yes.	**Section 3.3.4**
Does the proposal comply with the performance criteria by applying acceptable solution A3.3?	Not applicable.	-
Does the proposal comply with the performance criteria by applying acceptable solution A3.4?	Not applicable.	-
Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Not applicable.	-
Does the proposal comply with the performance criteria by applying acceptable solution A3.6?	Not applicable.	-
Does the proposal comply with the performance criteria by applying acceptable solution A3.7?	Not applicable.	-
Does the proposal comply with the performance criteria by applying acceptable solution A3.8?	Not applicable.	-
4: Water		
Does the proposal comply with the performance criteria by applying acceptable solution A4.1?	Yes.	**Section 3.4.2**
Does the proposal comply with the performance criteria by applying acceptable solution A4.2?	Not applicable.	-
Does the proposal comply with the performance criteria by applying acceptable solution A4.3?	Not applicable.	-

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Appendix C

Asset Protection Zone and Construction Standard Considerations

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Bushfire Safety CONSULTING

Asset Protection Zones (APZ)

One of the most important bushfire protection measures influencing the safety of people and property is to create an Asset Protection Zone (APZ) around buildings. The APZ is a low fuel area immediately surrounding a building. Non-flammable features such as irrigated landscapes, gardens, driveways and roads can form parts of an APZ.

Managing vegetation in the APZ has two main purposes:

- To reduce direct flame contact and radiant heat from igniting the building during the passage of a fire front.
- To reduce ember attack and provide a safer space for people to defend (if required) before, during and after a fire front passes.

The *Guidelines for Planning in Bushfire Prone Areas Version 1.2* (the Guidelines) (WAPC and DFES 2017) state that an APZ needs to be wide enough to ensure that the maximum BAL rating for buildings adjacent to classified vegetation will not exceed BAL-29. For the majority of the site, no specific internal setbacks/APZs are required to be provided within future lots to achieve the indicative BAL ratings, as these are provided by public open space or public roads.

While no setback is specifically required within the lot, it is recommended that future lot owners maintain their property in accordance with APZ standards to provide a low fuel area within the vicinity of their home. This include:

- **Fine fuel load**: Combustible dead vegetation matter less than 6 mm in thickness/size reduced to and maintained at two tonnes per hectare.
- **Trees**: No trees located within two metres of the future dwelling and branches do not overhang the future dwelling within four metres. Crowns are a minimum distance of ten metres apart. A small group of trees within close proximity to one another may be treated as one crown provided the combined crowns do not exceed the area of a large or mature crown size for that species.
- **Shrubs:** No tall shrubs (i.e. greater than 1.5 m high) located within two metres of the future dwelling. Shrubs taller than 5 m to be treated as trees.
- **Grassland:** should be managed to maintain a height of 100 mm or less.
- **Fences:** Any fences within the APZ are constructed of non-combustible materials (see AS 3959 for further information).
- **Sheds:** Sheds within the APZ are constructed of non-combustible materials (or meet the requirements of AS 3959) and should not store volatile materials.

In addition to the management measures outlined above, future lot owners will be required to comply with the City of Gosnells *Annual Fire Hazard Reduction Notice*, as published.

Shielding provisions

Under Section 3.5 of AS 3959, the construction requirements for the next lower BAL rating determined for a dwelling may be applied to the elevation of the building not exposed to the source of bushfire attack. For example, if the building was rated at BAL-19, certain elevations may only need to meet the building standards applicable to a BAL rating of BAL-12.5. Under AS 3959, an elevation is deemed to not be subject to the source of bushfire attack if all straight lines between the elevation and source of bushfire attack are obstructed by another part of the building. Examples of this are shown within **Plate C2** below.

Under AS 3959 where a dwelling is subject to a BAL rating of BAL 12.5 or higher, the minimum construction standard is BAL 12.5 regardless of whether elevations of the building are exposed to the source of bushfire attack or not. It is possible that future dwellings within the site may be able to apply shielding provisions as part of building construction, however this should be determined on an individual basis.

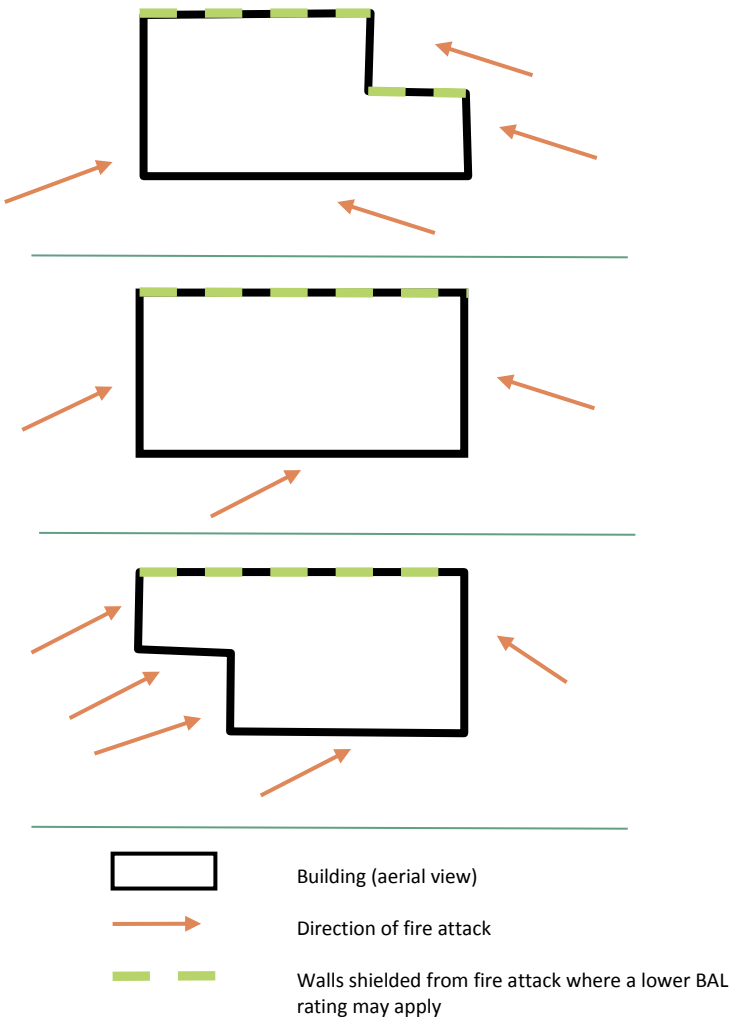

Plate C2: Examples of walls subject to shielding (Source: Standards Australia 2009)

Figure 1: **AS 3959 Vegetation Classification and Effective Slope (Post Development)**

Project:	BAL Contour Plan Lot 309 Burselm Drive, Maddington Subdivision Proposal
Client:	Wellington Parkland Pty Ltd

Plan Number:
EP17-077(03)--F18

Drawn:	GAR
Date:	25/10/2023
Checked:	PPS
Approved:	KK
Date:	26/10/2023

N

0 50 100
Metres
Scale: 1:3,500@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

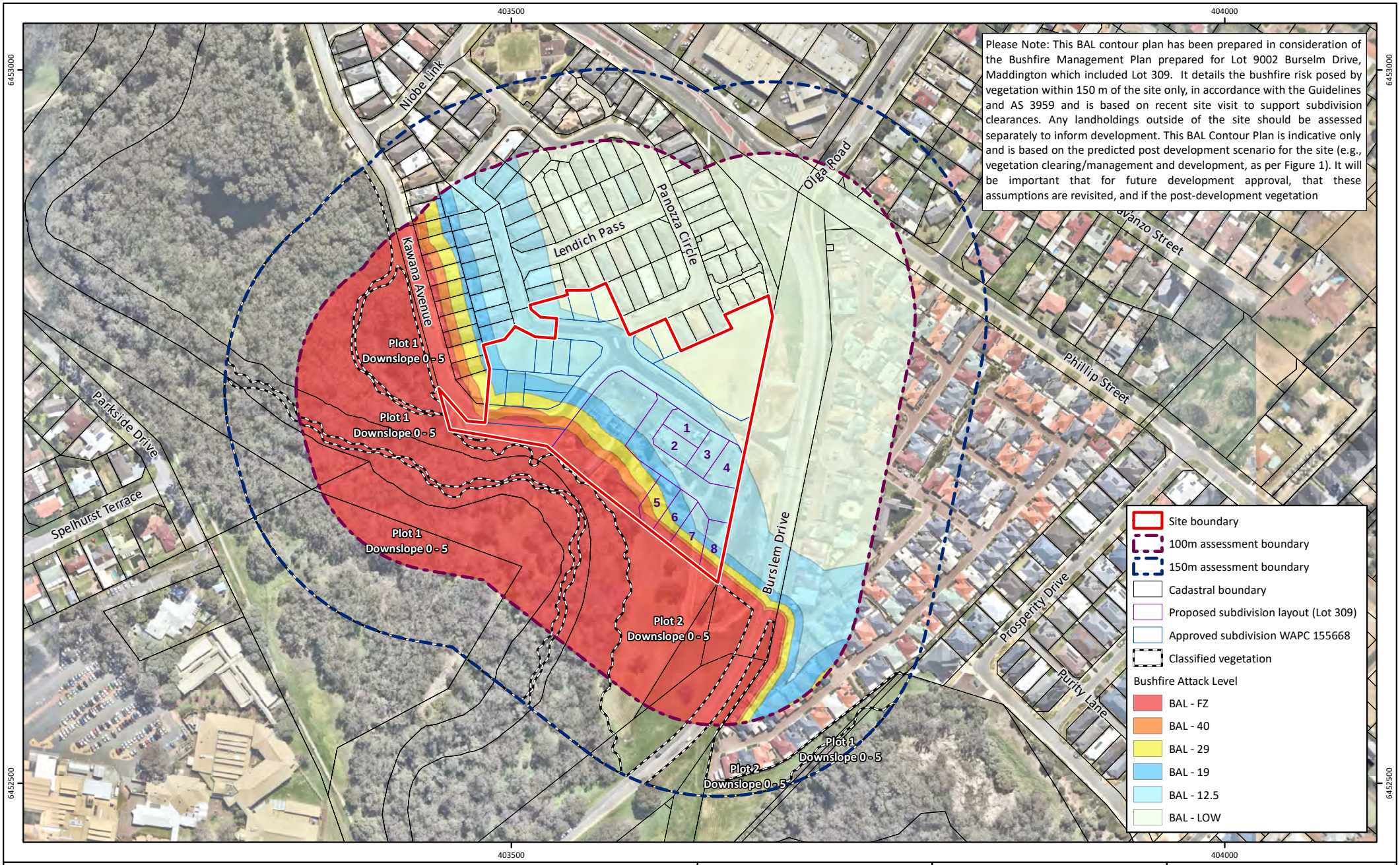

Figure 2: Bushfire Attack Level Contour Plan

Project: BAL Contour Plan
Lot 308 Burselm Drive, Maddington Subdivision Proposal
Client: Wellington Parkland Pty Ltd

Plan Number:
EP17-077(03)--F19

Drawn:	GAR
Date:	25/10/2023
Checked:	PPS
Approved:	KK
Date:	26/10/2023

N

0 50 100
Metres

Scale: 1:3,500@A4

GDA 1994 MGA Zone 50

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Appendix 2
DRAINAGE AND NUTRIENT MANAGEMENT PLAN

PENTIUM WATER

GOLDEN RIVERS ESTATE – STAGE 4

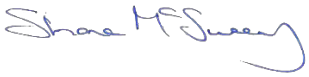
Urban Water Management Strategy

WELPARK_01
14/02/2023

Document Status

Version	Purpose of document	Authorised by	Reviewed by	Review Date
Rev 0	Final	GerEdw	ShaMcS	3/11/2022
Rev 1	Final	GerEdw	ShaMcS	9/11/2022
Rev 2	Final	GerEdw	ShaMcS	27/01/2023
Rev 3	Final	GerEdw	ShaMcS	7/02/2023
Rev 4	Final	GerEdw	ShaMcS	14/02/2023

Approval for Issue

Name	Signature	Date
Shane McSweeney		14/02/2023

Prepared By

Pentium Water Pty Ltd

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Author: Gerard Edwards

Reviewer: Shane McSweeney

Approved by: Shane McSweeney

Version: Rev4

Date: 14/02/2023

Prepared For

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Perth Western Australia 6000

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Contact: Abdul Mousli

Executive Summary

The Western Australian Planning Commission (WAPC) granted subdivision approval (subject to conditions) for Lot 9002 ("the site") Burslem Drive, Maddington of the Golden River Estate ("the estate") on 12 September 2017. The site location is presented in Figure 1.

The City of Gosnells (CoG) has requested an Urban Water Management Strategy (UWMP) be prepared to support the subdivision approval and development of the site, which is the fourth and final stage of the estate to be developed.

This UWMP details how stormwater will be managed within the site and also demonstrates how the site will be developed in accordance with Better Urban Water Management (BUWM) guidelines (Department of Planning and Infrastructure, 2008).

The design objectives of this UWMP are summarised in Table 1.

Table 1: Water management objectives and how they will be met

	Criteria
Stormwater	
Ecological protection (15 mm event)	The 1 exceedance year (EY) -1 hour (~15 mm) storm event is to drain into a bioretention swale ("the swale") located within the Public Open Space (POS) area within the site for infiltration. Subsoil drains under the swale will be conveyed into the constructed wetland area ("the wetland") within the foreshore reserve area (Lot 800) area.
Conveyance (20% Annual Exceedance Probability (AEP) event)	A pit and pipe system will convey runoff up to and including the 20% AEP (5-year ARI) event to the swale, prior to discharge into the wetland and finally discharge into the Canning River. Road drainage system will be designed so that roads are passable in the 20% AEP event.
Flood protection (1% AEP event)	Finished lot levels will be at least 0.3 m above the 1% AEP top water level of local drainage systems. Flood conveyance pathways (including the road reserve) will be provided for safe passage of flows through the development during the 1% AEP event (100-year ARI).
Mosquito management	The swale will be designed so that detained stormwater will be infiltrated or discharged in less than 96 hours following storm events to prevent mosquito and midge breeding conditions.
Groundwater	
Groundwater level control	A subsoil drainage system has been designed to control post-development groundwater level rise and maintain adequate separation distance to finished road and lot levels.
Nutrient management	The swale located within the site will provide bioretention treatment. Subsoil drainage under the road reserve will be installed with soils that have a >10 Phosophorus Retention Index (PRI) to provide inline treatment. Additional bioretention treatment of stormwater runoff and groundwater will be provided downgradient of the site in the constructed wetland area.

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1. Introduction

Wellington Parkland Pty Ltd is developing Lot 9002 Burslem Drive, Maddington within the Golden River Estate. The site area is approximately 2.24 ha and consists of a mix of R30 residential lots, R40 group housing lots, road reserve, a heritage lot and POS zoned land.

The Western Australian Planning Commission (WAPC) granted subdivision approval (subject to conditions) for Lot 9002 ("the site") Burslem Drive, Maddington of the Golden River Estate ("the estate") on 12 September 2017. This UWMP has been prepared to address the conditions of subdivision approval and as requested by the CoG.

The subdivision plan for the site is presented in Figure 2.

This UWMP details how stormwater will be managed within the site and demonstrates how the site will be developed in accordance with BUWM guidelines (Department of Planning and Infrastructure, 2008).

1.1. Design objectives

This UWMP has been developed with reference to the following guiding documents:

- Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions (Department of Water, 2008).
- Decision Process for Stormwater Management in Western Australia (Department of Water, 2017)
- Better Urban Water Management (Department of Planning and Infrastructure, 2008)
- Stormwater Management Manual for Western Australia (Department of Water, 2004–2007)
- Liveable Neighbourhoods (Western Australian Planning Commission, 2003)
- Water resource considerations when controlling groundwater levels in urban development (Department of Water, 2013)
- Specification separation distances for groundwater controlled urban development (IPWEA, 2016).

This UWMP details the integrated water management strategies and will achieve integrated water management through the following design objectives:

- Effectively manage the risk to human life, property damage and environmental degradation from water contamination, flooding, and waterlogging
- Maintain and if possible, improve water quality (surface and groundwater) within the development in relation to pre-development water quality
- Implement best management practices regarding stormwater and groundwater management
- Incorporate where possible, low maintenance, cost-effective landscaping, and stormwater treatment systems.

1.2. Drainage and Nutrient Management Plan

A Drainage and Nutrient Management Plan (DNMP) was prepared for the Golden Rivers estate by VDM Environmental (2007) (Appendix B). This UWMP has been prepared with consideration of the stormwater management proposed in the DNMP, and in accordance with BUWM guidelines (Department of Planning and Infrastructure, 2008).

2. EXISTING ENVIRONMENT

2.1. Site location and existing land uses

The site is located on Lot 9002 Burslem Drive, Maddington, which is approximately 2.24 ha in size and 15 km south-east of Perth City (Figure 1).

The site is part of the Golden River Estate and within the CoG. The site is the fourth and final stage to be developed within the estate.

The proposed landuse within the site consists of road reserve, POS, Heritage, R40 lots and R30 lots (Figure 2).

The site has been previously cleared for agricultural. Runoff from the site drains into Lot L800 foreshore reserve area which has constructed wetlands and ultimately to the Canning River. There is existing native vegetation located along the Canning River foreshore area.

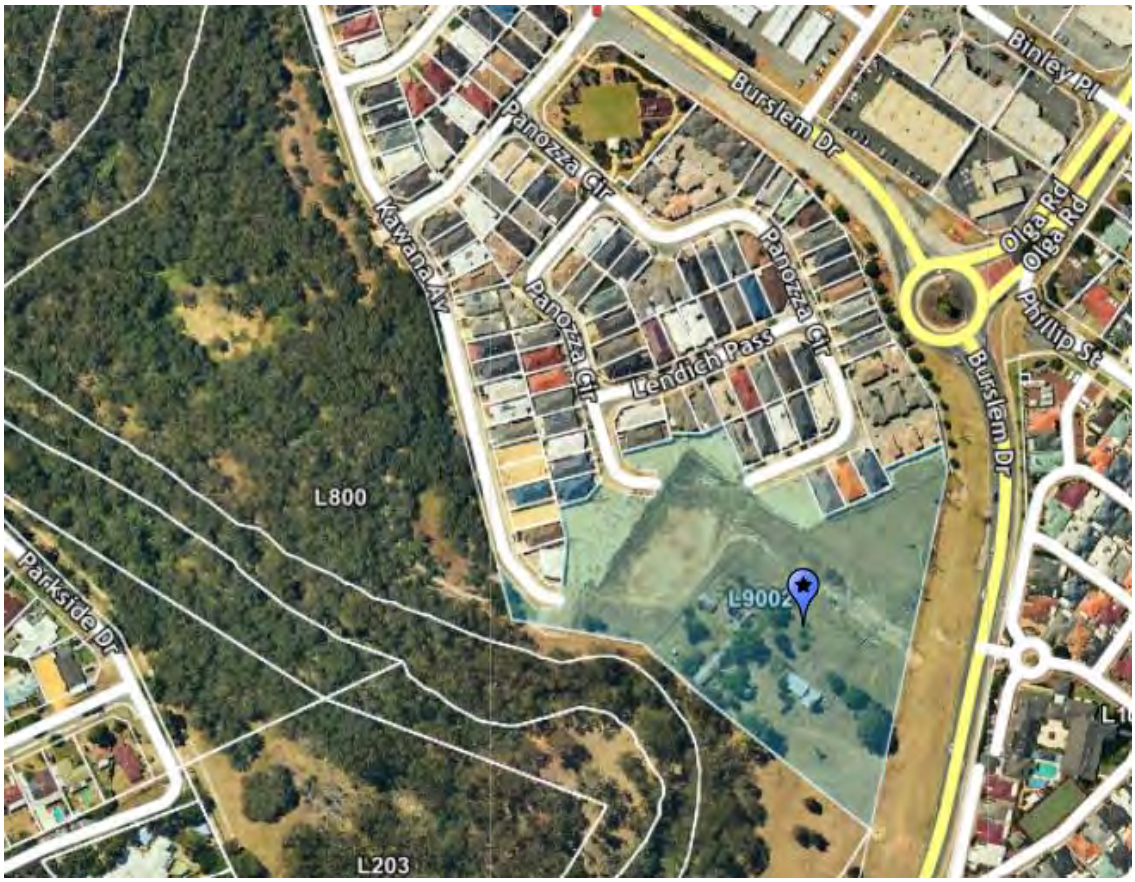

Figure 1: Site location (L9002)

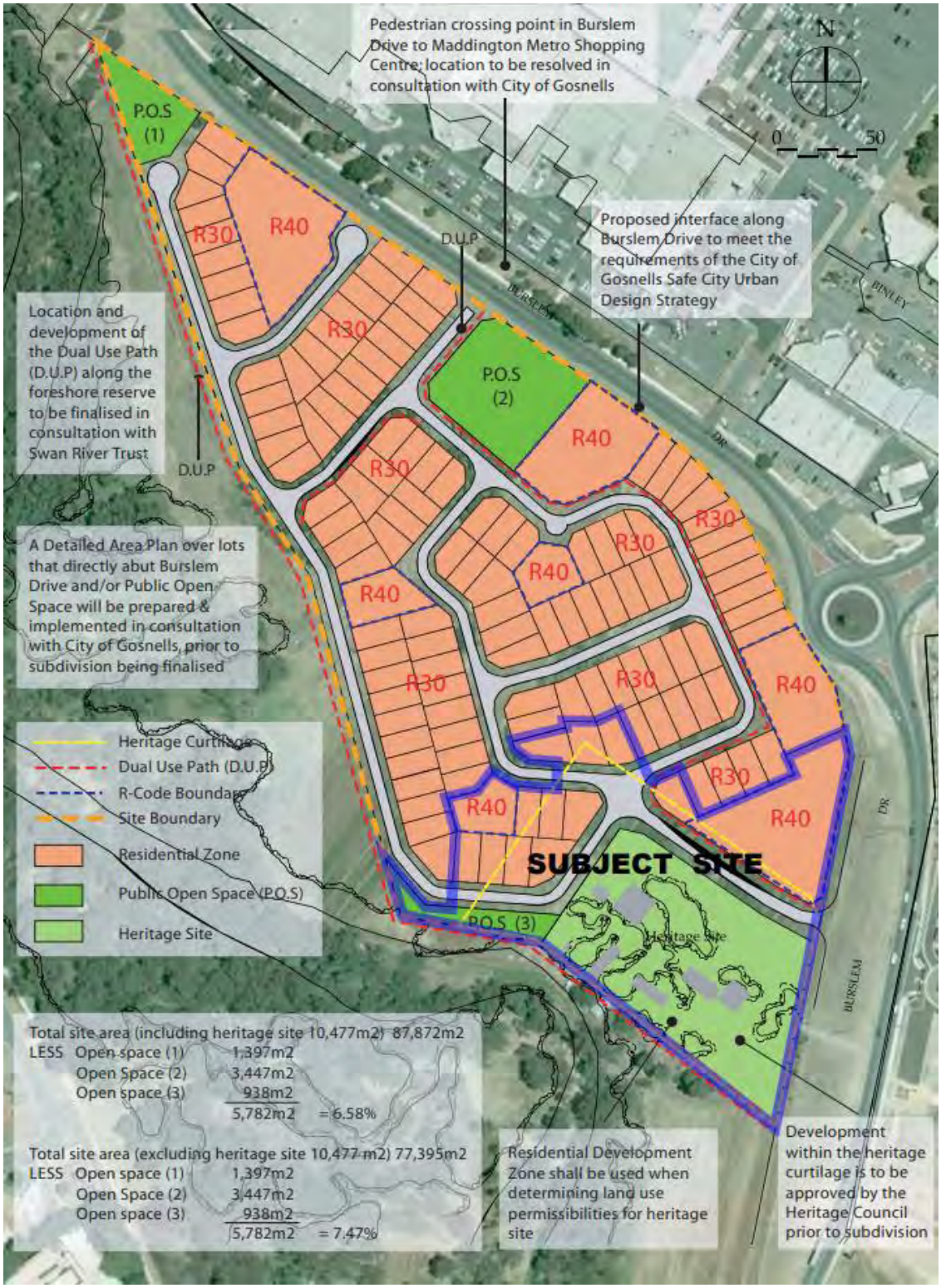

Figure 2: Site landuse type

2.2. Soil type and topography

The site comprises soils from the Pinjarra System that are predominantly pale brown sandy silty clay (Cms) (Perth Sheet; Gozzard, 1986).

The site is relatively flat and generally grade from 9mAHD in the centre of the site to 7 mAHD in the west. Surface levels drop sharply to the west of the site within the foreshore reserve area and is associated with the wetland and Canning River system. Topographic contours over the site are presented in Figure 3.

Figure 3: Site topography

2.3. Groundwater

Maximum Groundwater Levels (MGLs) within the site range from approximately 8.5 mAHD in the east to 6 mAHD in the west DWER 2022) and are presented in Figure 4.

Figure 4: Pre-development MGL

2.4. Flood mapping

The site is located adjacent to the Canning River. DWER floodplain mapping is presented in Figure 5 and shows that the site is not located within the floodplain. The 1% AEP flood height in the Canning River adjacent to the site is 4.94 mAHD. The existing roads and lots within the estate have a finished surface level greater than 0.5 m clearance above this flood level.

Figure 5: Flood mapping

2.5. Acid sulphate soils

Department of Water and Environmental Regulation (DWER) regional Acid Sulphate Soil (ASS) Risk Mapping has classified the whole site as having a moderate to low risk of ASS occurring within three metres of the natural soil surface (Figure 6).

An ASS risk assessment was conducted in 2004, and preliminary investigations documented in their report indicated that the potential for ASS does not appear to be an environmental risk at the site (ENV 2004).

Figure 6: Regional Acid Sulphate Soils risk mapping

2.6. Wetlands

Geomorphic wetland mapping classify the entire estate and the constructed wetland area within Lot L800 as Multiple Use Wetland (MUW) (DBCA 2022). However, there is no ecological function associated with the site or the estate as it has been previously been cleared.

The Canning River Floodplain Conservation Category Wetland (CCW) is located adjacent to the west of the site.

Geomorphic wetland mapping is presented in Figure 7.

Figure 7: Geomorphic wetlands (DBCA 2022)

2.7. Bush forever

There are no bush forever sites mapped within the site boundary. Located adjacent to the west of the site is Bush Forever site 246 (DPLH 2019), as presented in Figure 8.

Figure 8: Bush forever site 246 mapped in green (DPLH 2019)

3. STORMWATER MANAGEMENT

3.1. Drainage objectives

The key relevant drainage design strategies for the site include:

- Runoff from residential, group housing and heritage lots will be directly connected to the roadside pipe and pit system
- The northern subcatchment to drain directly into the existing pipe and pit network along Panozza Circle without any water quality treatment or attenuation of runoff
- The southern subcatchment to drain into a bioretention swale, sized to provide treatment of the first 15 mm of rainfall
- The swale will also provide attenuation of runoff so that peak discharge rates are not greater than predevelopment rates in up to the 20% AEP event
- The site will be developed with at least 0.5 m clearance from the adjacent Canning River floodplain level and 0.3 m above the swale 1% AEP water level.

3.2. Predevelopment stormwater

3.2.1. Subcatchment breakdown

Under predevelopment conditions the site comprises of two subcatchment (Figure 9). Subcatchment areas and peak discharge rates are summarised in Table 2 and were modelled using XPSWMM.

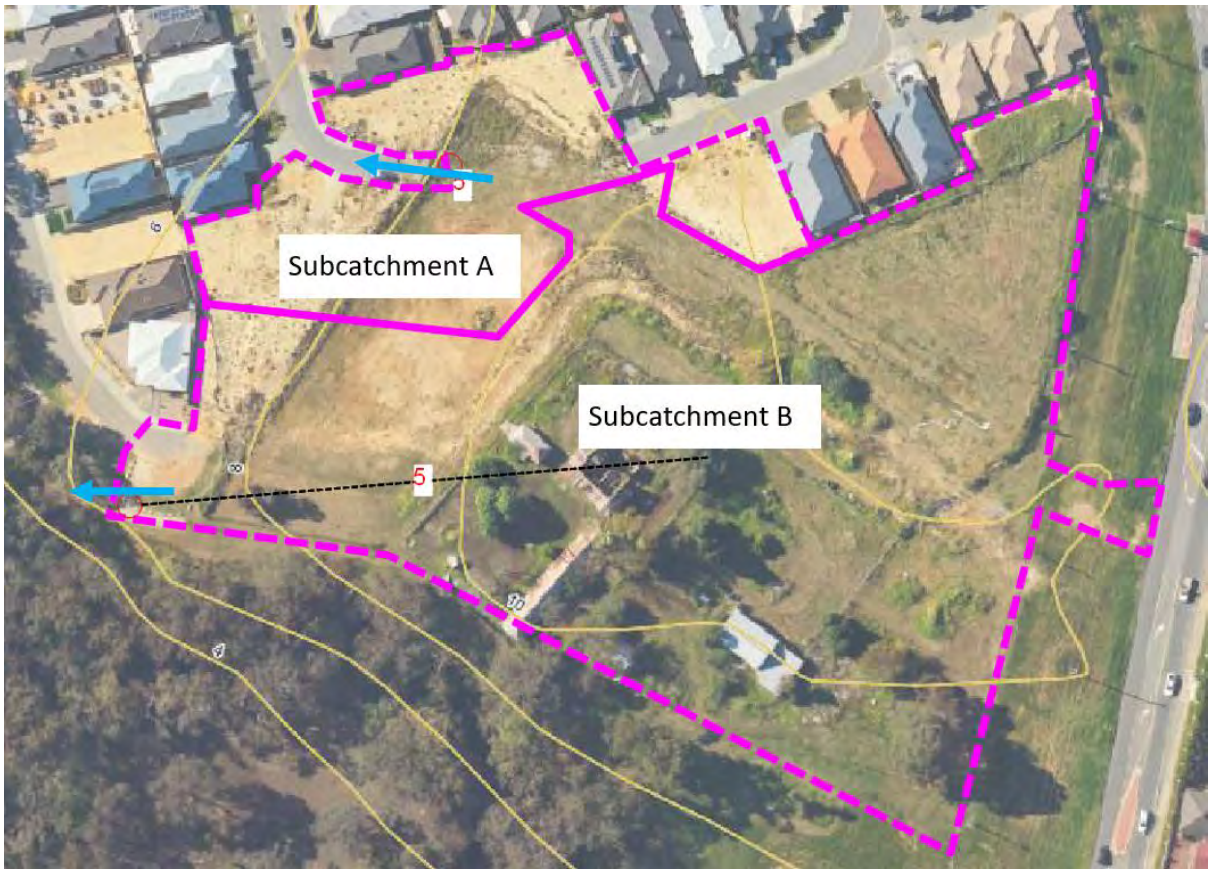

Figure 9: Predevelopment subcatchments

Table 2: Predevelopment stormwater discharge to west

Subcatchment	Outlets to	Area (ha)	1 EY (m3/s)	20% AEP (m3/s)	1% AEP (m3/s)
Subcatchment A	Panozza Circle Drainage	0.462	0.013	0.026	0.058
Subcatchment B	Existing constructed wetland area	1.798	0.046	0.080	0.194

3.3. Post development stormwater management

3.3.1. Subcatchment breakdown

Post development the site has two subcatchments (Figure 10). The landuse breakdown within each of these subcatchments is detailed in Table 3.

Subcatchment A land use type consists of residential lots, a group home lot and road reserve. Runoff generated in this subcatchment will discharge into the existing roadside pipe and pit network along Panozza Circle prior to discharge into the constructed wetland area (Figure 11).

Subcatchment B consists of road reserve, residential, group home and heritage lots that will be directly connected to the roadside pipe and pit network and discharges into a bioretention swale.

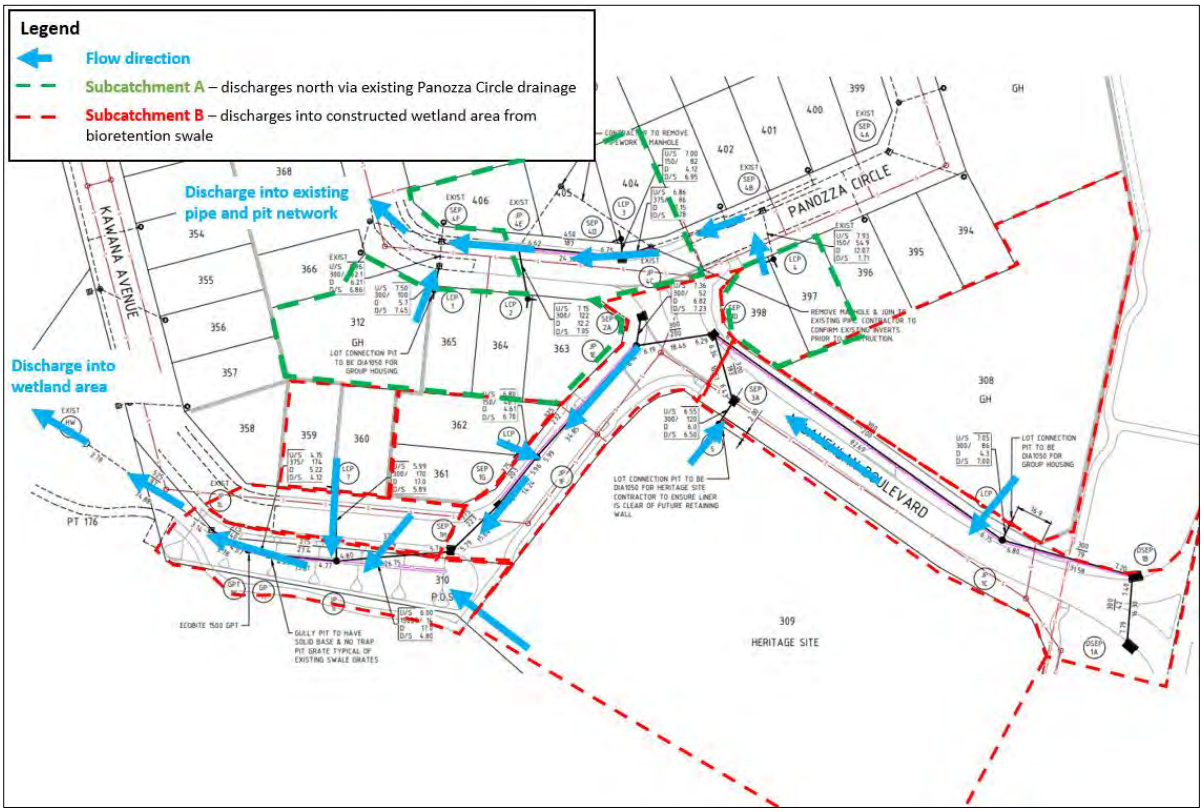

Figure 10: Subcatchment breakdown

Table 3: Subcatchment landuse area breakdown

Catchment ID	Total (ha)	Road reserve (ha)	R30 & R40 lots (ha)	Heritage lots (ha)	POS / drainage (ha)
Subcatchment A	0.462	0.035	0.427	0	0
Subcatchment B	1.798	0.253	0.488	0.946	0.105
Total	**2.26**	**0.288**	**0.915**	**0.946**	**0.105**

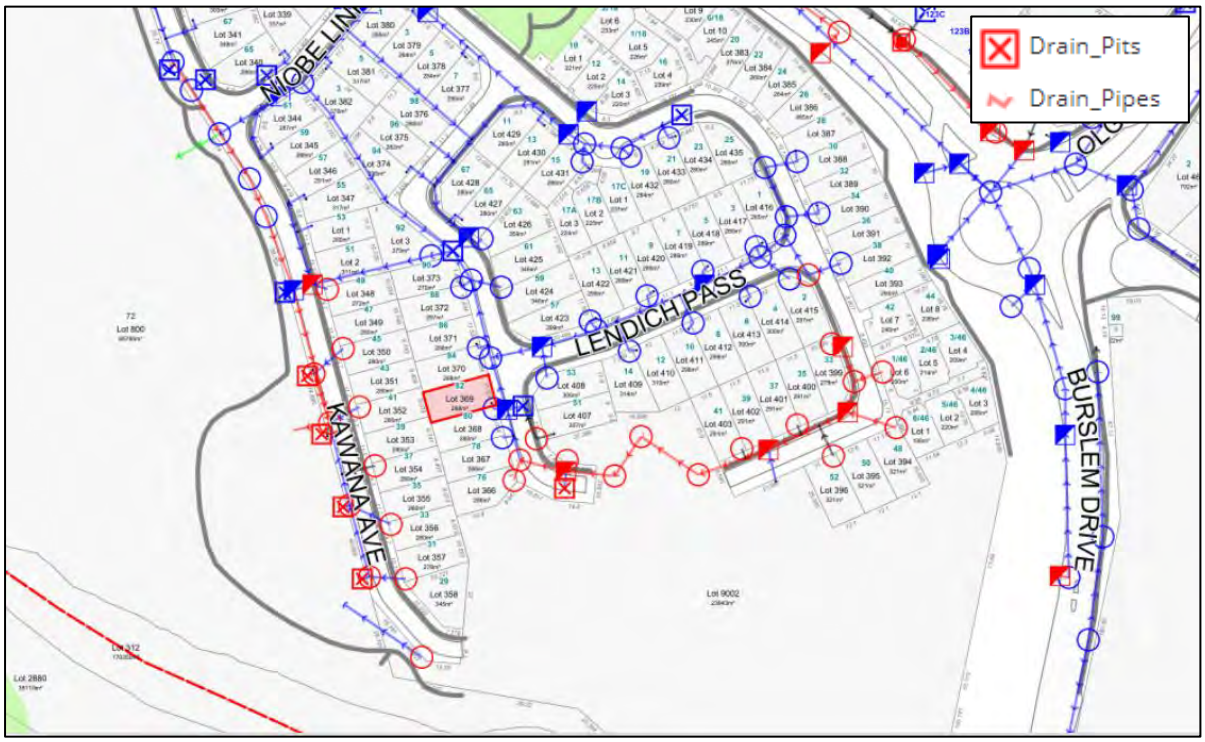

Figure 11: Roadside pipe and pit drainage infrastructure (CoG 2022)

3.3.2. Post development stormwater discharge

Post development stormwater modelling was undertaken using XPSWMM modelling software. Conservatively low loss rates were adopted for residential, group housing and heritage lots as these will be directly connected to the roadside pipe and pit network (Table 4).

Peak flow rates for three different design rainfall events are detailed in Table 5. For both subcatchments the peak post development discharge rates in the 1 EY and 20% AEP events are less than predevelopment rates. In the 1% AEP event the post development discharge rates will be slightly greater than the predevelopment rates from both subcatchments, however this additional flow is not considered to pose a flood risk as this runoff will empty into the adjacent Canning River.

Table 4: Uniform Loss runoff routing rates

	Road reserve	R30 & R40 lots	Heritage lots	POS / drainage
Initial Loss (mm)	1	2	5	2
Proportional Loss	0.1	0.15	0.2	0.15

Table 5: Post development vs predevelopment stormwater discharge rates

		Post development			Predevelopment		
Catchment ID	**Outlets to**	**1 EY (m3/s)**	**20% AEP (m3/s)**	**1% AEP (m3/s)**	**1 EY (m3/s)**	**20% AEP (m3/s)**	**1% AEP (m3/s**
Subcatchment A	Panozza Circle Drainage	0.028	0.036	0.086	0.013	0.026	0.058
Subcatchment B	Existing constructed wetland area	0.037	0.059	0.277	0.046	0.080	0.194

3.3.3. Swale design

The swale located in Subcatchment B will provide flood storage, attenuation of peak flows and treatment of the first 15 mm of rainfall. The swale design is provided in Appendix A and summarised below:

- 1 in 4 side slopes with a lower internal retaining area in the east
- Runoff from the pit and pipe network will discharge into the swale via a bubble-up pit which is 0.5 m deep
- Runoff will enter the swale from the adjacent road reserve and POS area via overland flow
- A check-weir will be located towards the centre of the swale to provide attenuation of peak flows and greater flood storage. The weir will be 700 mm high with an underlying low flow 150 mm culvert at the swale invert
- The first 15 mm of rainfall runoff will be infiltrated within the swale to provide water quality treatment.
- The swale will be underlain by subsoil drainage to facilitate infiltration
- All runoff stored in the swale will be infiltrated in less than 96 hours following a storm event
- A bubble down pit will be located in the west of the swale and will have a lid level at 6.4 mAHD, 0.1 m above the swale invert
- The bubble down pit will have capacity to convey runoff in up to the 20% AEP event
- An overflow weir will be located in the west of the swale at a level of 6.5 mAHD, approximately 0.3 m above the swale invert. This weir will convey runoff in storm events greater than the 20% AEP event to the constructed wetland.
- The maximum depth and volume in the swale in the 1 EY, 20% AEP and 1% AEP events are detailed in Table 6.

Table 6: Swale depth and volume

Design event	1 EY depth (m)	1 EY volume (m^3)	20% AEP depth (m)	20% volume (m^3)	1% AEP depth (m)	1% AEP volume (m^3)
Eastern portion of swale upgradient of weir	0.50	52.5	0.71	95.5	0.75	105
Western portion of swale near outlet	0.15	16.8	0.17	20.0	0.24	32.9

3.4. Flood mitigation

All lots and roads within the site will be developed at least 0.5 m above the adjacent flood level in the Canning level of 4.94 mAHD. Lots will also be developed at least 0.3 m above the 1% AEP top water level that is 6.54 mAHD in the west and 7.25 mAHD in the east of the swale.

All runoff generated in the 20% AEP event will be conveyed in the pipe and pit network.

Due to the small size of the site the pipe and pit system will have capacity to convey the majority of runoff in the 1% AEP storm event, with negligible overland flow.

3.5. Non-structural controls

Non-structural controls to improve stormwater quality includes native vegetation within the swale and downstream wetland areas to help prevent erosion, maintain soil infiltration, restrict water flows and remove particulate and soluble pollutants.

4. GROUNDWATER MANAGEMENT

To ensure that an adequate separation distance to finished road and lot levels are maintained, a subsoil drainage system within the road reserve will be installed. Subsoils are also proposed under the swale located within the POS to facilitate infiltration. Subsoils will be encased with high PRI soils (>10) that will provide inline water quality treatment.

To address an existing inundation issue raised by the CoG, a subsoil drain will be installed along the interface of Lot 312 and Lots 356, 357, 358, 359, 360, 362 and 365 connecting into the Lot 312 Lot Connection Pit 1 (Appendix A).

The proposed subsoil layout is presented in Appendix A.

5. IMPLENTATION

As the site is the last stage to be developed within the site, the POS and swale are relatively small in area, and the downstream wetland area has already been constructed, ongoing monitoring is not proposed.

The operation and maintenance program is proposed in Table 8 below.

Table 7: Roles and responsibilities

Principles	Role	Responsibility	Timescale
Subdivision management	Construction and site work management	The Proponent	As required during construction until handover to the CoG
	Waste and pollution management	The Proponent	As required during construction until handover to the CoG
	Dust suppression and erosion Control	The Proponent	As required during construction
POS and swale	Maintenance of drainage infrastructure	The Proponent	Until handover to the CoG
	Fertiliser application	The Proponent	Until handover to the CoG.
	Irrigation systems	The Proponent	Until handover to the CoG

6. REFERENCES

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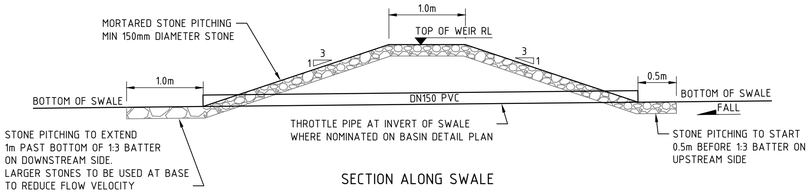
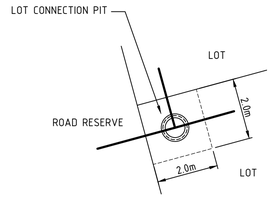
Appendix A: Drainage Plan (JDSi 2023)



SECTION ALONG SWALE

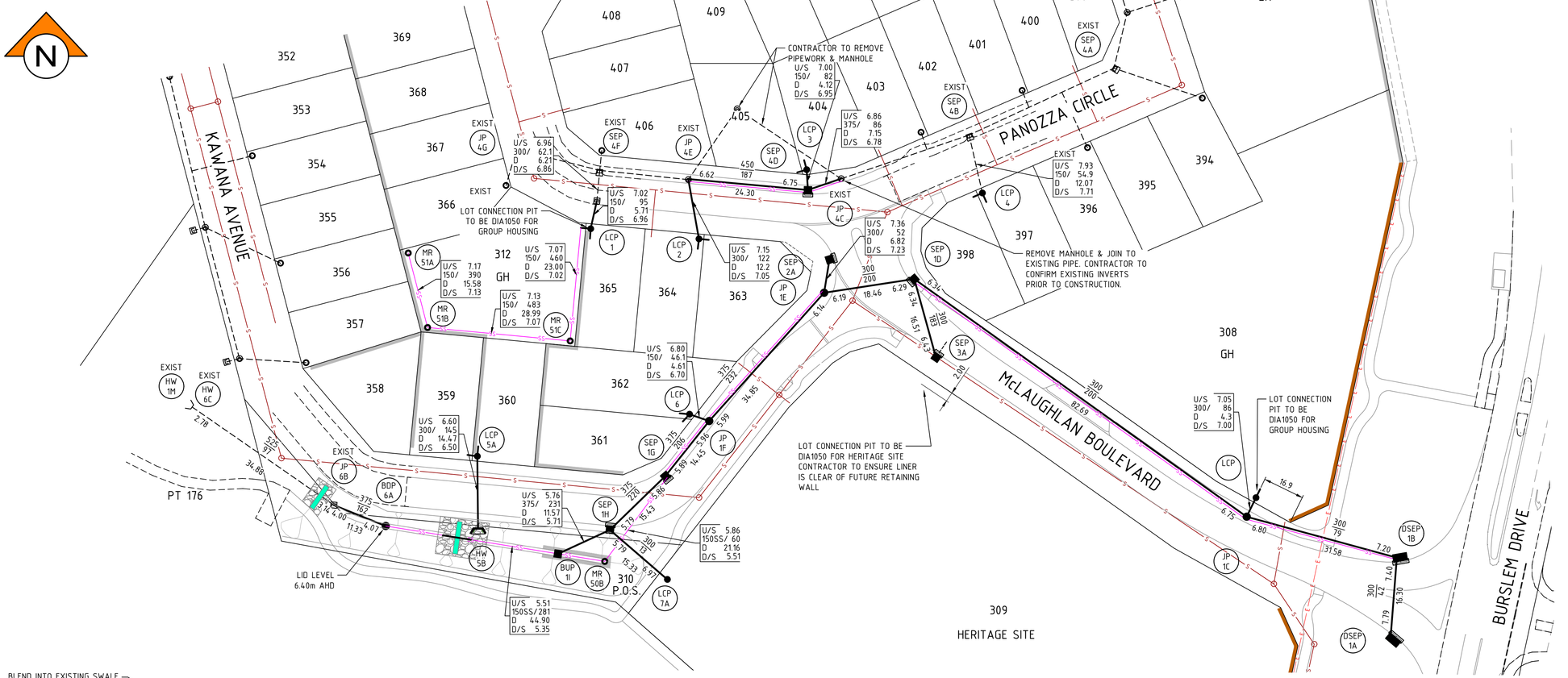
DRAINAGE WEIR

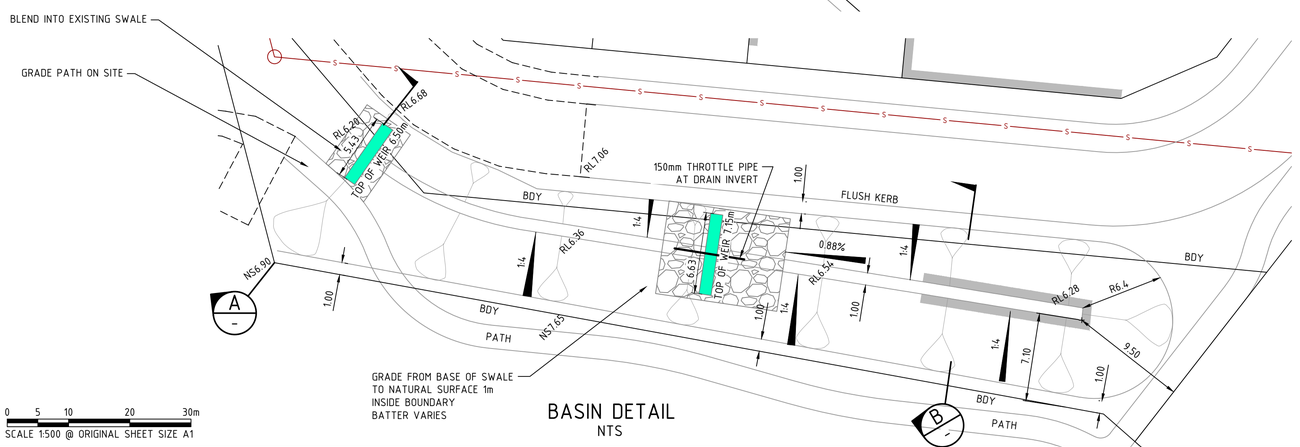
NOT TO SCALE



DRAINAGE EASEMENT DETAIL

SCALE 1:100



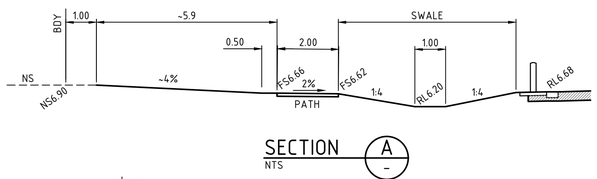


BASIN DETAIL

NTS

0 5 10 20 30m

SCALE 1:500 @ ORIGINAL SHEET SIZE A1



NOTES

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DRAWINGS AND SPECIFICATION
2. SETOUT OF ROAD CENTERLINE, FACE OF KERB AND EDGE OF SEAL FOR UN-KERBED ROADS SHALL BE BASED ON SUPPLIED AUTOCAD DATA. ALL OTHER WORKS SHALL BE SETOUT BASED ON INFORMATION CONTAINED ON THE CONTRACT DRAWINGS
3. THE CONSTRUCTION OF WORKS SHALL BE TO THE APPROVAL OF THE LOCAL AUTHORITY
4. ALL DIMENSIONS ARE IN METRES UNLESS SHOWN OTHERWISE
5. ALL LEVELS SHALL BE DETERMINED FROM BENCHMARKS ESTABLISHED BY THE PROJECT SURVEYOR
6. ALL TRENCHING, PIPE BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH AS3725
7. ALL DRAINAGE PITS SHALL BE LOCATED AS SHOWN IRRESPECTIVE OF PIPE LENGTHS SHOWN ON THE DRAWINGS
8. AT LOW POINTS THE ENTRY PITS SHALL BE LOCATED AT THE LOW POINT OF THE ROAD PAVEMENT
9. THE DRAINAGE PIT LIDS SHALL BE SET TO SUIT THE VERGE SLOPE, NOMINALLY 2% UPWARDS FROM THE TOP OF BACK OF KERB
10. WHERE A SEWER LINE INTERSECTS WITH STORMWATER DRAINAGE LINE AND THE SEWER PASSES OVER THE DRAIN THEN THE SEWER SHALL HAVE A TIMBER PILE AND KEEL PROVIDED FOR THE FULL EXTENT NECESSARY TO SUPPORT THE SEWER DURING EXCAVATION FOR THE DRAIN
11. THE CONTRACTOR SHALL IMMEDIATELY REPORT ANY DISCREPANCY OR CLASH WITH OTHER SERVICES TO THE SUPERINTENDENT
12. ALL JUNCTION PITS LOCATED IN THE ROAD PAVEMENT SHALL HAVE TRAFFICABLE LIDS
13. IRRIGATION DUCTS TO BE DETERMINED ON SITE WITH SUPERINTENDENT
14. FOR SERVICE CROSSING LEVELS REFER TO DRAINAGE LONGITUDINAL SECTIONS
15. ROAD PAVEMENT TYPES AND BRICK PAVING REMOVED FOR CLARITY - REFER TO PAVEMENT DRAWING FOR DETAILS
16. IN CIRCUMSTANCES WHERE MULTIPLE PIPES ENTER A LINER A MINIMUM OF 40% OF THE LINER SHALL REMAIN IN ANY HORIZONTAL PLANE

LEGEND

- LIMIT OF WORKS
- 2 — LOT NUMBER
- PIPE DIA-CLASS / GRADE, IL, IL, LENGTH(m) — PROPOSED DRAINAGE WITH NOTATION
- CLASS — (CLASS IF NOT CLASS 2)
- U/S 00.00 — UPSTREAM INVERT LEVEL
- 300/ 0.0 — PIPE DIA / GRADE
- D 0.0 — LENGTH
- D/S 00.00 — DOWNSTREAM INVERT LEVEL
- PROPOSED DRAINAGE
- PROPOSED WEIR
- EXISTING DRAINAGE
- EXISTING DRAINAGE TO BE REMOVED
- FUTURE DRAINAGE
- PROPOSED JUNCTION PIT
- PROPOSED SIDE ENTRY PIT
- PROPOSED DOUBLE SIDE ENTRY PIT
- PROPOSED COMBINATION SIDE ENTRY/GULLY PIT
- PROPOSED GULLY PIT
- JP 1 / CH 0.0 — PIT TYPE / PIT NUMBER / CHAINAGE
- JP — JUNCTION PIT
- DSEP — DOUBLE SIDE ENTRY PIT
- GP — GRATED PIT (TRAPPED WHEN IN SWALES)
- SEP — SIDE ENTRY PIT
- CSEP — COMBINATION SIDE ENTRY/GULLY PIT
- LCP — LOT CONNECTION PIT
- BUP — BUBBLE-UP PIT
- BDP — BUBBLE-DOWN PIT
- MR — MAINTENANCE RISER
- S — PROPOSED/EXISTING/FUTURE SEWER
- PM — PROPOSED/EXISTING/FUTURE PRESSURE MAIN
- PROPOSED/EXISTING RETAINING WALL
- PROPOSED ESTATE WALL (REFER LANDSCAPE PLANS)

WARNING

BEWARE OF UNDERGROUND SERVICES

The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Worksafe Regulation 3.21.

DIAL 1100 BEFORE YOU DIG

REV	DATE	DRAWN	CHECKED	APPROVED	
L	30.01.23	JF	BT	AS	REISSUED FOR COUNCIL APPROVAL
K	23.12.22	JF	BT	AS	REISSUED FOR COUNCIL APPROVAL
J	04.10.22	BG	BG	AS	ISSUED FOR TENDER
I	16.08.22	AG	BG	AS	ISSUED FOR COUNCIL APPROVAL
H	13.09.21	AG	BG	KP	TRAFFIC CALMING RAMP REMOVED
G	09.09.21	AG	BG	KP	ISSUED FOR TENDER
F	09.11.18	BG	BG	KP	REISSUED FOR COUNCIL APPROVAL
E	18.07.18	BG	BG	KP	REISSUED FOR COUNCIL APPROVAL
D	23.06.17	BG	BG	JL	REISSUED FOR COUNCIL APPROVAL

NOTE
This drawing shall be preliminary only until it is issued for Construction.
Certified Quality System to ISO 9001

JDSi
CONSULTING ENGINEERS
Level 1, 432 Murray Street, Perth WA 6000
P: (08) 9227 0595 F: (08) 9227 8617

CLIENT: GOLDEN GROUP PTY LTD

PROJECT: GOLDEN RIVER ESTATE, MADDINGTON STAGE 4

DRAWING TITLE: DRAINAGE PLAN

DRAWN: B. GRIFFITHS		WAPC No.	155668
DESIGNED: B. GRIFFITHS		SCALE @ A1	1:500
PROJECT MANAGER: J.LEE		DATUM: AHD	CO-ORDS: PCG94
JDSi PROJECT No.	DRAWING No.		REVISION
JDS15849	C350		L

Appendix B: Drainage and Nutrient Management Plan (VDM Environmental 2007)

PROPOSED RESIDENTIAL DEVELOPMENT
LOTS 173-177 BURSLEM DRIVE,
MADDINGTON,
W.A.

Section 1:
INTRODUCTION

Issue 1: December 2007

VDM Environmental

DOCUMENT CONTROL RECORD

VDM Environmental ***63 Burswood Rd, Burswood WA 6100*** ***PO Box 186, Victoria Park WA 6979***		**Job No:**	71250
Telephone:	08 6250 9900	**File Reference:**	**W:\VDM Environmental\Projects\71250 - Lots 173-177 Burslem Drive, Maddington\Reports\Section 1-Intro\71250_Intro_Issue_1.doc**
Facsimile:	08 6250 9999	**Date of Issue:**	14/12/07
Email:	info@vdmenvironmental.com.au	**Project Leader:**	Carel van der Westhuizen

Report Details:

Title:	Proposed Residential Development Lots173-177 Burslem Drive, Maddington, WA. Introduction
Author(s):	J. Rostom
Status:	Issue 1
Client (s):	Ewing VDM
Client Contact(s):	Fabio Otranto / Craig Benfield
Synopsis:	This report presents the introduction to the documents included in the following sections relating to the proposed residential development at Lots 173-177 Burslem Drive, Maddington.

Revision History:

Issue No	Date	Checked By & Date		Issued By & Date		Distributed to:	No. of Copies
1	14/12/07	RH	14/12/07	JR	14/12/07	Swan River Trust	1
						City of Gosnells	1
						Ewing VDM	1
						VDM Environmental	1

Introduction

VDM Environmental has been engaged by Ewing VDM to prepare the following documents for the Proposed Residential Development at Lots 173-174 Burslem Drive, Maddington (the subject site).

- Drainage and Nutrient Management Plan (DNMP): Section 3
- Water Quality Monitoring Program (WQMP): Section 4
- Maintenance and Asset Management Plan (MAMP): Section 5
- Subdivisional Works Management Plan (SWMP): Section 6

In preparing these reports, VDM Environmental has complied with the City of Gosnells local guidelines and policies to ensure that these documents meet the information requirements of the relevant authorities.

These reports have been compiled to address the following current Western Australian Planning Commission (WAPC) and the Swan River Trust (SRT) conditions:

- WAPC Condition no. 20 of Application no. 129247 (DNMP)
- SRT condition no. 14 of Approval Ref: SRT2401 (WQMP)
- SRT condition no. 8 of Approval Ref: SRT2401 (MAMP)
- SRT condition no. 12 of Approval Ref: SRT2401 (SWMP)

The *Decision Process for Stormwater Management in WA* (DoE and SRT, 2005), and the *Stormwater Management Manual for WA* (2007) and other local and State guidelines and manuals have all been addressed within these reports.

Section 2 that follows offers the Description and Characteristics of the subject site.

VDM ENVIRONMENTAL

PROPOSED RESIDENTIAL DEVELOPMENT
LOTS 173-177 BURSLEM DRIVE,
MADDINGTON,
W.A.

Section 2:
SITE DESCRIPTION & CHARACTERISTICS

Issue 1: December 2007

VDM Environmental

DOCUMENT CONTROL RECORD

VDM Environmental ***63 Burswood Rd, Burswood WA 6100*** ***PO Box 186, Victoria Park WA 6979***		**Job No:**	71250
Telephone:	08 6250 9900	**File Reference:**	**W:\VDM Environmental\Projects\71250 - Lots 173-177 Burslem Drive, Maddington\Reports\Section 2-Site\71250_Site_Issue_1.doc**
Facsimile:	08 6250 9999	**Date of Issue:**	14/12/07
Email:	info@vdmenvironmental.com.au	**Project Leader:**	Carel van der Westhuizen

Report Details:

Title:	Proposed Residential Development Lots173-177 Burslem Drive, Maddington, WA. Site Description & Characteristics
Author(s):	J. Rostom
Status:	Issue 1
Client (s):	Ewing VDM
Client Contact(s):	Fabio Otranto / Craig Benfield
Synopsis:	This report presents the site description and characteristics for the proposed residential development at Lots 173-177 Burslem Drive, Maddington. It has been developed in accordance with Government Requirements and to the satisfaction of government and local shire specifications.

Revision History:

Issue No	Date	Checked By & Date		Issued By & Date		Distributed to:	No. of Copies
1	14/12/07	RH	14/12/07	JR	14/12/07	Swan River Trust	1
						City of Gosnells	1
						Ewing VDM	1
						VDM Environmental	1

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1. Location

The subject site is located on Lots 173-177 Burslem Drive, Maddington and is located within the City of Gosnells. It is located approximately 15 kms south-east of the city of Perth (refer to Figure 1) with geographic coordinates of 32° 03' 21" S and 115° 58' 40" E.

Figure 1: Aerial Photograph of Subject Site
(Google Earth)

The subject site comprises of five different cadastral subdivisions (Lots 173, 174, 175, 176 & 177 Burslem Drive), which comprise of the following areas:

Lot number:	Area (m^2):
173	9,754
174	11,578
175	15,732
176	20,529
177	30,279

2 Existing Land Use, Vegetation and Soil Condition

The subject site itself occupies an area of approximately 8.8 hectares and is bound by Burslem Drive on the northern and eastern boundaries and the Canning River on the western and southern boundaries in an area comprising both mixed use and residential development. The site has been previously cleared for agricultural purposes and predominant vegetation is introduced species including citrus and fruit trees. Native vegetation is located along the Canning River foreshore area.

The site comprises soils of the Guildford Formation which follow the present alignment of the Canning River. The landholding is dominated by pale brown sandy silty clay (Cms) whereas the area immediately adjacent to the river comprises clayey sandy silt (Msc_1) (refer ODP, VDM 2003).

3 Topography and Hydrogeology

The subject site generally slopes from Burslem Drive along the north and eastern boundaries towards the river along the western boundary. The highest point of the site is adjacent to the roundabout at the intersection of Burslem Drive, Phillip and Olga Streets. Site gradients range between 1 in 10 to 1 in 120, with an average slope of 1 in 50.

Levels across the site range from RL 4m AHD along the south-eastern boundary to RL 9m AHD approximately in the north-eastern periphery adjacent to the roundabout at Olga Street.

Figure 2 below illustrates the contour elevations for the subject site.

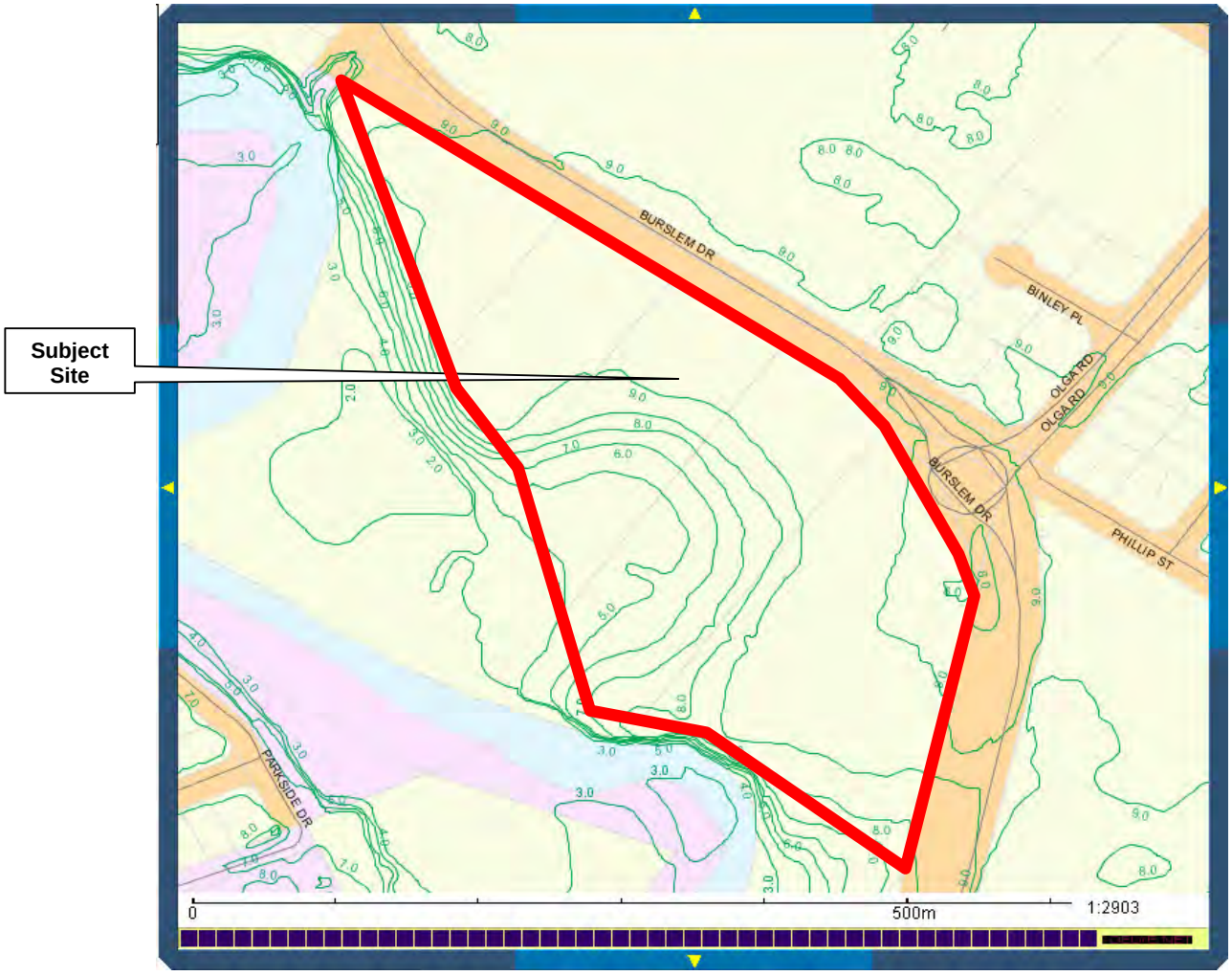


Figure 2: Ground Contour Elevations of Subject Site
(Perth Groundwater Atlas, DoW)

According to Groundwater Contour Maps compiled by the Water Corporation (estimated maximum recorded water levels 1993) the Groundwater Levels across the site are essentially at just below surface levels. The average groundwater level in the study area is therefore approximately RL 6.0m AHD.

Based on the Perth Groundwater Atlas, groundwater levels were obtained for each of the five lots. With reference to Figure 3 below, the following table presents the values obtained for the groundwater levels.

Table 1: Groundwater Depth Levels

	Lot 173 (32.05427° S; 115.97641° E)	**Lot 174** (32.05493° S; 115.97699° E)	**Lot 175** (32.05552° S; 115.97761° E)	**Lot 176** (32.05632° S; 115.97797° E)	**Lot 177** (32.05699° S; 115.97886° E)
Levels relative to ground level (m)					
Watertable	6.5	6.0	5.0	3.0	6.0
Base of Aquifer	14.0	14.0	13.0	11.0	14.0
Levels relative to AHD *(Australian Height Datum)* (m)					
Natural Surface Level	9.0	9.0	8.0	6.0	9.0
Watertable Level	2.5	2.5	3.0	3.0	3.0
Base of Aquifer Level	-5.0	-5.0	-5.0	-5.0	-5.0

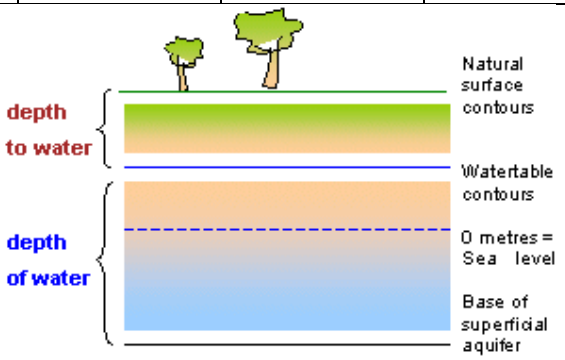


Figure 3: Groundwater Depth Levels
(Perth Groundwater Atlas, DoW)

4 Rainfall

As part of the designs, VDM Environmental undertook a review of relevant climate information obtained from the Bureau of Meteorology. Rainfall data from the Bureau's climate statistics was obtained for Perth Metro, being the closest measuring station to the subject site. Most rain falls between May and September with heaviest falls during the winter months.

Relevant rainfall statistics derived for Perth Metro were as follows:

- Mean rainfall 758.9 mm/year
- Dry Year (10th percentile) 647.3 mm/year
- Wet Year (90th percentile) 885.8 mm/year

Rainfall for Perth Metro, which provides a mean rainfall of 758.9 mm/year, has been utilised for this analysis.

5 Local Planning Policies

The following policies directly relate to stormwater drainage and water management:

5.1 City of Gosnells Policy No. 2.3.14 on Artificial Waterbodies:

This policy reiterates the City of Gosnells' support for the "Living Streams" concept of stormwater treatment, whereby:

- The infiltration of drainage waters to recharge groundwater is maximised.
- Permanent standing water is avoided, although there will be temporary standing water.
- Water quality is improved through overland flow via a "Living Stream".

5.2 City of Gosnells Policy No. 6.2.1 on Environmental Management Plan:

This policy reiterates the City of Gosnells' commitment to protect the global and local natural environment and heritage, and minimising any adverse environmental impacts associated with its services, activities and operations, and those of its community and local industry.

To fulfil this commitment, the City of Gosnells will observe all environmental laws and, consistent with the principles of sustainable development, will:

- Progressively establish, maintain and promote City-wide environmental standards for its operations and activities
- Implement Best Practice Environmental Management
- Integrate environmental factors into planning and operational decisions and processes
- Take action with its planning, development and regulatory processes to protect and conserve the natural environment and heritage of the City
- Strive to prevent pollution and manage its waste products so as to safeguard the community, workplace and environment.

5.3 City of Gosnells Policy No. 6.1.19 on Subdivision and Development Approval in Environmentally Sensitive Areas:

This policy stipulates that any subdivision or development application received by Council which in the opinion of the Manager Planning Services may affect an environmentally sensitive area shall be referred to the Department of Environmental Protection (DEP) for comment.

6 Contamination / Acid Sulfate Soils

Assessment of Acid Sulfate Soils (ASS) Maps from the Western Australian Planning Commission's Bulletin 64 (Figure 19) shows that the subject site is located in areas that are classified as having a moderate to low risk of ASS occurring within 3 metres of the natural soil surface, (illustrated in Figure 4 below).

However, a site assessment including ASS risk was conducted by ENV.Australia in May 2004. Preliminary investigations documented in their report indicated that the potential for acid sulfate soils does not appear to be an environmental risk at the site.

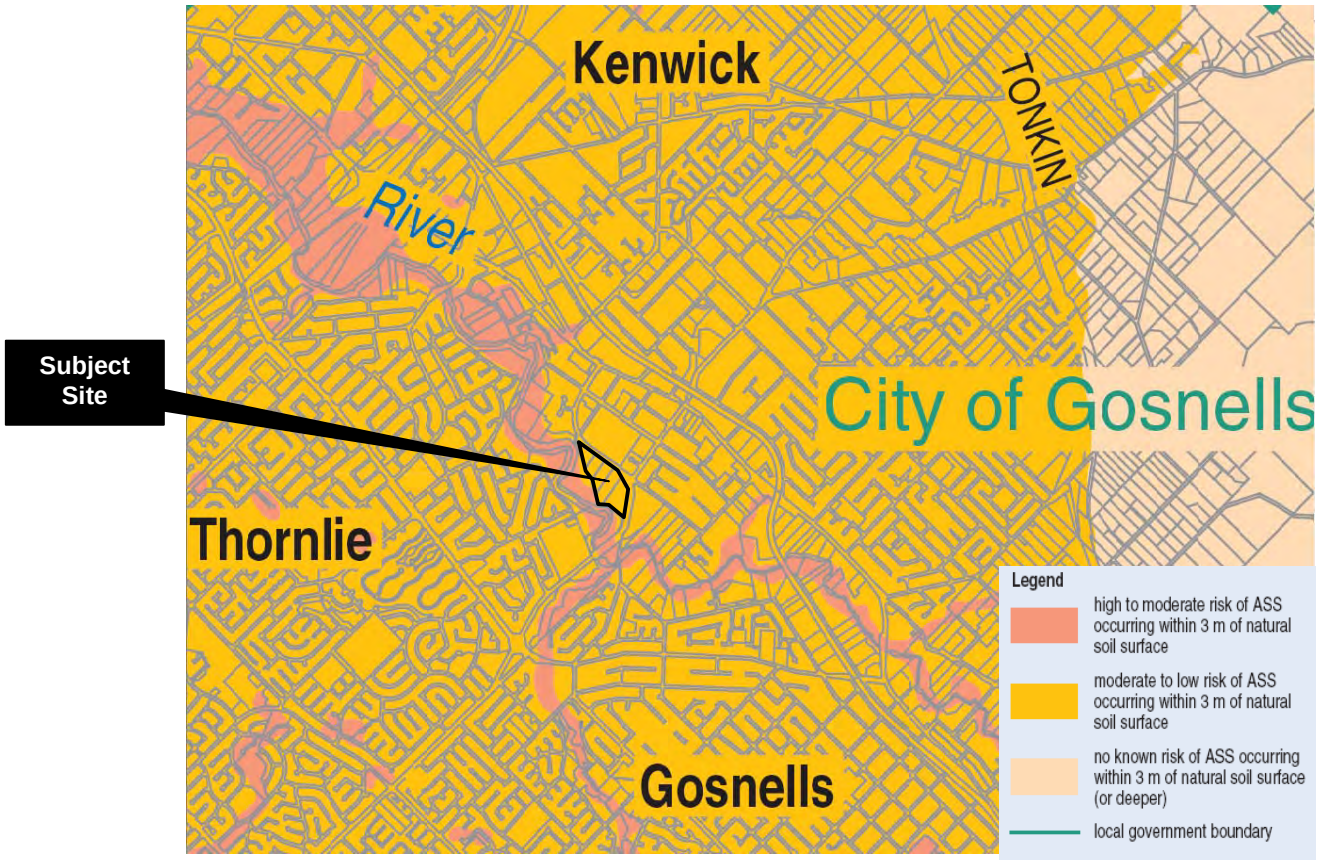


Figure 4: Acid Sulfate Soils Map
Central Metropolitan Region Scheme (Fig. 19, WAPC Bulletin 64)

7 Description of Development

The entire subject site is zoned as “urban” under the Metropolitan Region Scheme Map sheet 20 (WAPC, July 2007), and Burslem Drive has been identified as “Other Regional Road”. The adjoining land abutting the Canning River is included within the Parks and Recreational reservation. The land is currently zoned Residential R30 and R40.

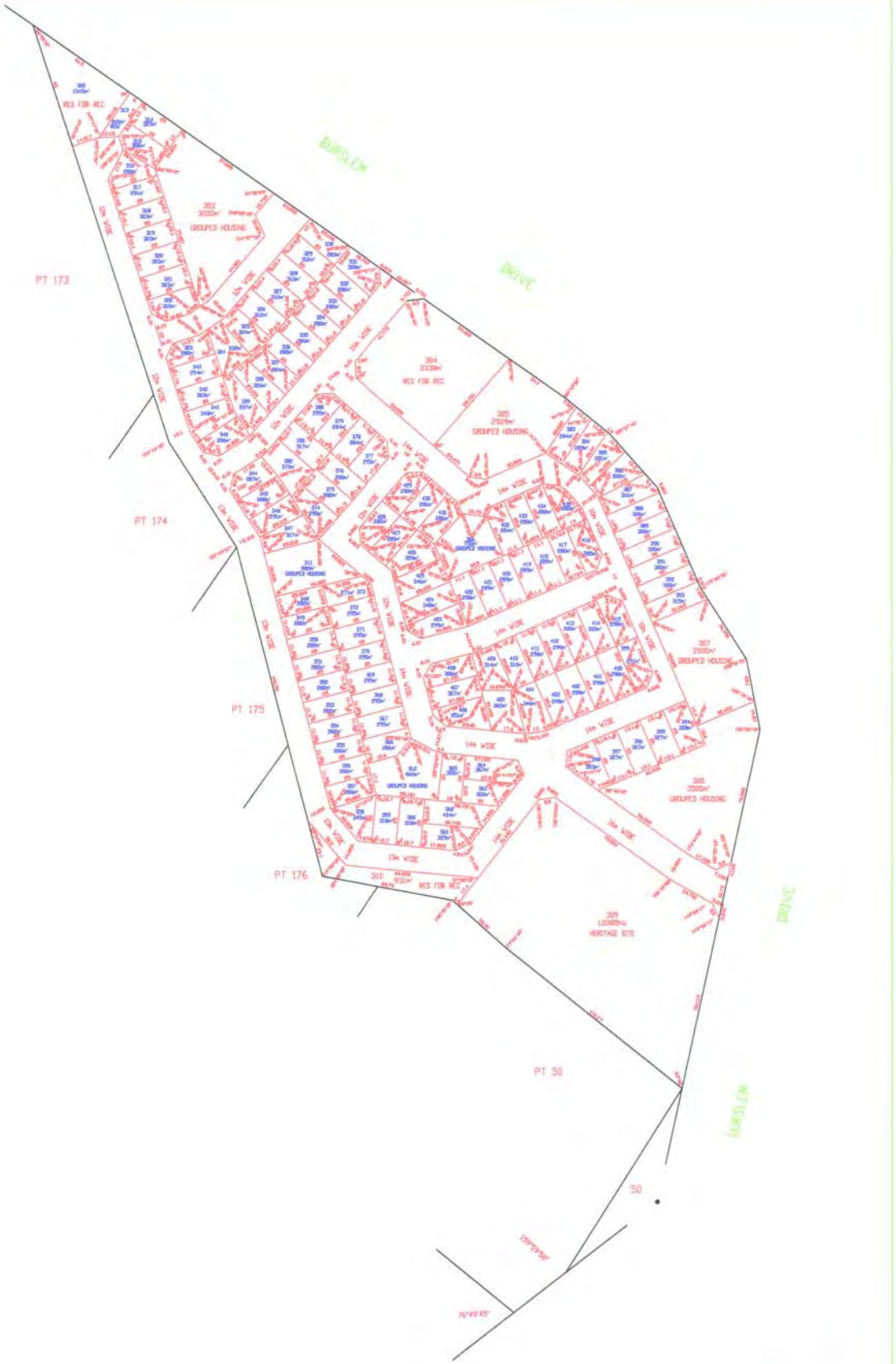
The development is proposed to be subdivided into 122 single residential lots averaging approximately 300m^2 in size, and 7 grouped dwelling sites ranging in size from 750m^2 to 3500m^2. The subdivision also results in 1 heritage site (Maddington homestead) of 1.0385 hectares, which will encompass the existing buildings of heritage significance.

An internal road network will provide access to the lots from two points on Burslem Drive, both 16m wide. Both these roads connect to a loop road which is predominantly 14m wide. The road reserve adjoining the foreshore reserve is 12-13m wide and the road servicing the north eastern lots is 12m. There will be a provision of dual use paths along the foreshore to be developed in consultation with the WAPC, City of Gosnells and the Swan River Trust. These will provide pedestrian links from the proposed development to the major facilities and recreational opportunities surrounding the site.

Three Public Open Space areas are proposed measuring 5,614m^2 in total. This represents 6.39% of the total site (including the heritage site).The POS areas are deemed significant in terms of creating an identity, interest and entry statement to the development. The location of the POS areas enables a connection between the shopping centre to the north and river to the east.

It is recognised that residential development of the site may, if not addressed properly, cause environmental impact on the Canning River. The retention of stormwater and nutrients is addressed in this management plan’s design, with stormwater being disposed of into the local drainage system and the POS areas, which are located away from the river. Furthermore, it is noted that there should be no increase in the amount of nutrients entering the Canning River as per Swan River Trust submissions.

The Proposed Subdivision and Precalculated Plan of Lots 173-177 Burslem Drive by the surveyors is presented in Figure 5, while the Outline Development Plan is presented in Figure 6.



NOTE ALL AREAS AND DISTANCES SUBJECT TO SURVEY

BROOK MARSH

CLIENT: WELLINGTON PARKLAND PTY LTD

TITLE: PRECALCULATED PLAN PROPOSED SUBDIVISION PT LOTS 173-177 INC OF CANNING LOC 13 BURSLEM DRIVE MADDINGTON

DATE	AMENDMENTS

DATED: 18 AUGUST 2025
SCALE: 1:1500
DATUM : MHD
COORD DATUM PCG
SURVEYOR: W.J FRANCE

N
W
E
S

Pedestrian crossing point in Burslem Drive to Maddington Metro Shopping Centre; location to be resolved in consultation with City of Gosnells

N

0 50

P.O.S (1)

R30

R40

D.U.P

Proposed interface along Burslem Drive to meet the requirements of the City of Gosnells Safe City Urban Design Strategy

BURSLEM

BINLEY

Location and development of the Dual Use Path (D.U.P) along the foreshore reserve to be finalised in consultation with Swan River Trust

D.U.P

P.O.S (2)

R40

R30

DR

A Detailed Area Plan over lots that directly abut Burslem Drive and/or Public Open Space will be prepared & implemented in consultation with City of Gosnells, prior to subdivision being finalised

Heritage Curtilage

Dual Use Path (D.U.P)

R-Code Boundary

Site Boundary

Residential Zone

Public Open Space (P.O.S)

Heritage Site

P.O.S (3)

Heritage Site

BURSLEM

DR

Total site area (including heritage site 10,477m2) 87,872m2

LESS	Open space (1)	1,397m2	
	Open Space (2)	3,447m2	
	Open space (3)	938m2	
		5,782m2	= 6.58%

Total site area (excluding heritage site 10,477 m2) 77,395m2

LESS	Open space (1)	1,397m2	
	Open Space (2)	3,447m2	
	Open space (3)	938m2	
		5,782m2	= 7.47%

Residential Development Zone shall be used when determining land use permissibilities for heritage site

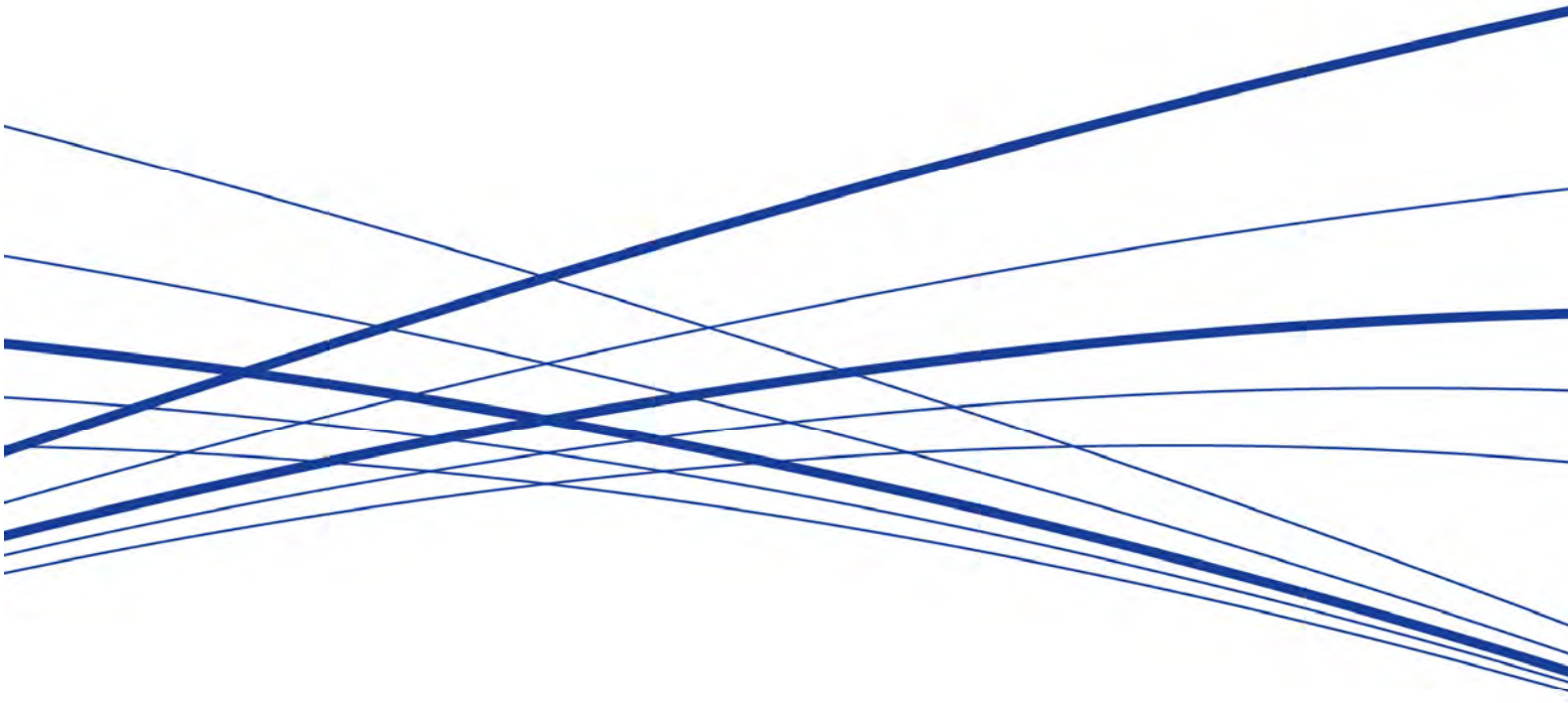
Development within the heritage curtilage is to be approved by the Heritage Council prior to subdivision

CONSULTANT	CLIENT	PROJECT	DATE	FILE NAME	SHEET TITLE	SCALE	SHEET NO
PMdR	-	LOTS 173 - 177 BURSLEM DRIVE MADDINGTON	MAY 2005		OUTLINE DEVELOPMENT PLAN	1:2000	

PROPOSED RESIDENTIAL DEVELOPMENT
LOTS 173-177 BURSLEM DRIVE,
MADDINGTON,
W.A.

Section 3:
DRAINAGE & NUTRIENT MANAGEMENT PLAN

Issue 1: December 2007



VDM Environmental

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Report Details:

Title:	Proposed Residential Development Lots173-177 Burslem Drive, Maddington, WA. Drainage & Nutrient Management Plan
Author(s):	J. Rostom
Status:	Issue 1
Client (s):	Ewing VDM
Client Contact(s):	Fabio Otranto / Craig Benfield
Synopsis:	This report presents the drainage and nutrient management plan for the proposed residential development at Lots 173-177 Burslem Drive, Maddington. It has been developed in accordance with the Department of Water's *Stormwater Management Manual for Western Australia* and to the satisfaction of government and local shire specifications.

Revision History:

Issue No	Date	Checked By & Date		Issued By & Date		Distributed to:	No. of Copies
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Executive Summary

VDM Environmental has been engaged by Ewing VDM to prepare a Drainage and Nutrient Management Plan (addressing current WAPC condition no. 20 of Application no. 129247) for the proposed residential development at Lots 173-177 Burslem Drive, Maddington. This report has been prepared to meet the requirements of the Department of Water, the Swan River Trust, and the City of Gosnells' applicable stormwater management policies and guidelines.

The topography of the post-development subject site will be such that stormwater runoff will gravitate to various sub-catchment areas, which will see runoff discharged into a "living stream" system as part of a treatment train. It is proposed that stormwater runoff from the post-development catchment area be conveyed to a piped roadside network, through Gross Pollutant traps before discharging into the "living stream" system within the wetland area. This system is a combination of a series of grassed and vegetated swales that interconnect several nutrient stripping basins/ponds before final discharge through the wetland area in the foreshore reserve area (Lot 800) and finally discharging into the Canning River.

The proposed development of Lots 173-177 Burslem Drive, Maddington will change the local land use to urban residential. This, in turn, changes the stormwater characteristics generated from the site. In particular, any increase in TN, TP and TSS needs to be quantified and evaluated. Stormwater generated onsite will be conveyed through the Stormwater Quality Improvement Devices (SQID's) mentioned above and ultimately be discharged into the receiving environment.

Hydraulic modelling was undertaken by Ewing VDM to ensure that these SQID's were sized to accommodate the design 1 in 1 years Average Recurrence Interval (ARI) storm events, as agreed with the Swan River Trust and the City of Gosnells. The detained storm water will reduce the risk of flooding and ensure post-development runoff does not significantly exceed pre-development runoff that would compromise the quality and integrity of the receiving environment.
The SQIDS proposed for this development are described in detail in the DNMP.

The DNMP for the site ensure minimal impact on the local and downstream environments. This report, with the aid of the Rational Method and MUSIC software modelling, has identified and quantified the potential impacts on the local environment, and has proved that this is minimal. Furthermore, the subject site's nutrient balance for both pre-development and post-development scenarios has been modelled using MUSIC software, and this has also been assessed and quantified as part of the DNMP.

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1. Introduction

1.1 Background

VDM Environmental has been engaged by Ewing VDM to prepare the Drainage & Nutrient Management Plan (DNMP) for the Proposed Residential Development at Lots 173-177 Burslem Drive, Maddington (the subject site).

In preparing this report, VDM Environmental has complied with the City of Gosnells local guidelines and policies to ensure the DNMP meets the information requirements of the relevant authorities.

This report has been compiled to address current WAPC condition no. 20 of Application no. 129247 and local shire requirements.

The *Decision Process for Stormwater Management in WA* (DoE and SRT, 2005), and the *Stormwater Management Manual for WA* (2007) have all been addressed within this report.

1.2 Scope

Specifically, this report details the following:

1. Catchment hydrology and stormwater conveyance including:
   a. Land use and vegetation;
   b. Topography and hydrogeology;
   c. Rainfall analysis; and
   d. Overland flow for pre and post-development scenarios

2. Water Quality issues including:
   a. An estimate of sediment and nutrient transport from the development site; and
   b. Comparison with water quality objectives of the receiving environment

3. Stormwater Management Controls for:
   a. Construction phase; and
   b. Operational phase

This report shall be amended as required in response to the Monitoring and Maintenance Program described herein to avoid significant and/or sustained deterioration in existing water quality of waterways downstream, when operational works are approved.

1.3 Objectives

The objective of this DNMP is to ensure that there is no worsening of stormwater quality or any reduction in the environmental values of the downstream receiving environment as a result of the proposed activities on the subject site, and ensure that water quality monitoring measures are put in place. In addition, there will be no increase in peak discharge flow rates from the development site to ensure conveyance and flooding on downstream properties are not impacted.

Within this context, the principles of the specific design and management objectives of the IUWMP are:

- Water Conservation: minimize the use of potable water where drinking water quality is not essential
- Water Quantity: for stormwater, to ensure post development peak flows and event discharge volumes are maintained relative to pre-development conditions; and

  for groundwater, to minimize change in peak winter levels at groundwater dependent wetlands
- Water Quality: for stormwater, to reduce the average annual loads of stormwater pollutants discharged by the development into receiving surface waters and groundwater systems; and

  for groundwater, to minimize the discharge of pollutants from the development into the groundwater, and from the groundwater to the receiving water (if applicable).

These principles and consequent objectives will be achieved through the implementation of:

- Management strategies designed to minimise water pollution from the development of the subject site;
- Specific operational phase controls to minimise sediment and nutrient export from the subject site;
- Hydraulic controls to mitigate the effect of the increased development flows on the downstream environment; and
- Defined performance criteria and actions to be taken if the criteria are not met.

2. Stormwater Assessment and Management Design

2.1 Proposed Drainage Design

It is proposed that rainfall generated from the road networks will feed into a drainage system that will discharge into drainage control structures. The stormwater drainage conveyance system will be sized to ensure that post-development flows do not exceed pre-development flows in a 1 in 1 year Average Recurrence Interval (ARI) storm event.

Therefore, to ensure that the drainage system will be able to sufficiently retain the flow, flow calculations for the critical 12 hours 1 in 1 year ARI storm events and sizing of drainage control structures undertaken by Ewing VDM were used as part of this report. This section of the report will review the drainage design and basin characteristics to ensure the development meets the Department of Water's requirements.

The main philosophy of the design is based on the "living stream concept" and has been proposed to:

- Provide an integrated treatment train that addresses nutrients, flood attenuation, sediment control and regulates catchment outflow to ensure existing outfalls and flows into the Canning River are maintained;
- Establish a wetland interface by incorporating a "living stream" and swale system that defines the edge between rehabilitated/restored foreshore and the proposed development;
- Ensure volume and flow requirements of the treatment train have been calculated to take up a 1 in 1 year ARI storm event as advised by Ewing VDM;

This plan has been compiled taking due cognisance of the Department of Water's Stormwater management objectives:

Water Quality	Maintain or improve surface and ground water quality within the development relative to pre development conditions.
Water Quantity	Maintain the total water cycle balance within development areas relative to the pre-development conditions.
Water Conservation	Maximise the reuse of stormwater.
Ecosystem Health	Retain natural drainage systems and protect ecosystem health.
Economic Viability	Implement stormwater management systems that are economically viable in the long term.
Public Health	Minimise risk to the public, including risk of injury or loss of life, to the community.
Protection of Property	Protect the built environment from flooding and water logging.
Social Values	Ensure that social, aesthetic and cultural values are recognised and maintained when managing stormwater.
Development	Ensure the delivery of best practice stormwater management through planning and development of high quality developed areas in accordance with sustainability and precautionary principles.
Liveable Neighbourhoods	Ensure sustainable development by creating linkages between water management infrastructure, urban and landscape design.

2.2 Stormwater Control Strategy

The stormwater drainage measures are required as per the *Stormwater Management Manual of Western Australia* in conjunction with the CSIRO *Water Sensitive Urban Design Engineering Procedures: Stormwater (2005)* to provide design discharge for a 1 in 1-year ARI storm event.

The following principles of design are proposed for this development:

- Rainfall generated on roof areas on each lot to be collected in rainwater pits. Due to the subsoil conditions, each pit will be connected to either subsoil drainage or to the site drainage system.
- All stormwater collected from the subdivision site's road network will be piped to one of four Gross Pollutant Traps (GPT's) located on the southern boundary of the subdivision.
- Surface water for the majority of road 1 will flow over a flush edge kerb along the southern edge of the road into a vegetated V-drain
- GPTs and v-drains will discharge to a "living Stream network" located in the reserve for recreation. The living stream will consist of a series of vegetated swales, nutrient stripping / silt trap ponds, and a larger compensating basin.
- The living stream discharges into an existing dam located in the southern aspect of the development. Water discharges from this spillway into the river system.

- Large rainfall events (greater than 1 in 1 year, 12 hour storm intensity) will overtop the compensating basin and living stream and adopt an overland flow path through the natural wetland and vegetation into the Canning River.

The main changes in hydrology as part of the proposed development include:

- The potential use of rainwater tanks for the collection and harvesting of rainwater runoff;
- An increase of the impervious area of the subject site;
- Concentrating stormwater flows within the proposed drainage network; and
- Utilisation of landscaped areas as treatment areas, e.g. grassed V-drains, the "living stream", etc.

2.3 Pre-Development Drainage and Hydrology

The proposed drainage strategy is to enhance the natural drainage system and to ensure that the status quo of the existing drainage regime is maintained after development.

The current site discharges directly to the Canning River across cultivated fields that are covered with weed and native grasses. Only a narrow band of fringed vegetation along the existing riverbanks provides some nutrient stripping but in the main there is little stopping surface flows from directly discharging into the Canning River. Several natural gullies have formed over the years at the locations where this drainage concentrates and has cut small entry channels through the riverbank.

These areas have revegetated over the years and now appear stable forming localised wetland / features outside the riverbank area and in what may be classed as a silt-trap / "entry zone" to the river floodway. These zones are seasonally inundated and have overhanging vegetation.

2.4 Post-Development Drainage and Hydrology – Mitigated

The Rational Method provides a simple means for the assessment of design peak flow rate (peak discharge) for the drainage design. For this purpose, the design formula is:

$$Q = \left(2.78 \times 10^{-3}\right) C_y \cdot {}^{t}I_y \cdot A$$

where: Q = peak flow rate (m^3/s) for average recurrence interval (ARI) of *y* years

C_y = coefficient of runoff (dimensionless) for ARI of *y* years (i.e. for 5 years of ARI)

I_y = average rainfall intensity (mm/h) for a design duration of t_c hours and an ARI of *y* years

A = area of catchment (ha)

The value of 2.78×10^{-3} is a conversion factor to suit the units used.

The value of C_y is determined from the formula: $C_y = F_y \cdot C_{10}$

where F_y = frequency factor determined from Table 5.04.3 *QUDM* assuming a fraction impervious f_i of 0.20 for the pre-development catchment;

C_{10} = coefficient of runoff for a 10 year ARI determined from Table 5.04.2 *QUDM*

Drainage design flow rates and sizing of grassed V-drains, vegetated swales and compensating basins was undertaken by Ewing VDM. Table 2 below presents the expected peak pre-development and post-development flows.

Table 1: Pre & Post-development drainage flows for subject site

	Subject Site Sub-catchment zones			
	Sub-catchment 1	Sub-catchment 2	Sub-catchment 3	Sub-catchment 4
Pre- Development Flow, Q (m^3/s)	**0.05**			
Post- Development Flow for 12-hr 1 in 1 yr ARI storm, Q (m^3/s)	**4.55**	**4.07**	**15.82**	**2.90**

The post-development catchment delineation plan is shown in Figure 1.

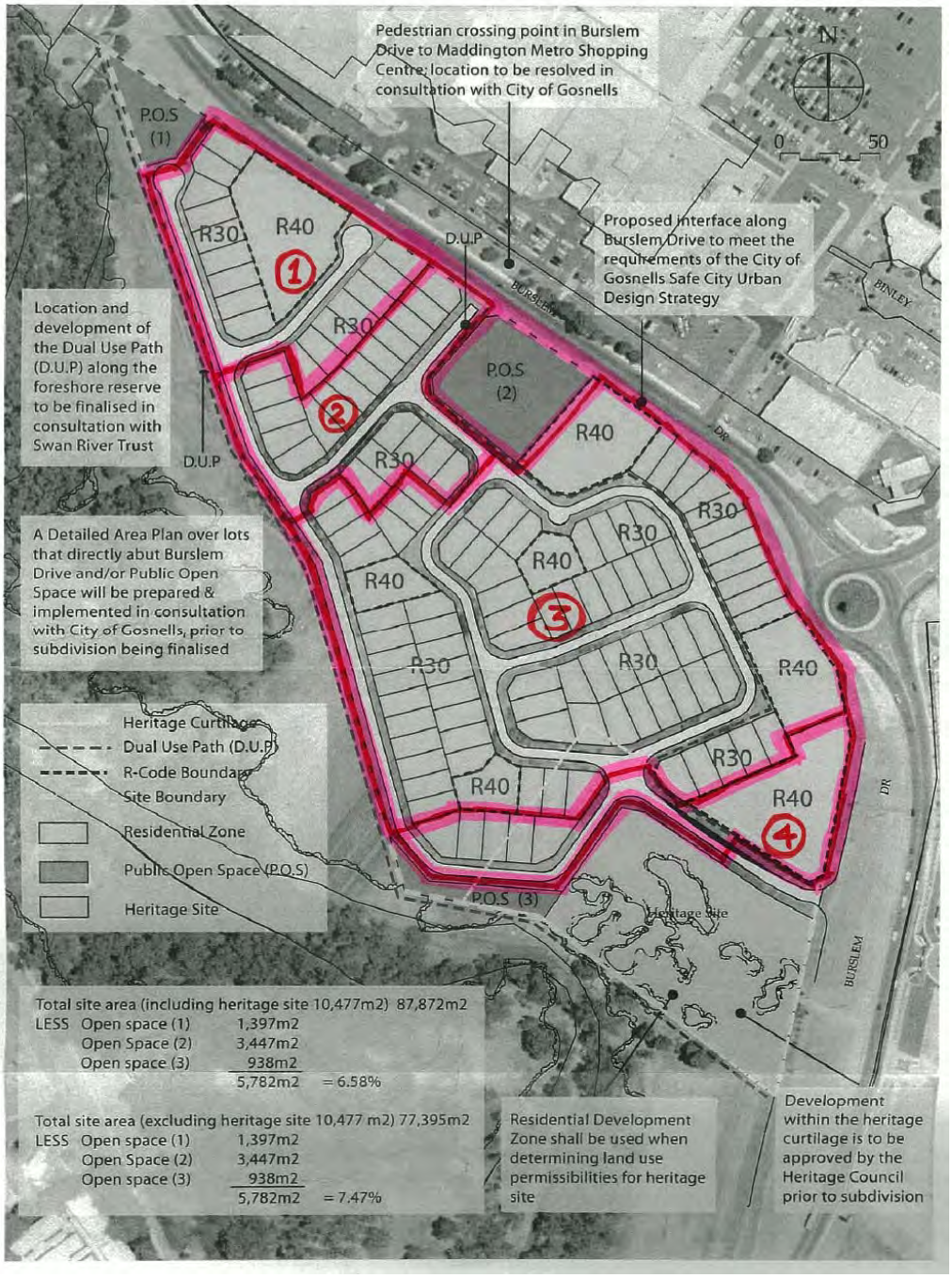


Figure 1: Catchment Delineation (Post Development)

A wide range of structural Water Sensitive Urban Design (WSUD) Best Management Practices (BMP's) for stormwater quantity control have been considered for inclusion within the development layout of the site. These, coupled with On Site Detention (OSD) systems contribute to mitigate the increases in flows as a result of the development. These structural BMP's are elaborated as follows:

- 3 Gross Pollutant Traps to collect any floating debris and litter prior to entering the treatment train;
- Utilisation of landscaped areas as detention and treatment areas within the wetland area, i.e. grassed V-drains and vegetated swales;
- Incorporating into the "living stream" a series of 2 nutrient stripping ponds and 1 compensating basin that are interconnected by the swales within the wetland area.

Gross Pollutant Traps (GPT's) typically consist of a sediment trap with a weir and trash rack at the downstream end. Flows enter a large typically concrete lined basin and are detained in the basin by a weir, decreasing flow velocities and encouraging sedimentation. The trash rack collects debris from flows overtopping the weir.

Grassed V-drains and vegetated swales convey stormwater, promoting infiltration and reducing stormwater runoff peak flow, velocity and volume, as well as remove coarse and medium sediments. They are usually placed in public open space, or within the median or along the shoulders of main roads, rather than within residential lots and verges.

Nutrient Stripping Ponds or water pollution control ponds incorporated in the stormwater drainage system are designed to collect and retain runoff for sufficient time to allow self-purification process inherent in natural wetland systems to reduce the nutrient and chemical load. The primary aim is to protect water bodies both on-site and interconnected ecosystems from nitrification and the possibility of algal blooms.

Nutrient stripping ponds work to improve water quality, physically, biologically and through chemical reactions. Dense plantings slow the progress of water through the system and allow suspended particles to settle. At the same time the plant biomass and porous substratum act as a filter that removes both suspended and colloidal solids. Removed solids are then degraded by microbial action.

Many aquatic plants compensate for natural fluctuations in levels of nutrients in water by the ability to absorb an amount of nutrients greater than their immediate requirements, storing these up for later use, removing them from the water. Aquatic macrophytes (large leaved water plants) have a great capacity for transporting oxygen to their root zones. This in turn creates environment for the microbial activity involved in pollutant removal or immobilisation. Micro-organisms attached to plant roots or substrata in this oxygen-enriched zone are able to aerobically oxidise organic matter.

Chemical conversions of nutrients into ammonium and ammonia gas are released to the atmosphere.

2.4.1 Grassed V-Drain and Vegetated Swale Design

Design guidelines from the Stormwater Management Manual for Western Australia (2007) stipulate the following storm events for consideration in the design of swales:

- Frequent storm flows – 1 yr ARI
- Minor storm flows – 5 and 10 yrs ARI's
- Major flood flows – 100 yrs ARI

Grassed swale geometric design takes into consideration the following elements:

- To maintain conveyance and prevent ponding during low flows, the longitudinal slope should not be less than 1%. Where slopes are steeper than 4%, riffles should be constructed at regular intervals to prevent scouring and reduce flow velocity.

- Swale dimensions and contributing catchment area should be selected to ensure 1 in 1-year ARI flow velocities for the swale are maintained at less than 0.5 m/s, with maximum velocities not exceeding 1.8 m/s

- Side batters should be constructed at 1:6 where possible and should not be steeper than 1:3.

The required width of the swale is that which can adequately contain the design flow within the banks of the swale, given the above design considerations. The Hydraulic Capacity of a swale can be determined by application of Manning's Equation for open channel flow:

$$Q = \frac{1}{n} \cdot A \cdot R^{\frac{2}{3}} \cdot S^{\frac{1}{2}}$$

where Q = flow (m^3/s)
n = roughness coefficient
A = Cross sectional area of flow (m^2)
R = Hydraulic Radius (m) defined as A/P, where P is the wetted perimeter.
S = longitudinal slope (m/m)

In order to accommodate the design flow for a 1 in 1-yr ARI storm event, the following grassed swale geometry is proposed by Ewing VDM for the V-drain and the vegetated swale:

<u>Grassed V-drain:</u>

Top width =**5.0m**
Side Slope = **1:5**
Swale Depth = **0.5m**

<u>Vegetated Swale:</u>

Avg. top width = **6m**
Side Slope = **1:6**
Swale Depth = **0.5m**

2.4.2 Nutrient Stripping Ponds and Compensating Basin Design

These are also included as part of the civil works and designs by Ewings VDM. The following are the sizings for the two nutrient stripping ponds and the compensating basin:

Nutrient Stripping Pond 1:

Volume of Storage: 51.8m^3
Approx. surface area: 150m^2

Nutrient Stripping Pond 2:

Volume of Storage: 95.2m^3
Approx. surface area: 220m^2

Compensating Basin:

Volume of Storage: 1,722m^3
Approx. surface area: 2,150m^2

2.5 Detention Times for OSD systems

The concept of detention time (also known as 'Ponding Time' or 'Emptying Time') stems from arising situations where there is natural water removal from storage installations by way of infiltration an/or percolation as well as the 'hydraulic' means of abstraction such a slow-drainage pipes releasing water into a nearby waterway or formal drainage path.

The detention time therefore refers to the time it will take for a retention device of a given type and dimension to empty from full under natural or 'hydraulic' emptying conditions.

Using the formula $T \approx \frac{2H.e_s}{k_h}$ seconds

Where T = Detention time

H = height of detention structure

e_s = void space ratio (equal to 1.0 for open water recession cases)

k_h = hydraulic conductivity of infiltration surface (equal to 2.5 X 10^{-4} m/s for 'as constructed' soil for grassed area.

Using this equation, the following average detention times are estimated:

- Grassed V-drain: 2,400 s (≈0.7 hours)
- Vegetated swales: 4,800 s (≈1.3 hours)
- Nutrient Stripping Pond 1: 3,200 s (≈0.9 hours)
- Nutrient Stripping Pond 2: 8,000 s (≈2.2 hours)
- Compensating Basin: 3,500 s (≈1 hour)

For the design 1 in 1 yr storm event, it is recommended that detention/emptying times do not exceed 0.5 days as an interim relationship. Therefore, the above-mentioned OSD structures are suitably sized to cater for recommended detention times, since they would take less than 1 day to drain assuming full capacity and provided the infiltration hydraulic conductivity is maintained at site.

2.6 Overflow contingency

The "living stream" treatment train is designed to provide storage for the critical 1 in 1 years ARI storm event. During any larger storm event the on-site detention (OSD) systems that comprise this treatment train will be inundated and could consequently overflow. This potential overflow and any excess volume of water are designed to flow directly into the existing foreshore POS reserve area.

2.7 Management of Disease Vector and Insect Control

Mosquito monitoring traps should be placed monthly within the riparian zone of the existing wetland area (bordering the foreshore POS reserve area) from September through to February (the peak mosquito breeding times) for the first year. If mosquito numbers are found to be a problem, the monitoring should continue thereafter.

If mosquito numbers are found to become a problem, a control program can be undertaken to target the mosquito species found in the traps. Controls that may be undertaken include biological controls such as introducing indigenous predatory fish (*Pseudogobius olorum* and *Galaxias occidentalis*) and chemical agents such as PROLINK and the organophosphate Temephos (Doggett 1998). However, an expert with knowledge of mosquito control and its impact on freshwater ecosystems should be consulted before mosquito control is undertaken.

Residents should undertake the following actions to help reduce mosquito populations in the area;

- Disposal of containers in backyards which hold water;
- Keep ornamental ponds stocked with ornamental fish (preferably native);
- Ensure roof guttering does not hold water; and
- Screen rain water tanks or add paraffin oil to cover the surface.

3. Stormwater Quality Assessment

3.1 Pollutants of Concern

The conversion of undisturbed or cleared land into residential land use has the potential to affect many water quality parameters within stormwater. The key pollutants generated by various urban developments are listed in the *Water Corporations – MUSIC Guidelines for Perth*, and the *Stormwater Management Manual for Western Australia* for both the Construction and Operational (Post Construction) phases. Although there are several potential pollutants and pressures to stormwater, their environmental impacts are only significant as per the conditions of the subject site. Land use therefore dictates the stormwater pollutant profile of the catchment, and ultimately dictates the pollutants of concern as a result of the proposed development. The pollutants of concern for the concerned subject site are as follows:

- Total Suspended Solids (TSS)
- Total Phosphorus (TP)
- Total Nitrogen (TN)

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software has been used in this IUWMP to provide a water and nutrient balance for the entire subject site.

The proposed development will result in the conversion of a large portion of the site to an urban land use. This report will concentrate on the potential increase in pollutant values as a result of the proposed development, and in turn the required treatment to mitigate potential increases.

This IUWMP will concentrate on the potential increase in pollutant values at the receiving environment as a result of the proposed development and in turn, the required treatment to mitigate potential increases.

3.2 Water Quality Objectives

The downstream quality of water within the local waterway may be impacted on by the proposed development. Best management practices outlined in the Stormwater Management Manual for Western Australia indicate that stormwater management should aim to:

- Prevent pollution at the source,
- Maximise infiltration to reduce runoff,
- Recharge groundwater, and
- Minimise change to the natural water balance.

The "*Stormwater Management Manual for Western Australia*" sets out the following water quality objective for new developments:

> "Maintain or improve surface and ground water quality within the development relative to pre development conditions".

This will ensure the environmental values of the downstream receiving waters are maintained.

3.3 Pre and Post-Development Water Quality

To determine the potential increase in pollutant export from the developed site without Stormwater Quality Improvement Devices (SQIDs), Model for Urban Stormwater Improvement Conceptualisation (MUSIC) was used for the following conditions:

- Pre-development scenario
- Post-development unmitigated scenario
- Post-development mitigation scenario

Pre-Development and Post-Development scenarios have been modelled based on the following assumptions:

- The entire catchment was calculated using structural plan drawings provided by the planners.
- The subject site has been modelled using the Water Corporation's Draft Final Report for MUSIC guidelines for Perth (GHD, June 2006).
- For the post-development scenarios, the subject site has been split into multiple source nodes for and modelled as Impervious and Pervious areas (parameter values being set for each).

Note:

- *Stochastically generated pollutant values were adopted for analysis; &*
- *The Perth 10 year 60 min rainfall data file from the BOM has been utilised for this analysis.*

3.4 Model Parameter Definition

Draft MUSIC Guidelines for Perth (June 2006) produced by GHD have been used to model the existing and post development scenarios. Guideline values are presented in Table 2 below.

Table 2: MUSIC guideline values

Pollutant Source Parameters	Total Suspended Solids (log mg/L)		Total Phosphorous (log mg/L)		Total Nitrogen (log mg/L)	
Non-Roof Impervious areas	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Concentration	2.32	0.544	-0.532	0.43	0.33	0.29
Pervious Areas	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Storm Flow Concentration	1.05	0.28	-0.64	0.16	0.55	0.14
Base Flow Concentration	1.08	0.34	-0.62	0.18	0.42	0.15
Roof Runoff	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Concentration	1.55	0.38	-0.89	0.29	0.33	0.29

In Perth it is common that a rainfall event which falls on pervious areas or roof

catchment areas is infiltrated to the subsurface, while rain on impervious areas such as roads is collected and disposed via a piped or open channel drainage system. In Perth it has been deemed to be inappropriate in many cases to direct surface runoff and base flow to the same treatment train.

In order to accommodate the different stormwater pathways, a system of separate source nodes is advocated by the GHD study. It is assumed that by dividing the stormwater generation into multiple specialised sub-sources, (such as impervious areas, roof areas and pervious areas) that stormwater can be directed to the appropriate treatment node.

3.5 Pre- and Post-Development MUSIC Results

The modelled net pollutant loads prior to Stormwater Best Management Practices for the proposed development are summarised in Table 3 below. The table gives total pollutant loads exiting the site for the pre and post-development cases without inclusion of SQIDS.

Table 3: Modelled median Pollutant Loadings

Scenario	Runoff (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)
Pre – Development	17.1	268	4.39	53.4
Post – Development Unmitigated	36	6,510	153	97.2
% INCREASE	**110%**	**2,300%**	**3,300%**	**82%**

The modelling shows that without mitigation, pollutant loads in the subject site's watercourses will be increased. Consistent with Water Sensitive Urban Design principles, SQIDs will be incorporated into the development layout to mitigate the effect of the proposed development on both runoff and diffuse pollution. Figure 2 below shows the layout of the MUSIC treatment train for the subject site.

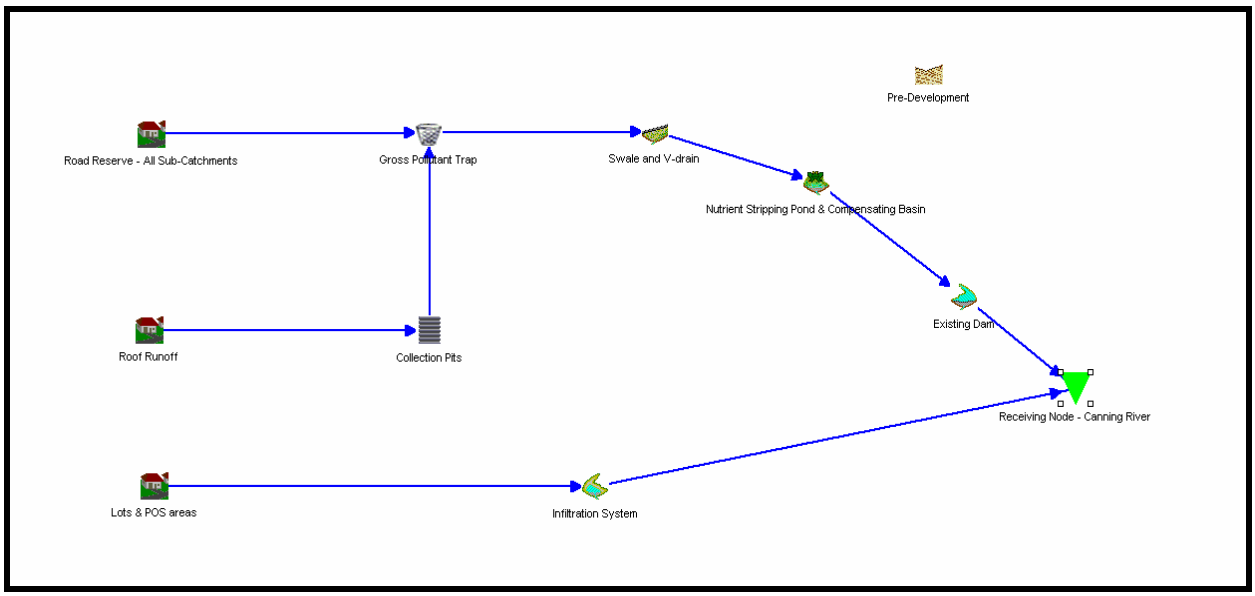


Figure 2: MUSIC Model Screen Capture

4. Stormwater Management Controls

A comprehensive review of all available stormwater quality improvement devices (SQIDs) and BMPs was undertaken as part of this investigation. Developed in accordance with IEAust Guidelines, the following sections provide a summary of the construction and operational phase management plans.

4.1 Construction Controls

During the construction phase of the development the following sediment and erosion control devices and stormwater management controls will be implemented on the site.

4.1.1 During Construction

Measures to mitigate water quality impacts during the construction will include:

- Sediment fences to be erected at the edge of the reserve for recreation to prevent sediment laden stormwater from flowing from the road surface into the canning River and wetland area;
- Progressive re-vegetation of waterway banks, as well as filled and disturbed areas;
- Regular inspections as soon as practicable after storm events to check and maintain controls;
- Sediment to be removed from fences when controls are 40% full and at the completion of construction. All material to be re-used or stored on-site in a controlled manner or taken off-site for re-use or disposal at a licensed waste disposal facility;
- All workers and sub-contractors to be inducted in these sediment and erosion control measures;

Sediment fence detail is provided as Appendix E. The *Stormwater Management Manual of WA* (DoW, 2007) identifies an approximate unit cost (2004 dollars) for sediment fences at $1.30 per metre, plus the cost of backfilling and digging a shallow (100 – 150mm) trench.

Additional erosion and sediment control measures include weed free hay bales, and geomat/geocell type products. However, the cost of these ranges from $4 to $7 per metre (for hay bales), upto $11/m^2 for geocell products, which does not make them economically viable.

4.2 Operational Structural Controls

The selection and use of SQID depends on the site conditions, and also on the management objectives aiming to be achieved by using the particular SQID. In many cases there may be multiple goals or needs for a particular area. In this case, there is often merit in combining SQIDs in series (and in parallel) to achieve these multiple goals. Combining SQIDs in this manner will improve and better guarantee performance, or alternatively overcome site factors that limit the effectiveness of a single measure.

Based on the site characteristics, and the range of available SQIDs, this study has developed an overall concept that will satisfy the requirements of downstream environmental protection. The layout of the proposed treatment measures for the subject site is illustrated in Figure 3.

Due to the nature of the development layout, most of the runoff from this catchment will occur from the roofs, hardstand areas and the proposed road. The SQIDS proposed for this catchment are described below and further illustrated in Figure 4:

- A stormwater capture from roof runoff, through rainwater pits, that are connected to local drainage system;
- A piped drainage system throughout the subject site to convey stormwater runoff from the internal road reserve network;
- Conveyance of runoff from the piped network through 4 Gross Pollutant Traps before entering a "living stream" system within the wetland area;
- A "living stream" system that comprises of grassed V-drains and vegetated swales which link various nutrient stripping ponds before accumulation in a compensating basin, with eventual outfall into Canning River. This is designed to be part of the wetland system bordering the foreshore POS reserve area.

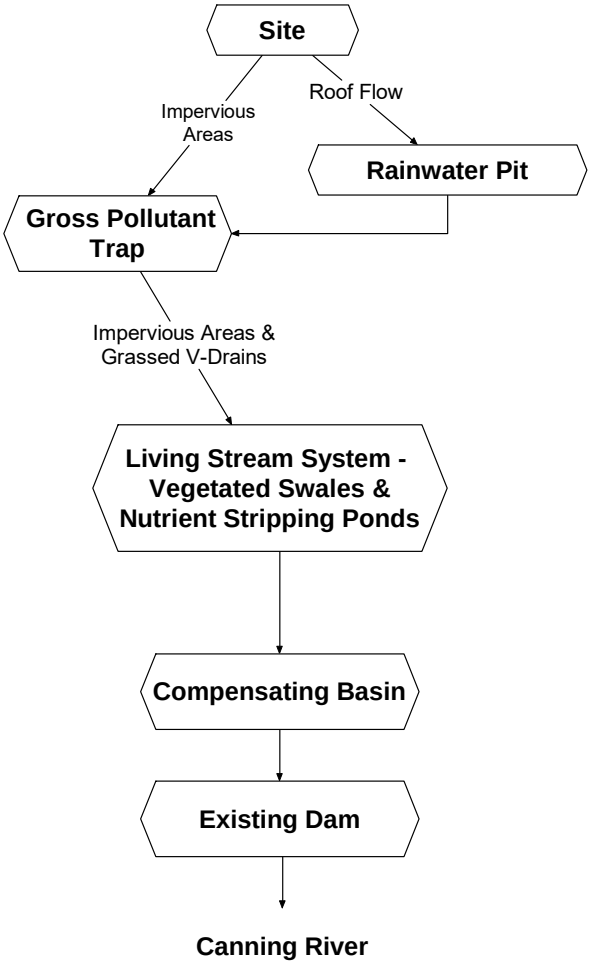
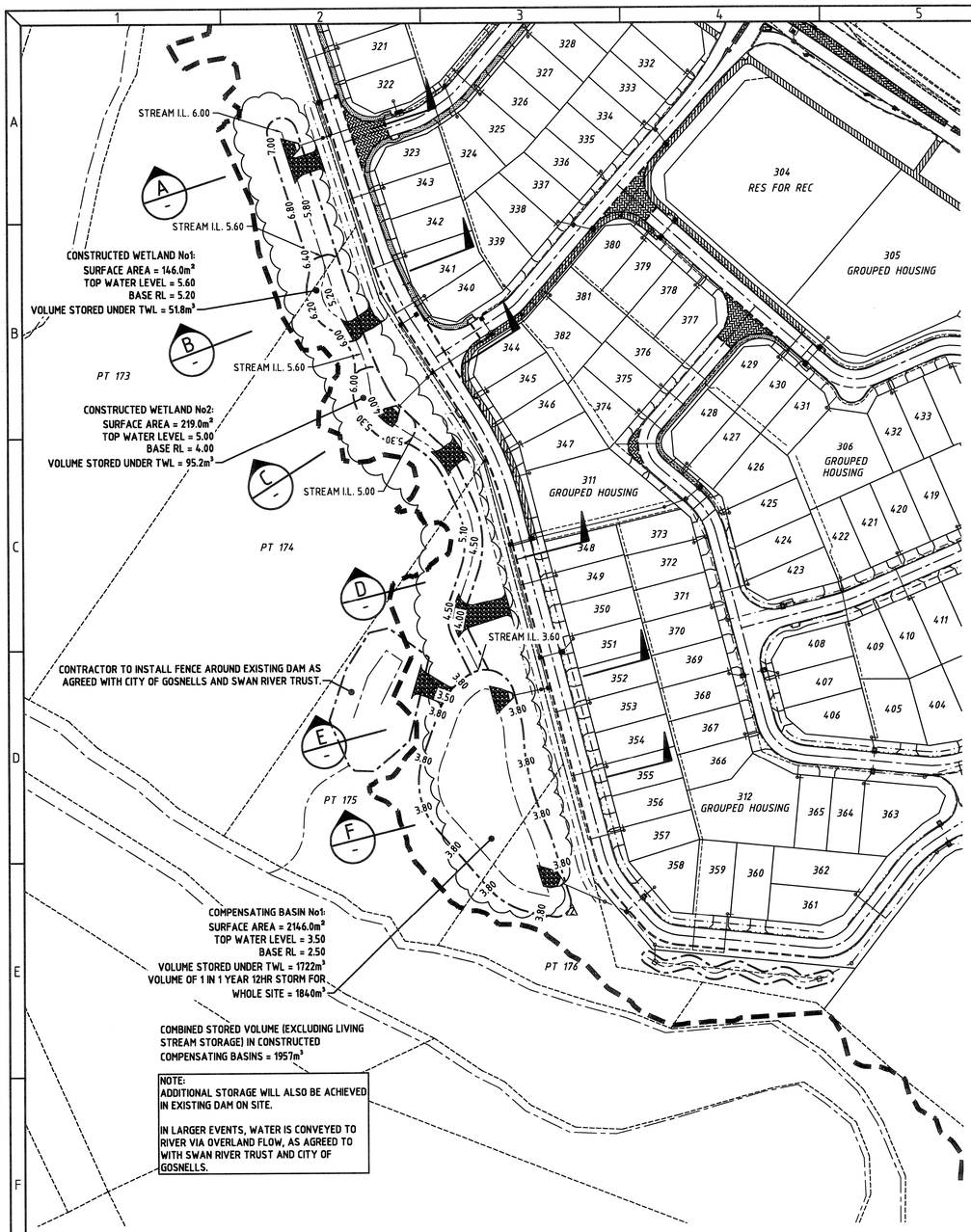
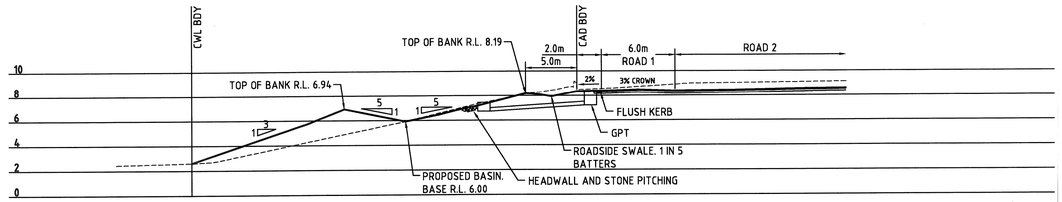


Figure 3: Proposed Stormwater Treatment Measures





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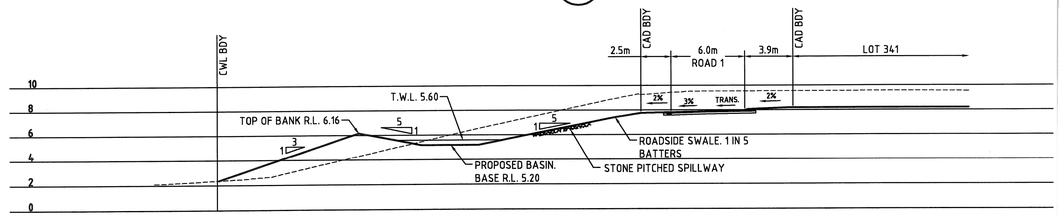

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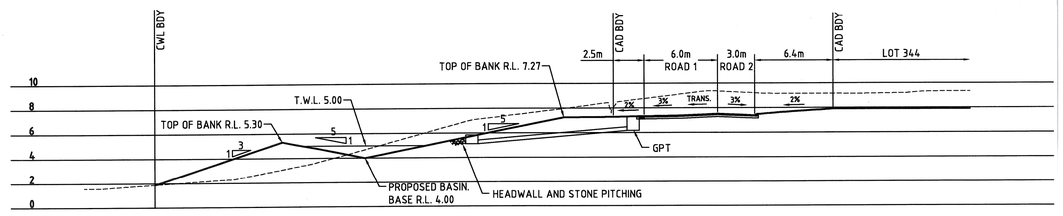

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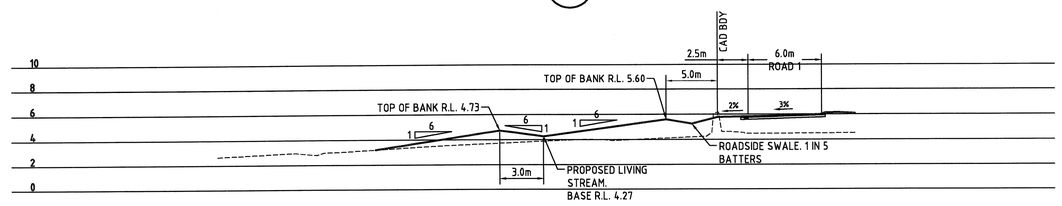

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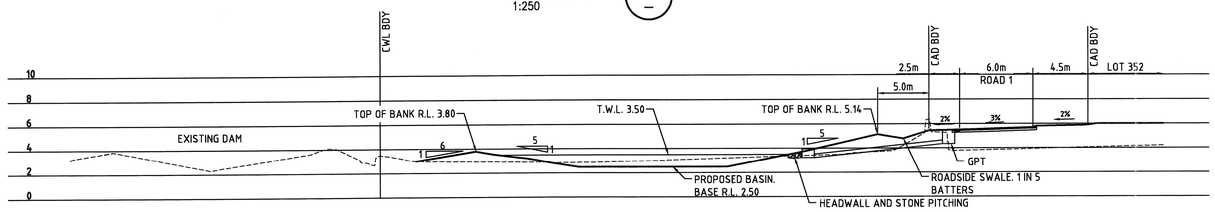

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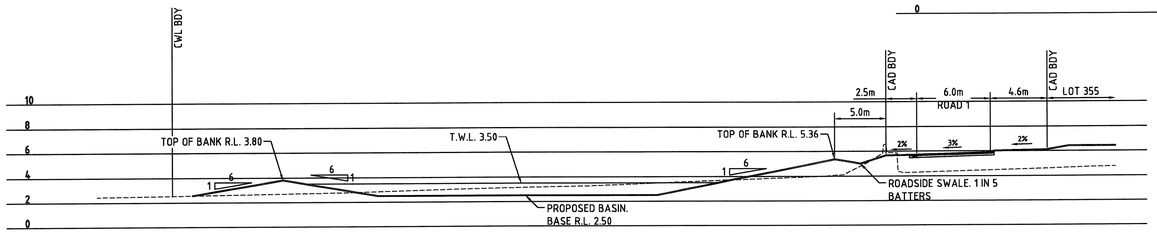

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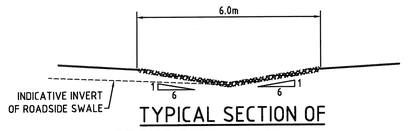
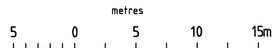


TYPICAL SECTION OF STONE PITCHED SPILLWAY



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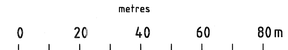

SCALE 1:1000

ISSUED FOR CONSTRUCTION

REFERENCE DRAWINGS:

REVISION:

No.	REVISION DESCRIPTION	DRAWN	CHECKED	APPROVED	DATE
2	DRAINAGE BASIN PLAN AND SECTIONS AMENDED	DA			12.12.07
1	DRAINAGE LAYOUT AMENDED	DA	CTB	CTB	10.07.07
0	ISSUED FOR CONSTRUCTION	DA	CTB	CTB	26.04.07
D	RE-ISSUED FOR COUNCIL APPROVAL	DA	CTB	CTB	02.03.07
C	AMENDED AS PER COUNCIL COMMENTS	DA	CTB	CTB	13.12.06
B	ISSUED FOR COUNCIL APPROVAL	JB	CTB	CTB	06.09.06
A	ISSUED FOR TENDER	CTB	–	–	02.08.06

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CLIENT: WELLINGTON PARKLAND PTY. LTD.

PROJECT: PT LOTS 173-177 (INC.) BURSLEM DRIVE - STAGE 1

DRAWING TITLE: FORESHORE DRAINAGE MANAGEMENT PLAN

ORIGINAL DRAWING SIZE: A1	SCALE: AS SHOWN
PROJECT LEADER: ENZO BIAGIONI-FROUDIST	DATUM: AHD
DESIGNER: CRAIG BENFIELD	WAPC No: 129247
DRAFTSPERSON: CRAIG BENFIELD	DATE: MARCH 2006
JOB No.: CE03-0090	DRAWING No.: C105 REVISION: 2

4.3 Design and Efficiency of Stormwater Quality Improvement Devices

Detailed review of all relevant industry guidelines was undertaken to define relative pollutant removal efficiencies and appropriate design considerations for SQIDs within the proposed development. Particular attention was paid to the following guidelines:

- Stormwater Management Manual of Western Australia (DoE)
- Water Sensitive Urban Design Engineering Procedures: Stormwater (2005)
- Water and Rivers Commission WA. 1998, A Manual for Managing Urban Stormwater Quality in Western Australia;
- Neville Jones & associates, 1994, Queensland Urban Drainage Manual;
- GHD, 2006, DRAFT MUSIC Guidelines for Perth; and
- CSIRO, Water Sensitive Urban Design Engineering Procedures: Stormwater.

The following sections summarise the relative pollutant removal rates for each of the SQIDs incorporated in the proposed stormwater quality treatment train and the considerations made in their inclusion.

4.3.1 Grassed V-Drains and Vegetated Swales

Grassed v-drains and vegetated swales are used to convey stormwater in lieu of pipes and to provide removal of coarse-to-medium sediments and nutrients through biological uptake. Depending on longitudinal grade and vegetation height, swales can remove up to 90% TSS, 60%TP & 35%TN (CSIRO 2005). Swales should be kept between 1 & 4% longitudinal grade for maximum pollutant removal efficiency.

Maintenance

Swales require regular maintenance. If maintenance is not undertaken, the performance of the system will not reach design requirements. Most maintenance requirements will be on an as needs basis. Anticipated maintenance work will include the following:

- Clearing of litter and debris whenever required;
- Mowing/slashing, edging and weeding when required; &
- Inspection after rainfall events to repair eroded areas.

4.4 Stormwater Management Assessment

Having identified appropriate Stormwater Management Controls the suitability of the system in meeting the water quality objectives was assessed. The results of the Post-Development modelling is summarised in Table 4 below.

Table 4: Mitigated Pollutant Export

Scenario	Runoff (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)
Pre – Development	17.1	268	24.39	53.4
Post – Development Mitigated	9.2	99.9	0.88	16.6
% REDUCTION	**46%**	**11%**	**155%**	**51%**

MUSIC modelling results clearly show that the reduction percentages comply with the water quality objective outlined in Section 4.2.

4.5 Operational Non-Structural Controls

As part of the Best Management Practices (BMP's for stormwater control, a combination of structural and non-structural controls are advised as part of this DNMP for the proposed development.

Non-structural controls are institutional and pollution-preventing practices designed to prevent or minimize pollutants from entering stormwater runoff and/or reduce the volume of stormwater requiring management. They do not involve fixed, permanent facilities and they usually work by changing behaviour through government regulation (e.g. planning and environmental laws), persuasion, residential behaviour and/or economic instruments.

The five principal categories of non-structural controls that are recommended for the proposed development include:

1. Town planning controls
2. Strategic planning and institutional controls
3. Pollution prevention procedures
4. Education and participation programs
5. Regulatory control

4.5.1 Town planning controls

These include the use of town planning instruments to promote water sensitive urban design features in new developments, e.g. promoting infiltration and biofiltration. The City of Gosnells already has similar policies in place, which are elaborated on in Section 2.5.

4.5.2 Strategic Planning and Institutional Controls

These controls refer to the use of strategic, regional or citywide urban stormwater management plans and stable funding arrangements to support the implementation

of these plans. *The Urban Water Management Strategy: Southern River/Forrestdale/Brookdale/Wungong Structure Plan, Volumes 1 & 2*, and the *Interim Approach for Integrating Urban Water Management with Land Use Planning within the Southern River Area: Guidance for developers* are examples of strategic regional controls that support the implementation of development plans within the context of urban stormwater management.

4.5.3 Pollution Prevention Procedures

The non-structural procedures that ensure prevention of pollution via stormwater runoff include maintenance practices (e.g. maintenance of the drainage network) and elements of environmental management systems (e.g. procedures on material storage and staff training on stormwater management at government sites).

4.5.4 Education and Participation Programs

These include training programs and involving the community in the development and implementation of stormwater management plans. The details entailed in this IUWMP should be addressed and initiatives set up such that occupants within the proposed development are aware of water conservation strategies in place. Furthermore, the City of Gosnells should continue any educational programs for its staff and the residents of the development that deal with water management issues and maintenance procedures.

4.5.5 Regulatory Controls

These include enforcement of local laws to improve erosion and sediment control on building sites, the use of regulatory instruments such as environmental licences to help manage premises likely to contaminate stormwater or groundwater, and programs to minimise illicit discharges to stormwater management systems (e.g. drains).

All these measures are non-structural best management practices that ensure source controls are in place to minimise the generation of excessive stormwater runoff and/or pollution of stormwater at or near the source, and protect receiving environments, including groundwater, estuaries, waterways and wetlands.

Further reference could be made to Chapter 7 of the DoW's *Stormwater Management Manual for Western Australia*.

5. Conclusions

The drainage management for the site ensures minimal impact on the local environment. This report, in using the Rational Method and MUSIC modelling softwares, has identified and quantified any impact on the local estuarine environment, and has proved that this is minimal.

Excess nutrients are bound to the soil and vegetation in the highest horizons of the subject site to be developed as well as through the “living stream” system prior to discharging into the Canning River. This combined with the provision and maintenance of designed structural BMP devices throughout the treatment train should result in minimal nutrient transfer into the subsoil water system and the receiving environment.

The proposed DNMP and WQMP will ensure that post development nutrient levels expelled into ground water and the Canning River will not increase above pre development levels. Furthermore, other environmentally sensitive receptors within the vicinity, such as the P&R foreshore reserve area, should not be negatively impacted upon as a result of the proposed development, provided the stormwater mitigation measures designed and presented in this combined DNMP and WQMP are adhered to.

PROPOSED RESIDENTIAL DEVELOPMENT
LOTS 173-177 BURSLEM DRIVE,
MADDINGTON,
W.A.

Section 4:
WATER QUALITY MONITORING PROGRAM

Issue 1: December 2007

VDM Environmental

DOCUMENT CONTROL RECORD

VDM Environmental ***63 Burswood Rd, Burswood WA 6100*** ***PO Box 186, Victoria Park WA 6979***		**Job No:**	71250
Telephone:	08 6250 9900	**File Reference:**	**W:\VDM Environmental\Projects\71250 - Lots 173-177 Burslem Drive, Maddington\Reports\Section 4-WQMP\71250_WQMP_Issue_1.doc**
Facsimile:	08 6250 9999	**Date of Issue:**	14/12/07
Email:	info@vdmenvironmental.com.au	**Project Leader:**	Carel van der Westhuizen

Report Details:

Title:	Proposed Residential Development Lots173-177 Burslem Drive, Maddington, WA. Water Quality Monitoring Plan
Author(s):	J. Rostom
Status:	Issue 1
Client (s):	Ewing VDM
Client Contact(s):	Fabio Otranto / Craig Benfield
Synopsis:	This report presents the water quality monitoring plan for the proposed residential development at Lots 173-177 Burslem Drive, Maddington. It has been developed in accordance with the Department of Water's *Stormwater Management Manual for Western Australia* and to the satisfaction of government and local shire specifications.

Revision History:

Issue No	Date	Checked By & Date		Issued By & Date		Distributed to:	No. of Copies
1	14/12/07	RH	14/12/07	JR	14/12/07	Swan River Trust	1
						Coty of Gosnells	1
						Ewing VDM	1
						VDM Environmental	1

Executive Summary

VDM Environmental has been engaged by Ewing VDM to prepare a Water Quality Monitoring Program (addressing condition no. 14 of the Swan River Trust Approval Ref: SRT2401) for the proposed residential development at Lots 173-177 Burslem Drive, Maddington. This report has been prepared to meet the requirements of the Department of Water, the Swan River Trust, and the City of Gosnells' applicable stormwater management policies and guidelines.

The topography of the post-development subject site will be such that stormwater runoff will gravitate to various sub-catchment areas, which will see runoff discharged into a "living stream" system as part of a treatment train. It is proposed that stormwater runoff from the post-development catchment area be conveyed to a piped roadside network, through Gross Pollutant traps before discharging into the "living stream" system within the wetland area. This system is a combination of a series of grassed and vegetated swales that interconnect several nutrient stripping basins/ponds before final discharge through the wetland area in the foreshore reserve area (Lot 800) and finally discharging into the Canning River.

The proposed development of Lots 173-177 Burslem Drive, Maddington will change the local land use to urban residential. This, in turn, changes the stormwater characteristics generated from the site. In particular, any increase in TN, TP and TSS needs to be quantified and evaluated. Stormwater generated onsite will be conveyed through the Stormwater Quality Improvement Devices (SQID's) mentioned above and ultimately be discharged into the receiving environment. Hydraulic modelling was undertaken by Ewing VDM to ensure that these SQID's were sized to accommodate the design 1 in 5 years Average Recurrence Interval (ARI) storm events. The detained storm water will reduce the risk of flooding and ensure post-development runoff does not significantly exceed pre-development runoff that would compromise the quality and integrity of the receiving environment.

The WQMP for the site ensures that an adequate and effective program is implemented for monitoring the water quality in the receiving environment. This will ensure that the quality of water entering the foreshore reserve area and the local and downstream environment is maintained to that of pre-development conditions and if not, contingency measures being adopted.

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1. Introduction

To minimise the impact of the proposed changes on the external environment the proponent shall implement this Water Quality Monitoring Program (WQMP). The DNMP shall be amended as required in response to the WQMP described herein to avoid significant and/or sustained deterioration in existing water quality of waterways downstream, when operational works are approved.

VDM Environmental will undertake water quality monitoring as required by the Department of Water from locations within Lot 800 where the development interfaces with the Parks and Recreation (P&R) and where the water discharges from the subdivision site. The monitoring will ensure that the quality of water entering the foreshore reserve is maintained to that of pre-development conditions and if not, contingency measures will be adopted to rectify the situation to the requirements of the Department of Water's *Stormwater Management Manual for Western Australia.* It is recommended that monitoring be undertaken upstream and downstream of the discharge point within the Canning River to enable comparisons be evaluated.

2. Scope

This WQMP includes, but is not limited to the following information:

- Monitoring locations;
- Water quality parameters in accordance with Chapter 10 of the *Stormwater Management Manual for Western Australia* (Department of Water, 2004);
- Frequency of monitoring;
- Contingency measures; and
- Manner and frequency that results will be submitted to the Swan River Trust.

3. Water Quality and Monitoring Program

3.1 Program Monitoring Locations

Monitoring locations will be established at the following points (refer Figure 1):

- At the point of discharge from the subdivision site (i.e. at the GPT outlets);
- Within Lot 800 where the development interfaces with the P&R foreshore reserve (i.e. along the V-drains);
- At the outlet of the wetland area where stormwater will discharge to the Canning River (i.e. at the compensating basin's overflow weir);
- After the existing dam; and
- Upstream and downstream of the discharge point to the Canning River

Monitoring and maintenance during the construction and operational phases will be conducted to ensure the impact of activities on the subject site minimised.

3.2 Water Quality Parameters

While the selection of parameters is issue, site and BMP specific, in accordance with Chapter 10 of the DoW's *Stormwater Management Manual for Western Australia*, the following is a list of common parameters for structural BMP monitoring:

- Physical parameters (conductivity, pH, temperature, dissolved oxygen)
- Flow rate
- Total suspended solids (TSS)
- Nutrients

Appendix A of Chapter 10 of the *Stormwater Management Manual for Western Australia* provides a summary of parameters that may be relevant to evaluation of structural BMP's, including what is measured, factors that may affect the parameter, and when it may be relevant to measure.

3.3 Frequency of Monitoring

All stormwater contained within the proposed development will be monitored monthly during construction on an event basis for large storm events (greater than 25mm). During the operational phase of the development yearly site inspections will be carried out. The treatment devices will be visually inspected for any deterioration in performance. Corrective actions will be undertaken if this occurs to ensure the performance of the system.

The Swan River Trust's River System Management Branch requires that frequency of monitoring be undertaken on a quarterly basis for year 1 and immediately following the "first flush" rainfall event (generally in May or June) and on a monthly basis during winter for year 1 and year 2.

The monitoring program will be for at least a 2 year period to ensure that the treatment train of the "living stream" is achieving the desired results to the requirements of the DoW's *Stormwater Management Manual for Western Australia*.

3.4 Investigation Indicators & Contingency Measures

The following indicators are used to identify if the objectives of the WQMP are being met.

1. Visible evidence of deterioration of downstream drainage that is directly attributable to the site;

2. Visible significant erosion; and/or

3. Failure of control measures.

The triggering of an investigation indicator will require the following remedial actions as part of the contingency measures:

1. Locate source of water quality deterioration;

2. Prevent continuing deterioration with temporary controls;

3. Repair existing controls, construct additional controls or modify procedures to prevent future deterioration in water quality; &

4. If, after new operation commences, there is a significant deterioration in water quality, the management plan and strategies will be reviewed in consultation with the relevant local authority.

The monitoring and maintenance program has been designed in accordance with the Western Australia Stormwater Guidelines. The guidelines outline three types of water-related monitoring, as outlined in Table 1.

Figure 1. Water Quality Monitoring locations

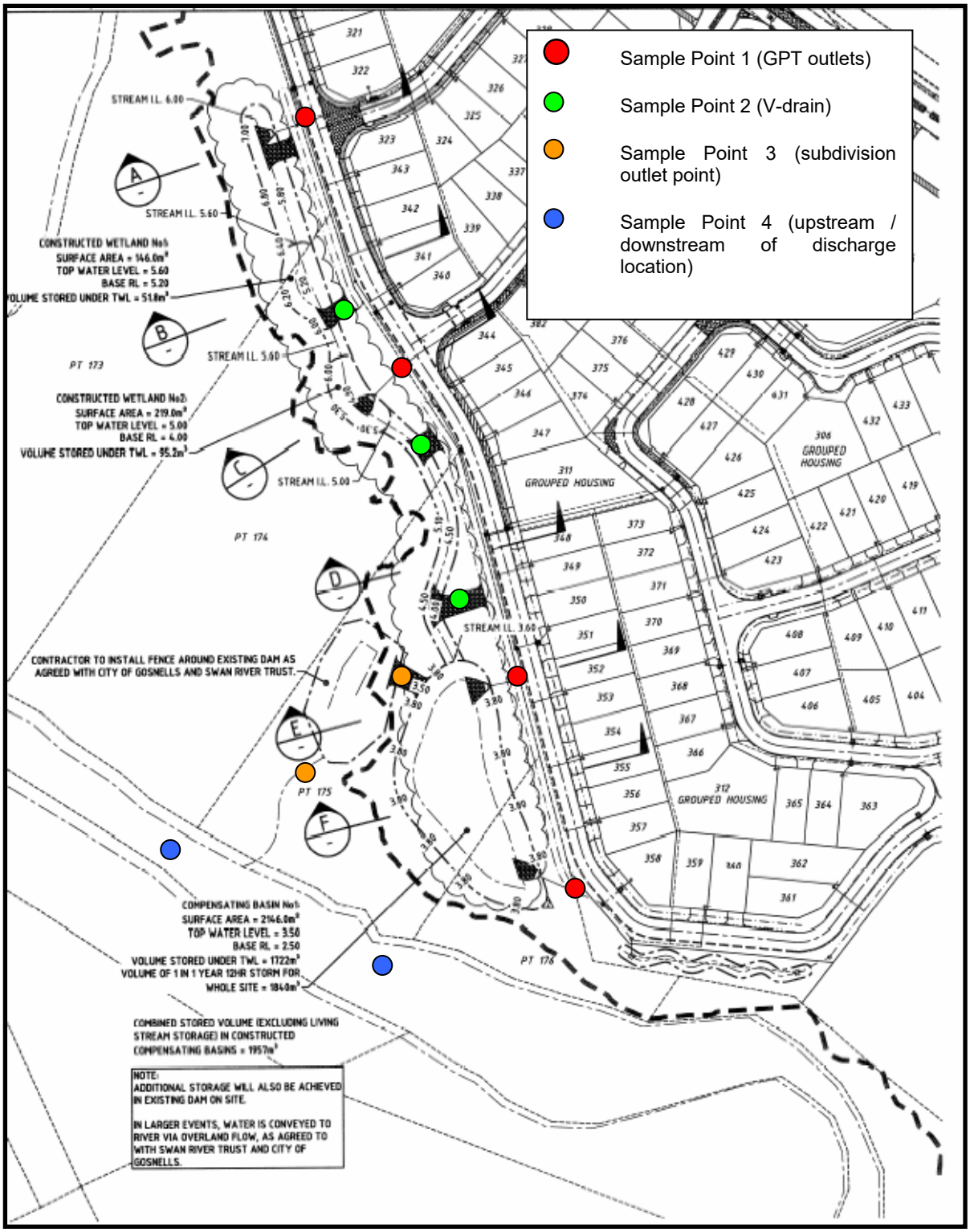


Table 1: Monitoring Requirements

Monitoring Type	Requirements	Responsibility	Notes
1. Refining Water Quality-related design objectives	Concentration-based design objectives	DoW	Background data from local City Council.
2. Monitoring the impact of the development on receiving water bodies	Based on site monitoring during- and post-construction.	Developer	Used to determine whether the development has affected the ability of these water bodies to support environmental values such as the protection of aquatic ecosystems.
3. Monitoring post-construction: a) Asset Construction b) Hydrologic and hydraulic performance monitoring	a) Site visits to ensure that SQIDs operating as designed b) Ensure that SQIDs operating in accordance with their design specifications	a) City Council b) Developer	

The WQMP results and reports are to be submitted to the City of Gosnells for review upon request. The final report is to be submitted to the Swan River Trust and the City of Gosnells at handover.

4. Conclusions

The drainage management for the site ensures minimal impact on the local environment. This report, in using the Rational Method and MUSIC modelling softwares, has identified and quantified any impact on the local estuarine environment, and has proved that this is minimal.

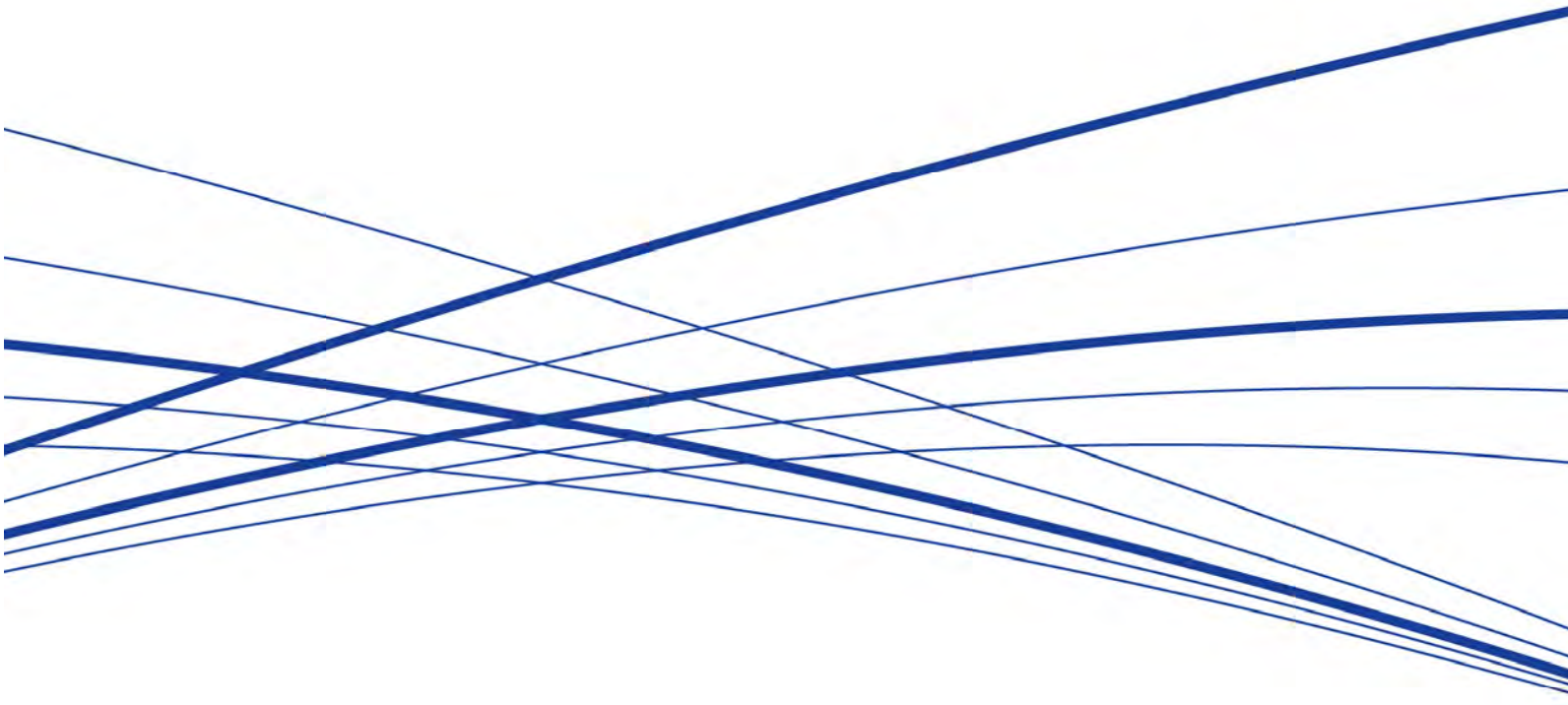
Excess nutrients are bound to the soil and vegetation in the highest horizons of the subject site to be developed as well as through the “living stream” system prior to discharging into the Canning River. This combined with the provision and maintenance of designed structural BMP devices throughout the treatment train should result in minimal nutrient transfer into the subsoil water system and the receiving environment.

The proposed DNMP and WQMP will ensure that post development nutrient levels expelled into ground water and the Canning River will not increase above pre development levels. Furthermore, other environmentally sensitive receptors within the vicinity, such as the P&R foreshore reserve area, should not be negatively impacted upon as a result of the proposed development, provided the stormwater mitigation measures designed and presented in this combined DNMP and WQMP are adhered to.

PROPOSED RESIDENTIAL DEVELOPMENT
LOTS 173-177 BURSLEM DRIVE,
MADDINGTON,
W.A.

Section 5:
MAINTENANCE & ASSET MANAGEMENT PLAN

Issue 1: December 2007



VDM Environmental

DOCUMENT CONTROL RECORD

VDM Environmental ***63 Burswood Rd, Burswood WA 6100*** ***PO Box 186, Victoria Park WA 6979***		**Job No:**	71250
Telephone:	08 6250 9900	**File Reference:**	**W:\VDM Environmental\Projects\71250 - Lots 173-177 Burslem Drive, Maddington\Reports\Section 5-MAMP\71250_MAMP_Issue_1.doc**
Facsimile:	08 6250 9999	**Date of Issue:**	14/12/07
Email:	info@vdmenvironmental.com.au	**Project Leader:**	Carel van der Westhuizen

Report Details:

Title:	Proposed Residential Development Lots173-177 Burslem Drive, Maddington, WA. Maintenance & Asset Management Plan
Author(s):	J. Rostom
Status:	Issue 1
Client (s):	Ewing VDM
Client Contact(s):	Fabio Otranto / Craig Benfield
Synopsis:	This report presents the maintenance and asset management plan for the proposed residential development at Lots 173-177 Burslem Drive, Maddington. It has been developed in accordance with the Department of Water's *Stormwater Management Manual for Western Australia* and to the satisfaction of government and local shire specifications.

Revision History:

Issue No	Date	Checked By & Date		Issued By & Date		Distributed to:	No. of Copies
1	14/12/07	RH	14/12/07	JR	14/12/07	Swan River Trust	1
						City of Gosnells	1
						Ewing VDM	1
						VDM Environmental	1

Executive Summary

VDM Environmental has been engaged by Ewing VDM to prepare a Maintenance and Asset Management Plan (addressing condition no. 8 of the Swan River Trust Approval Ref: SRT2401) for the proposed residential development at Lots 173-177 Burslem Drive, Maddington. This report has been prepared to meet the requirements of the Department of Water, the Swan River Trust, and the City of Gosnells' applicable asset management policies and guidelines.

During construction and post-development phases, various civil and drainage assets will comprise part of the infrastructure of the subject site. These assets need to be maintained and managed throughout all phases so as to ensure there is no degradation of environmental values of receiving water bodies, maximize efficiency of the assets' functions, and prolong the life-span of the assets throughout the site.

This Maintenance and Asset Management Plan for the site ensures the critical assets concerned with the development are identified and documented to ensure a proper record is kept that is updated and referenced whenever necessary. It also details the best management practices needed to ensure proper and adequate maintenance practices are implemented in managing the assets such that benefits and effectiveness of such practices are realised.

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1. Introduction

1.1 Background

VDM Environmental has been engaged by Ewing VDM to prepare the Maintenance and Asset Management Plan (MAMP) for the Proposed Residential Development at Lots 173-174 Burslem Drive, Maddington (the subject site).

In preparing this report, VDM Environmental has complied with the City of Gosnells local guidelines and policies to ensure the MAMP meets the information requirements of the relevant authorities.

This report has been compiled to address current condition no. 8 of the Swan River Trust Approval Ref: SRT2401, and local shire requirements.

The *Decision Process for Stormwater Management in WA* (DoE and SRT, 2005), and the *Stormwater Management Manual for WA* (2007) have all been addressed within this report.

1.2 Description and Scope

Maintenance of the site's stormwater drainage network includes inspection, cleaning and repair of open and piped drains, pits, treatment devices, detention basins and outfall structures. This network needs to be regularly cleaned to maintain its performance.

Regular cleaning of the stormwater drainage network provides an opportunity to remove pollutant loads that would otherwise enter receiving water bodies after heavy rainfall. In addition to transporting pollutants, drains with accumulated pollutants may also overflow, leading to localised flooding and erosion, as well as risks to human safety and constructed assets.

Most stormwater drainage networks have some capacity to capture and temporarily store pollutants (e.g. coarse sediment and litter). Such pollutants may be temporarily stored in drop inlets, gully pits, flat open drains or detention basins and ultimately removed by either large storm events or maintenance by the asset manager. This is particularly the case where the stormwater drainage network has infiltration pits/soak wells or detention basins along its length. These features can provide 'hot spots' for accumulation of gross pollutants and contaminated sediments. Sediments in open drains and basins may also contain iron monosulphide black oozes (MBO's) (black, organic rich oozes on the bottom of drains, usually occurring in drains with slow flowing summer water flows). Sediments that contain MBO's will require special removal techniques to prevent oxygenation and subsequent acid release and deoxygenation of the water body. Some sediment can accumulate pyrite between cleaning events that could results in a net release of acid on drying of sediments. The potentially high levels of contaminants such as heavy metals must be considered during the removal and disposal of the top layer of sediments from open drains and basins.

Specifically, this report focuses on those elements of the stormwater drainage system that are *not* specifically designed to trap pollutants (e.g. pits, soak wells,

pipes, open channels and detention structures). For structural controls that are designed to trap pollutants (e.g. GPT's), each device has site-specific maintenance details (refer Appendix D). Such information is prepared when the BMP's are designed and provide guidance on a suitable inspection regime and maintenance practices (including guidelines on the equipment to be used, health and safety procedures, waste disposal arrangements, etc.).

This Maintenance and Asset Management Plan includes, but is not limited to the following:

- Identification of maintenance requirements for Lot 800;
- Provision of an Asset Register; and
- Provision of management criteria for stormwater assets.

1.3 Objectives

The objective of this MAMP is to outline the procedures and programs to be put in place to ensure that all stormwater infrastructure and other assets within the subject site are adequately managed and maintained, and advice of routine maintenance be provided to the City of Gosnells, Swan River Trust and the WAPC.

This entails the following specific objectives:

- Identify inspection / monitoring programs;
- Determine frequency & method of maintenance; and
- Identify who is responsible for maintenance.

2. Applicability of Maintenance Practices

2.1 General

Various management practices are applicable to any particular site depending on the stormwater drainage system has an increased risk of pollutant accumulation, the premises on site are typically operated by local government, or whether the subject site includes areas where maintenance is undertaken on parks, gardens, and roads/drainage reserves.

In general, drainage networks that have a high proportion of open drains and detention basins provide a greater opportunity for the capture of contaminants than equivalent enclosed systems.

The recommended maintenance practices entailed in this MAMP are primarily intended to assist local government authorities and drainage service providers (such as the Water Corporation). However, they are also relevant to managers of privately owned stormwater drainage assets.

2.2 Site context

Lot 800 is located in a foreshore reserve for recreation which ultimately drains into the Canning River. As such, the site has characteristics of an area of open space that:

- Drains to sensitive receiving waters (e.g. conservation category wetlands, or the Swan-Canning estuary system that is under stress from nutrient inputs);
- Is close to a water body (e.g. river-side parks);
- Has soils with poor moisture and nutrient retention capabilities (e.g. sandy soils on the Swan Coastal Plain);
- Is subject to intense rainfall events that may generate surface runoff; and
- Is subject to intense maintenance practices.

The subject site's stormwater drainage network includes those assets that are within the proposed development area (i.e. Lots 173-177 Burslem Drive) and those located in the foreshore reserve area in Lot 800. Those assets within the proposed development area mainly comprise drainage pipework and its associated side entry and gully pits along the road. The assets in Lot 800 include GPT's, pipes to headwalls, headwalls, stone-pitched spillways, the "living stream" structural controls, nutrient stripping ponds, compensating basin, dual use path, boardwalks and stream crossings, and a lookout structure. These assets are further elaborated in the Asset Register.

2.3 Inspections and Maintenance Practices

In order to maximise the effectiveness of inspection and maintenance requirements for the various assets, it is crucial to focus on those control points and areas that are most susceptible to receiving and accumulating large amounts of pollutants and/or assets that may deteriorate rapidly in their function and operation. These control points, areas and assets are normally referred to as "hot spots" (DoW, 2007).

The maintenance practices provided below relate to these types of assets:

- Identifications of pollutant "hot spots", where relatively large quantities of pollutants of concern regularly accumulate in the drainage system.
- Focus on those parts of the drainage network with relatively flat grades or low flows, as pollutants tend to accumulate in these areas.
- Undertaking of regular inspections of "hot spots" to assess whether pollutants are accumulating.
- Inspection of all stormwater drains and detention basins at least once a year, preferably immediately prior to the wet season. Typical maintenance frequencies for assets in Perth are defined in the Water Corporation's *Drainage Maintenance Standards* (2004).
- Adjustment of the maintenance frequency of the drainage network to suit pollutant accumulation rates and seasonal conditions (flexibility of the maintenance regime is required given the uncertainty with accumulation rates and rainfall patterns).
- Preparation of an inspection program that assigns inspection tasks, frequencies and responsibilities.

The following maintenance practices are applicable to the subject site's assets that would be operated by the developer and local government:

- Keep stormwater that is likely to be relatively "clean" separate from potentially contaminated stormwater.
- Seek to minimise the percentage of the site that has directly connected impervious surfaces.
- Sweep up loose materials (e.g. sediment) as soon as possible after the material has accumulated on hard surfaces, rather than flushing it to stormwater.
- Seek expert advice on the installation of structural stormwater management devices, and install these devices where necessary. The installation of structural stormwater management devices should be an option of last resort. Where devices are installed, a sound maintenance regime will need to be developed and implemented.
- Stabilise any exposed soil on the site through erosion control methods,

particularly where there is a risk that the soils may be contaminated due to historic site activities.

- Investigate opportunities to reuse stormwater and/or shallow groundwater on the site (e.g. vehicle washing or toilet flushing).
- Monitor key pollution indicators for each park and garden (e.g. the number of people using the area, types of pollutants, proximity to water bodies, etc.).
- Determine appropriate work practices to minimise pollution risks, based on park activities. Determine where specialist maintenance methods and equipment may be required and, where necessary, implement structural controls to trap stormwater pollutants.
- Undertake erosion and sediment control on road reserves to minimise the export of sediment to stormwater. This is particularly important during maintenance activities involving re-grading the road shoulder and associated table drains.
- Undertake manual litter collections.
- Maintain a healthy grass/vegetation cover to help filter and infiltrate stormwater.
- Minimise the use of herbicides and pesticides during the maintenance of road reserves.

2.4 Desilting and Pollutant Removal Operations

Management of desilting operations aims to minimize movement of low dissolved oxygen and potentially heavy metal rich slugs of water downstream of cleaning operations. A major issue is that removed material may be too wet for landfill disposal, but contain too many solids for disposal to the wastewater system. Management of handling, drying and final disposal of the materials needs to be considered.

The following practices and considerations should be implemented:

- Usage of suitable equipment to extract the waste from the drainage system (e.g. for enclosed drains and pits, machinery that operates via suction rather than flushing, where possible).
- For major desilting works involving drainage assets that may be regarded as ‘waterways’ by members of the community (rather than ‘drains’), consultation must be made with local residents and relevant community groups before undertaking work.
- Management precautions when planning cleaning of open drains and basins should include spot testing to determine whether there is a potential soil acidity issue or the presence of iron monosulphide black oozes (MBO’s).
- For guidance on how to manage MBO’s, the Land and Water Quality Branch

at the Department of Environment should be contacted.

- Maximization of working in dry weather, when the drainage facility is dry or during low flow conditions. This will reduce the volume of material that will require disposal.

- Banks of any drains (e.g. the V-Drain) should not be disturbed, unless they are eroded and need stabilization.

- If banks need stabilization, physical and vegetative options should be explored, rather than scraping contaminated sediment onto the banks where it will erode again.

- Any sensitive flora and fauna in the vicinity of the work site should be determined and precautions established to protect these species when undertaking maintenance works. Records should be kept by maintenance staff of any area that requires special maintenance procedures (e.g. an area where maintenance activities need to be scheduled around months when birds nest in the area).

- Removal of sediment litter and weeds from the drainage asset without altering its design invert level. This is particularly important in areas where nutrient-rich base flow enters open drains in summer months and transports these nutrients to sensitive waterways and wetlands. In such locations, all efforts should be made to minimize the deepening of open drains and detention basins.

- A representative sample of the sediment should be analyzed before it is removed. In most of the urbanized catchments in the Perth region, removed sediment will contain high levels of nutrients and will often contain high levels of heavy metals and hydrocarbons. Analysis will determine if the sediment is suitable for use as a soil amendment, if it can be disposed on-site, or if it is contaminated and requires disposal at a landfill.

- When maintaining detention basins, it should be noted that the highest levels of contaminants are usually found in sediments closest to the outlet.

- Sediments should not be left alongside the drain or basin where it can erode and re-enter the drainage system.

- Before leaving the site, it must be ensured that collected vegetative matter and litter have been removed, sediment has not been ‘tracked’ onto sealed roads, and the site does not pose a significant erosion risk.

2.5 Other Recommended Maintenance Practices

The following practices mainly relate to Lot 800 and cover aspects relating to plant selection and landscaping design, nutrient management, irrigation management, and lawn mowing, top-dressing and pruning.

- Planting local native species.
- Where local native species are not planted, the following should be considered:
  - Minimizing the use of deciduous plants
  - Avoiding planting declared or noxious weeds
  - Minimizing the amount of grassed/lawn areas
  - Minimizing the extent of waste-consuming planting
  - Applying the basic principles of hydro-zoning (grouping plants on the basis of having similar water requirements) to planting design
- Maximizing the use of water conserving elements and techniques, such as using mulches, ground covers and porous paving instead of lawn.
- For turf and grassed areas, guidelines provided by the DEP & WRC (2001) should be used to determine each area's fertilisation requirements.
- When applying nitrogen to sandy soils on the Swan Coastal Plain, the quantity of nitrogen applied in any one application should not exceed 40 kg/ha (DEP & WRC, 2001).
- Where phosphorus is being applied, special consideration must be given to the level of available phosphorus in the soil; the Phosphorus Retention Index (PRI); and the results of leaf tissue analysis.
- When determining a suitable fertilisation regime, it should be recognised that reducing the amount of water used on gardens and lawns will also reduce the need for fertilisation (WAWC, 2004).
- It must be ensured that any irrigation system is water efficient.
- A visual check should be made on irrigation systems every week to identify maintenance needs (e.g. the repair of leaks), or for major irrigation systems, an automated warning system installed to identify malfunctions.
- Application of mulch to garden beds to improve water retention, smother weeds and prevent erosion.
- Where nutrient-rich wastewater is used as a source of irrigation water, it is particularly important to control application rates so that surface runoff and shallow groundwater contamination does not occur.
- Removal of litter and debris before mowing.

- Close cropping during mowing is not recommended, as it provides an opportunity for accelerated erosion and increases the area's irrigation requirements.
- In areas adjacent to roads with a kerb and channel, activities such as mowing or pruning should be coordinated with street cleaning operations.
- Mowing equipment is commonly hosed down after use at a particular location to prevent the transfer of weeds between mowing sites. Where this is done, the rinse water can be infiltrated into the soil. Under no circumstances should this rinse water be directed to the stormwater system.

2.6 Asset Register

Table 1: Asset Register for Subject Site

Asset	Type	Quantity	Locations (see Earthworks & Drainage Plans from Ewing VDM)
Gross Pollutant Traps (GPT's)	Civil	4	At the interface between Road 1 and the foreshore area on Lot 800
Pipes to Headwalls	Drainage	4	Connecting GPT's to Headwalls
Headwalls	Civil	4	Within foreshore area and directly downstream in line with GPT's
Stone-pitched spillways	Civil / Drainage	4	One at the beginning of the highest elevated swale, one at Constructed Wetland 1, and two between Constructed Wetland 2 and Compensating basin
Dual Use Path	Civil	1	From junction of Roads 1 and 6, throughout the reserve area and out at the POS area (1)
Boardwalks	Civil	1	Across the "living stream" swale between Constructed Wetland 2 and Compensating Basin
Look-out structures	Civil	1	Across from junction of Road 3 and Road 1
Grassed V-Drains	Drainage	1	Adjacent to Road 1
Vegetated Swale	Drainage	3	"Living Stream" connecting Constructed Wetlands & Compensating Basin
Constructed Wetlands / Nutrient stripping Ponds	Drainage	2	As located on Drawings
Compensating Basin	Drainage	1	As located on Drawings
Stone-pitched Outfall Spillway	Civil / Drainage	1	As located on Drawings

The asset register above outlines the various structural assets located within the foreshore reserve area on Lot 800 and those immediately bordering on the interface between the proposed development area and the foreshore area. It includes infrastructure mainly dealing with stormwater management and any new infrastructure should be registered on the database as part of the development approval process.

3. Management Criteria

3.1 Timeline and Responsibilities

The development will comprise of a construction phase and a post-development phase, each of which will entail various responsibilities by different stakeholders in the maintenance and management requirements for the assets on site. It is recommended that the developer is responsible for all aspects of maintenance and asset management throughout the site during the construction phase and the first three years post-development.

After the three years period, the responsibilities for asset maintenance and management will be shared between the developer, the Swan River Trust (under the auspices of the City of Gosnells) and local authorities whose assets would be part of the civil and drainage infrastructure throughout the subject site. The scope and limitations of responsibilities to be shared between the stakeholders during this post-development period is to be agreed upon after consultation with each relative party, subject to local and state-wide guidelines and conditions outlined by various authorities.

Table 2 below shows the timeline and responsibilities for the proposed development.

Table 2: Timeline & Responsibilities

Asset	Management Measure	Frequency	Responsibility	Notes
Gross Pollutant Traps (GPT's)	Cleaning of trapped material with vacuum eduction trucks	After first flushing rains occur (March/April)	Developer for first three (3) years, then local council	Undertake maintenance as per the supplier's cleaning and maintenance guidelines (Appendix D).
Pipes to Headwalls	Removal of litter and debris at outlets	As required	Developer for first three (3) years, then local council	
Headwalls	Removal of litter and debris at outlets	As required	Developer for first three (3) years, then local council	
Stone-pitched spillways	Removal of litter and debris at outlets Removal of weeds and vegetation Inspection for erosion	As required As required After large rainfall events	Developer for first three (3) years, then local council	
Dual Use Path	Remove overgrown vegetation	As required	Developer for first three (3) years, then local council	
Boardwalks	Remove overgrown vegetation	As required	Developer for first three (3) years, then local council	
Look-out structures	Remove overgrown vegetation	As requried	Developer for first three (3) years, then local council	

Asset	Management Measure	Frequency	Responsibility	Notes
Nutrient stripping Ponds	Routing investigation for the following: • Bank erosion • Excessive sediment deposits • Plant deterioration • Clogging of inlet and outlet structures • Identification of any isolated pools • Mosquito larvae and/or mosquito control	Biannual and after large storm events	Developer for first three (3) years, then local council	Refer: 5.2, section 9 of the *Stormwater Management Manual of WA* (2007) for further details of maintenance measures
	Remove overgrown vegetation	Yearly inspection, remove as required	Developer for first three (3) years, then local council	
	Remove environmental weeds, particularly those that are invasive	As required		
	Remove accumulated sediment at the inlet zone	Every 5 – 7 years or when accumulated sediment exceeds 10%	Review of sediment levels at handover, council to undertake maintenance afterwards	
	Remove accumulated litter and debris	Biannually – middle and end of wet season		
	Revegetation to keep density as prescribed in the landscaping plan	As required	Developer for first three (3) years, then local council	
	Monitoring of water quality	As prescribed in section 4 of this document		

Asset	Management Measure	Frequency	Responsibility	Notes
Compensating Basin	Clearing of Litter and Debris Mowing/Slashing, edging and weeding Inspection for erosion	As required As required After large rainfall events	Developer for first three (3) years, then local council	
Stone-pitched Outfall Spillway	outing investigation for the following: • Bank erosion • Excessive sediment deposits • Plant deterioration • Clogging of inlet and outlet structures	Biannual and after large storm events	Developer for first three (3) years, then local council	
Grassed V-Drains	Clearing of Litter and Debris Mowing/Slashing, edging and weeding Inspection for erosion	As required As required After large rainfall events	Developer for first three (3) years, then local council	
Vegetated Swale	Clearing of Litter and Debris Mowing/Slashing, edging and weeding Inspection for erosion	As required As required After large rainfall events	Developer for first three (3) years, then local council	

3.2 Benefits and Effectiveness

Regular cleaning of the stormwater drainage network can increase dissolved oxygen levels in stormwater, reduce levels of bacteria, reduce the load of common stormwater pollutants entering receiving waters (e.g. sediment, nutrients, litter, organic matter), minimise localised flooding and minimise erosion that is caused by localised flooding.

In regions like Perth, there is evidence to suggest that accumulated sediments in urban areas are enriched with nutrients, heavy metals and hydrocarbons. The flat grades, high infiltration rates, and relatively low rainfall intensity of the region would help sediments to be deposited in the drainage network rather than being flushed through it. Given these circumstances, it would seem likely that a high-quality drain inspection and maintenance program would be effective at removing considerable quantities of contaminants (including nutrients) from the system, thus preventing these contaminants from entering sensitive water bodies. Maintenance plans, such as this one, target areas that are most likely to generate contaminated sediments and potentially discharge the sediments to sensitive receiving water bodies (e.g. the foreshore reserve area and the Canning River).

4. Conclusions

The drainage management for the site ensures minimal impact on the local environment. This report, in using the Rational Method and MUSIC modelling softwares, has identified and quantified any impact on the local estuarine environment, and has proved that this is minimal.

Excess nutrients are bound to the soil and vegetation in the highest horizons of the subject site to be developed as well as through the “living stream” system prior to discharging into the Canning River. This combined with the provision and maintenance of designed structural BMP devices throughout the treatment train should result in minimal nutrient transfer into the subsoil water system and the receiving environment.

The proposed DNMP and WQMP will ensure that post development nutrient levels expelled into ground water and the Canning River will not increase above pre development levels. Furthermore, other environmentally sensitive receptors within the vicinity, such as the P&R foreshore reserve area, should not be negatively impacted upon as a result of the proposed development, provided the stormwater mitigation measures designed and presented in this combined DNMP and WQMP are adhered to.

PROPOSED RESIDENTIAL DEVELOPMENT
LOTS 173-177 BURSLEM DRIVE,
MADDINGTON,
W.A.

Section 6:
SUBDIVISIONAL WORKS MANAGEMENT PLAN

Issue 1: December 2007

VDM Environmental

DOCUMENT CONTROL RECORD

VDM Environmental ***63 Burswood Rd, Burswood WA 6100*** ***PO Box 186, Victoria Park WA 6979***		**Job No:**	71250
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Facsimile:	08 6250 9999	**Date of Issue:**	30/11/07
Email:	info@vdmenvironmental.com.au	**Project Leader:**	Carel van der Westhuizen

Report Details:

Title:	Proposed Residential Development Lots173-177 Burslem Drive, Maddington, WA. Subdivisional Works Management Plan
Author(s):	R. Lynch
Status:	Issue 1
Client (s):	Ewing VDM
Client Contact(s):	Fabio Otranto / Craig Benfield
Synopsis:	This report presents the Subdivisional Works Management Plan (SWMP) for the residential development at Lots 173-177 Burslem Drive, Maddington, WA.

Revision History:

Issue No	Date	Checked By & Date		Issued By & Date		Distributed to:	No. of Copies
1	17/12/07	RH	17/12/07	RL	17/12/07	VDM Environmental City of Gosnells Swan River Trust Ewing VDM	1 1 1 1

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1.0 Commitment

General

Golden Group is committed to undertake projects in full consideration of the potential impacts and perceived risks their activities, products and/or services may have on the environment.

The Ewing VDM on behalf of Golden Group is committed to implement the Works Management Plan prior to construction and to continually revise the plan throughout planning stages and subsequently, throughout construction.

Site-Specific

VDM Environmental Pty Ltd and Ewing VDM on behalf of Golden Group have prepared and compiled this Subdivisional Works Management Plan (SWMP) for construction at Lots 173-177 Burslem Drive, Maddington, to facilitate subdivision for residential development to meet the requirements of Condition 22 of the Western Australian Planning Commission, WAPC (Subdivision Application 128429, dated 16th February 2006), and in accordance with relevant state and local government and industry policies, guidelines and standards to:

- Embrace those environmental issues, required in terms of planning approvals, environmental legislation and, as an environmentally responsible organisation, of the broader community.
- Make all personnel, consultants and sub-contractors fully aware of our environmental commitments, obligations and objectives and to undertake all activities in accordance with this plan.
- Ensure that environmental risks are properly managed.

Validity

The currency of this document remains valid until a practical completion certificate has been issued and until obligations in terms of maintenance have been fulfilled, alternatively until withdrawn by the Golden Group.

2.0 Relevant Environmental Legislation

Ewing VDM on behalf of Golden group in addition to obtaining all relevant approvals, takes due cognisance of their statutory requirements detailed in the following relevant acts, regulations, frameworks and policies:

Table 1: Relevant Environmental Legislation and Application

Relevant Environmental and Other Legislation	Environmental Issue
Aboriginal Heritage Act 1972-1984, Native Title (State Provisions) Act 1999	Aboriginal sites and Native title
Environmental Protection Act 1986, National Environment Protection Council (Western Australia) Act 1996	Air Quality (Dust)
Occupational Safety and Health Act 1984, Health Act 1911	Construction
Contaminated Site Act 2003	Contamination
Soil and Land Conservation Act (1945), Soil and Land Conservation Act 1945-1982, Environmental Protection Act 1986	Erosion and Sediment/Soil Control
Bush Fire Act 1954, Fire and Emergency Services Authority of Western Australia Act 1998	Fire Management
Town Planning and Development Act 1928, Metropolitan Region Town Planning Scheme Act 1959, Western Australian Planning Commission Act 1985, Land Administration Act 1997	Landuse
Environmental Protection (Noise) regulations 1997 and Environmental Protection Act 1986	Noise and Vibration
Conservation and Land management Act 1984, Wildlife Conservation Act 1950, Environment Protection and Biodiversity Conservation Act 1999	Vegetation Management and Control
Western Australian Planning Commission Act 1985	Visual Amenity
Water and Rivers Commission Act 1995, Waterways Conservation Act 1976, Swan River Trust Act 1988	Wetland Management and Surface Water
Litter Act 1979	Waste Management
Local Policy	
Local Government Act 1995 (City of Swan Consolidated Local Laws 2005)	Local Law Provisions
Note: The above list of acts, regulations and guidelines are not considered exhaustive but rather detailing those considered most relevant to the construction of Lots 173-177 Burslem Drive, Maddington	

3.0 Responsibilities

It should be noted that the basic responsibility for environmental protection rests with all employees and sub-contractors. The following specific responsibilities pertain to this SWMP:

Party	Primary Responsibility
Golden Group Project Manager: Steven Tay, Golden Group. Contracts Manager: To be advised (TBA).	Overall implementation of the SWMP and management of environmental impacts and risks. Issuance and distribution of SWMP. Revision of the SWMP, as required, to reflect the *status quo*. Revisions are to be made by replacing the entire document by consecutively numbered amendments.
Civil Construction Team **Site Manager:** Tony Musgrave **Site Foreman:** Auzzie Majstovich **Safety Officer:** TBA **Workplace, Health & Safety Representative:** TBA	Implementation of strategies, requirements, procedures and measures to ensure that appropriate environmental protection is in place. Induction, supervising and monitoring of the Site Safety Rules, the Emergency Plan and the SWMP To attend construction at all times during working hours. Site inspections (random, daily) to ensure adherence to the different plans and procedures. Direct actions, as required, to protect the environment and to minimise and/or rectify any environmental concerns.
All other site personnel	Responsible for a *General Environmental Duty* under the Environmental Protection Act 1986: responsible for environmentally sound management of operations and reporting any observed incidents to the Site Manager. Adherence to Site Safety Rules, the Emergency Plan and the SWMP.
VDM Environmental Pty Ltd Environmental Consultants	Assist with implementation, monitoring construction and reporting, assessment of non-conformances, etc. (if any).

4.0 Awareness and Training

A copy of this document will be available at the site:

- Site Manager.
- Safety Officer.

Construction Safety Awareness Training is mandatory in Western Australia (effective 1 January 2007). The requirements for on-site personnel to be trained is detailed in the Occupational Safety and Health Act 1984 (Amended Regulation No. 2, 2005) together with the Occupational Safety and Health Regulations 1996 [Reg1.3]. Such training is not designed to take the place of work site or task specific instruction, training or supervision but rather training to provide all construction site works and regular visitors with basic knowledge of the hazards associated with construction work (Department of Consumer and Employment Protection, 2005).

As part of their site training all personnel engaged in construction shall be made aware of the provisions of this document in order to promote a general awareness of the environment and to minimise any potential impact and/or disturbances to the environment.

5.0 Emergency Contacts

The following parties are to be advised immediately of a non-conformance event:

Party	Contact Number
Musgrave Contracting – Site Manager: Tony Musgrave – Site Foreman: Auzzie Majstovich	 (08) 9453 3100 0419 049 443
VDM Environmental (as required) – Environmental Consultant:	 (08) 6250 - 9900
Emergency pollution response unit (Department of Environment and Conservation)	1300 784 782
Other (as required): incidents involving personal health and safety requiring police, ambulance or fire services.	000

6.0 Description of Site/Development

The subject site is located on Lots 173-177 Burslem Drive, Maddington and is located within the City of Gosnells. It is located approximately 15 kms south-east of the city of Perth (refer to Figure 1) with geographic coordinates of 32° 03' 21" S and 115° 58' 40" E.

FIGURE 1: AERIAL PHOTOGRAPH OF SUBJECT SITE
(Google Earth)

The subject site comprises of five different cadastral subdivisions (Lots 173, 174, 175, 176 & 177 Burslem Drive), which comprise of the following areas:

Lot number:	Area (m^2):
173	9,754
174	11,578
175	15,732
176	20,529
177	30,279

Site Area: 8.7872ha.

Proposed Use: Residential Development.

Topography: The subject land generally slopes from Burslem Drive along the north and eastern boundaries towards the river along the western boundary. The highest point of the site is adjacent to the roundabout at the intersection of Burslem Drive, Phillip and Olga Streets. Site gradients range between 1 in 10 to 1 in 120, with an average slope of 1 in 50.

Levels across the site range from RL 4m AHD along the south-eastern boundary to RL 9m AHD approximately in the north-eastern periphery adjacent to the roundabout at Olga Street.

Vegetation: The property was previously used for market garden and orchard cultivation predominately citrus and fruit trees and is therefore predominantly cleared of any original vegetation. Some native fringing regrowth vegetation exists along the river foreshore.

Downstream Environment: The Canning River is the receiving body for stormwater. Stormwater from the site is currently conveyed as sheet and channel flow into the Canning River.

Local Authority: City of Gosnells' Local Government Area.

Cultural Heritage: At the time of colonial settlement, the Canning River was the run of two Nyungar groups, the Beeloo who mainly lived between the river and the Darling Ranges, and the Beeliar who used the land between the Canning River and the ocean. According to O'Connor *et al*. (1984, in Swan River Trust, 1997), it is possible that the area of the Wellington Parkland P/L landholding (referred to in SRT (1997) as 'Maddington Park') was a meeting ground for both groups.

A search of the Department of Indigenous Affairs Aboriginal Heritage Management System (2004)

identifies the alignment of the Canning River as a site of significance. The upland area, comprising the Wellington parkland P/L landholding, is not registered as a site of significance according to the register.

Acid Sulfate Soils: According to the Central Metropolitan Region Scheme Acid Sulphate Soils, Planning Bulletin No. 64, the site has a moderate to low risk of Actual Acid Sulphate Soils (AASS) or Potential Acid Sulphate Soils (PASS) occurring generally at depths of greater than 3m (figure 2).

Investigative work was carried out by ENV.Australia (2004) which revealed that the potential for ASS does not appear to be an environmental risk at this site and further testing considered unnecessary.

The scope of works for the proposed development includes the following:

This SWMP deals with an application to subdivision into 129 lots, 1 heritage lot and 3 POS areas. Lot sizes range from 271m^2 to 434m^2 (refer Figure 3: Proposed Development Plan).

FIGURE 2: MAP OF ACID SULPHATE SOILS LOCATIONS

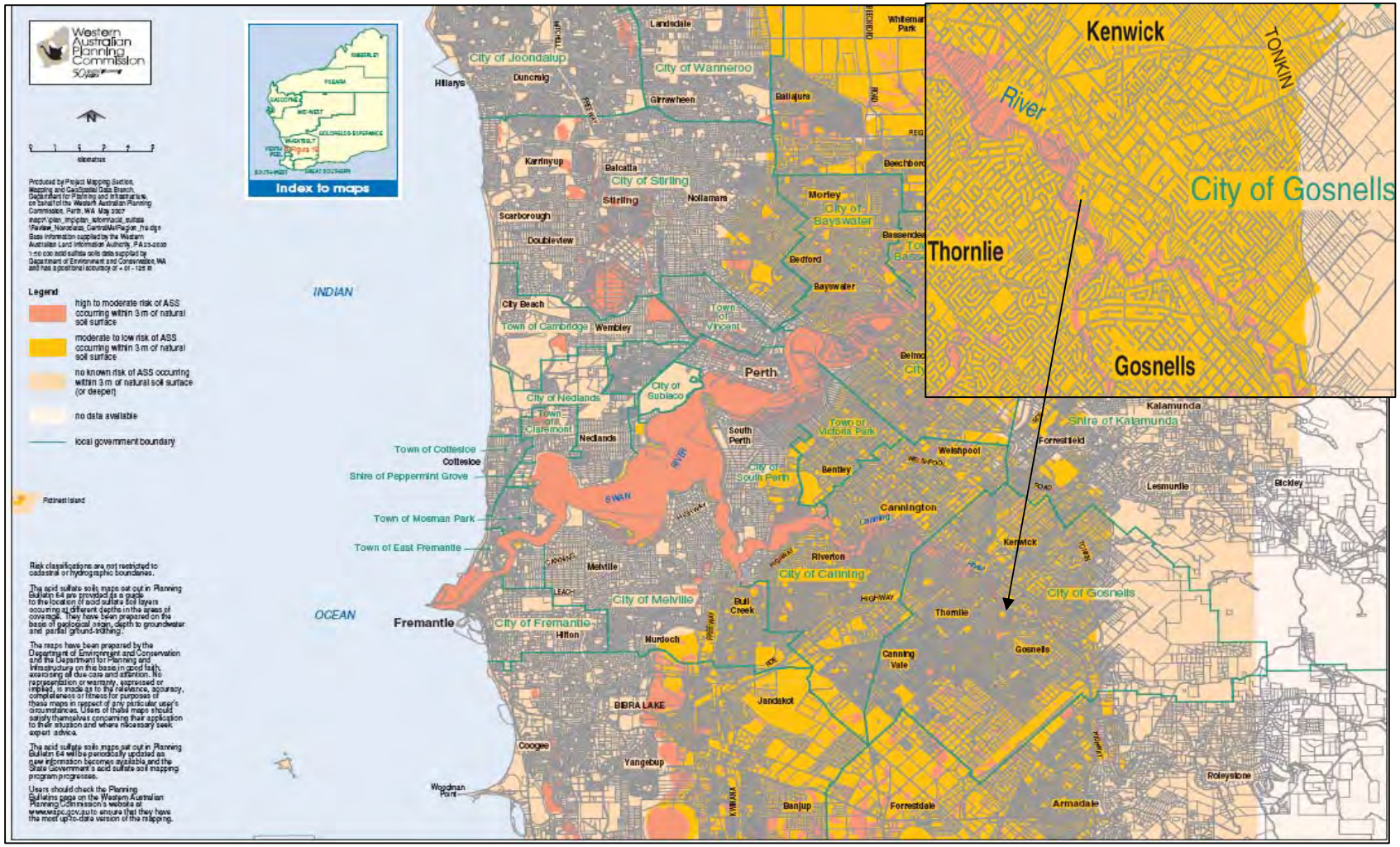
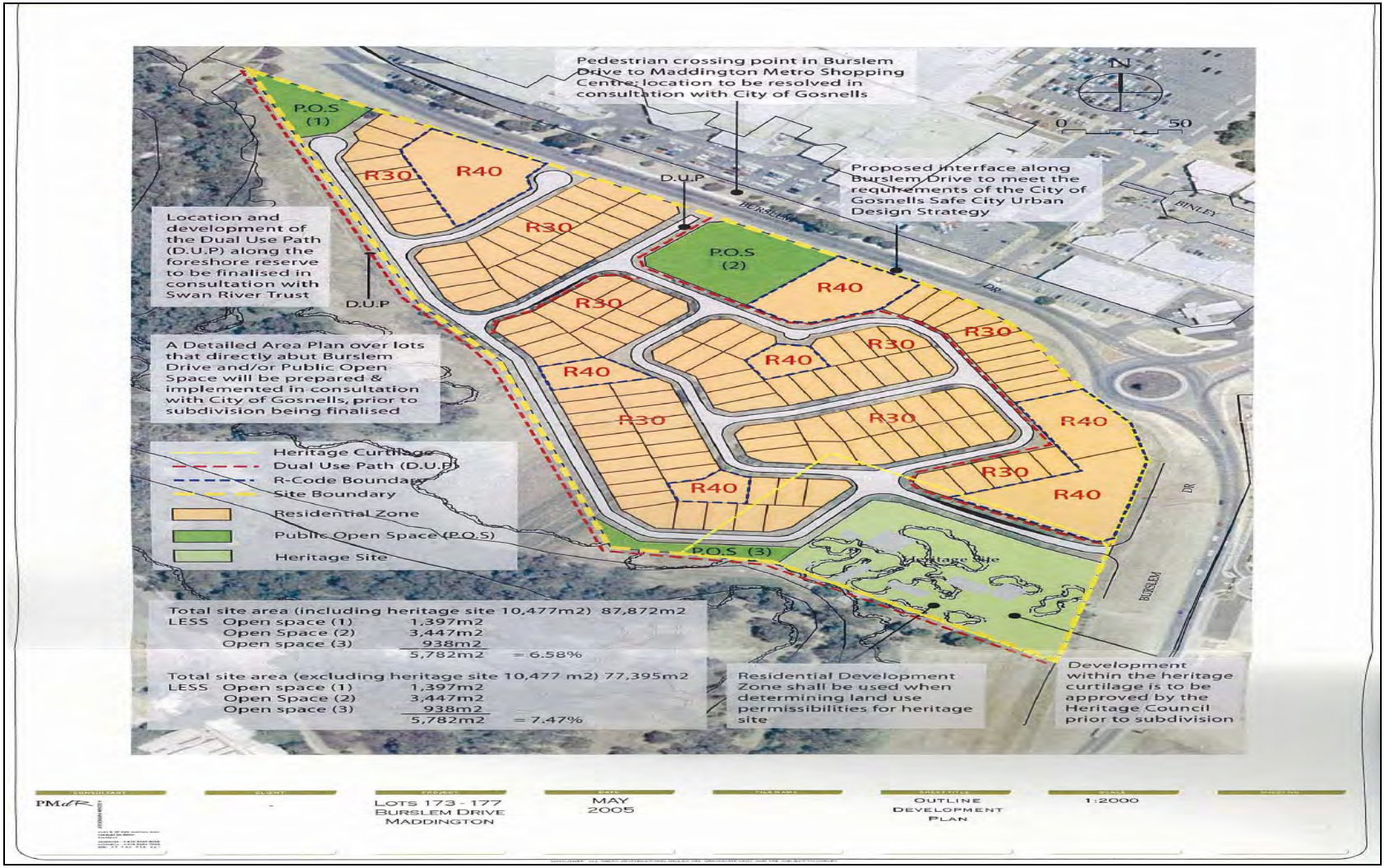


FIGURE 3: PROPOSED DEVELOPMENT LAYOUT



7.0 Subdivisional Works Management Plan

7.1 Aim and Scope

The aim is to provide a concise description of the environmental issues to be managed during and immediately after construction, the practices to be adopted to manage these issues and to nominate those responsible for ensuring adherence to the plan. The scope includes all activities and operations that will be undertaken for the duration of the construction phase.

7.2 Environmental/Construction Issues

The most important issues are:

- Stormwater including vegetation, erosion and sediment control and water quality.
- Air quality and vibration: dust and noise.
- Waste management including on-site storage, spills and leaks.

Other issues include:

- Traffic.
- Fire Management.

The City of Gosnells requires a 3m wide **firebreak**, cleared and maintained, inside all external boundaries of the land where the area is greater than 2000sqm (City Of Gosnells, 2007). Machines and vehicles shall be restricted to designated cleared areas. Vehicles operating over natural vegetation shall have exhausts in good working order. Burning of any material and/or campfire or barbecue is not permitted. In the event of a fire dial *000* immediately and follow the Emergency Plan: Evacuation Procedure for the site.

Traffic management and control will be the responsibility of the contractor. On-site traffic management plans, specific to the nature of the intended works, will be implemented at all times and during all stages. These plans should include details of the type of machinery to be used, transport routes, anticipated frequency of movement and safety measures to be implemented. The site manager shall ensure traffic runs fluently through and around the site as to minimise congestion and build up of construction traffic. Signage shall be erected at the entry and exit points to and from the site to warn pedestrians/oncoming traffic of construction traffic. The site manager shall inspect traffic safety on a daily basis.

7.3 Environmental Complaints and Incidents

All environmental complaints will be investigated. Where considered appropriate and/or required, the Site Manager shall notify the Environmental Consultant and/or the relevant statutory authority. Complaints received by external parties shall also be subject to investigation by the Site Manager.

Should an environmental incident occur during the course of construction, Ewing VDM on behalf of Golden Group shall take prompt action to minimise any impact and where necessary, liaise with all relevant authorities.

All complaints will be treated with respect. The Site Manager shall maintain a Complaints Register (refer Appendix F) and shall, in liaison with the Environmental Consultant, direct an appropriate course of action relating to the complaint. The Complaints Register will be included in any audit reports during construction and shall record the date, time and nature of any complaint, the name and contact details of the complainant, action taken, person responsible for action, and resolution of complaint. The Site Manager shall certify each entry on the record.

7.4 Environmental Notifications

In the event of an emergency or non-conformance that may cause or causes environmental harm, as soon as practicable after being made aware of the emergency or incident, the Site Manager shall notify the Environmental Consultant and the relevant authority of the incident by telephone and subsequently by facsimile. The Site Manager shall provide the following information:

- Number of the development approval.
- Name and telephone number of the designated contact person.
- Location of the incident.
- Time of the incident and the time the Site Manager became aware thereof.
- Cause of the incident.
- The environmental harm caused, threatened, or suspected to be caused by the incident.
- Details of actions to prevent further incidents and/or recurrence of similar incidents.
- Actions taken to mitigate any environmental harm caused by the incident.

7.5 Air Quality and Vibration

7.5.1 Noise

Commitment:

- Take all reasonable precautionary measures to minimise noise from construction.

Issue:	Noise impacting on site workers, traffic and surrounding environment.
Objectives:	To ensure noise impacts are minimised and managed appropriately. To ensure noise attenuation is in accordance with the provisions of AS 2436: 1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites* and the *Environmental Protection (Noise) Regulations 1997.* To comply with specific directives: ▪ Construction work to be carried out between 7:00am and 7:00pm. No work is to be undertaken on Sundays and public holidays. ▪ The noise levels emitted from all equipment, including earthmoving machinery, trucks, vibrating rollers and light vehicles, amongst others, are to be maintained to avoid noise omitted exceeding recommended guidelines and standards.
Management Procedure:	Adhere to working hours between 7:00am and 7:00pm. No work on Sundays and/or public holidays. Nearest residences to be advised of the construction work and provided with the

	necessary contact numbers in the event that they wish to complain/inform the City of Swan and/or the Site Manager of a noise nuisance. Ensure that all site workers are aware of commitments and specific directives including conditions of contract pertaining to the use/wearing of PPE. Ensure that all site workers have suitable personal protective equipment (PPE) to be worn at all times when near or operating plant and equipment making noise. Ensure each item of equipment is fitted with noise suppression devices as applicable. Manage use of equipment making noise and ensure workers are trained to manage use of equipment so noise is minimised. Check noise suppression system of any equipment making noise beyond acceptable levels and ensure its effective operation and state of repair. Instruct operator to cease work until suitable repairs were undertaken; when un-satisfactory, remove and replace equipment.
Performance Indicators:	Noise complaints (if necessary noise logger).
Responsibility:	Safety Officer and Site Manager. Sub-contractors are to provide/use their own PPE.
Critical Dates:	Prior to commencement of work/construction safety inductions (to include training, awareness of commitments, directives, working hours, use of PPE and managing use of equipment to minimise noise impacts).
Monitoring:	Daily inspections.
Response:	Report (first responsibility rests with person undertaking and/or observing incident) to Site Manager and/or Safety Officer. Site Manager to report to relevant authorities if required.
Corrective Action:	Remove offending equipment/worker from site. Observations and complaints shall be used to guide implementation of additional measures, if and when required.

7.5.2 Dust

Commitment:

- Take all reasonable precautionary measures to minimise airborne pollution by dust.
- Dust Management Plans/Controls will be the responsibility of the Contractor.

Issue:	Dust from, equipment and construction activities (e.g. earthworks) impacting on site workers, traffic and surrounding environment.
Objectives:	To ensure compliance with *National Environment Protection Measure for Ambient* Air Quality (1997), *Soil and Land Conservation Act (1945)* To ensure all dust/erosion related impacts are prevented and/or minimised and managed appropriately.
Management Procedure:	Ensure all site workers are aware of commitments and specific directives. Ensure that all site workers have suitable PPE to be worn at all times when near or operating activity equipment making dust. Ensure workers are trained to use/manage equipment making dust. Manage use of equipment/activity making dust. Minimise the time the disturbed areas are exposed without stabilisation or cover. Construct a stabilised site access at the entrance to the site and located to minimise erosion. Progressive re-vegetation of filled and disturbed areas and/or the application of Hydromulch. Dampen work areas by water spray/mist to control/reduce dust pollution. Clean work areas regularly to minimise rising dust. Dampen/cover/net imported materials (e.g. fill, soil, sand, gravel or landscaping materials) that require temporary stockpiling (arrange order of works to minimise) pending placement. Sediment to be removed from the fences and basins when controls are 40% full. Operate all vehicles in an efficient manner (shall be up-to-date with services and

	maintenance in accordance with acceptable industry standards: check log books if required). All trucks leaving the site will be covered and free of loose material. A water cart will be placed on site at all times to suppress dust emissions, and second available if required. Monitoring of water quality to determine the effectiveness of dust/sediment/soil erosion control management practises. Do not remove anti-pollution devices from equipment/vehicles.
Performance Indicators:	Complaints pertaining to dust (if required dust trackers will be employed by the Contractor)
Responsibility:	Safety Officer (Induction) and Site Manager. Sub-contractors are to provide/use their own PPE.
Critical Dates:	Prior to commencement of work/construction safety induction (to include training, awareness of commitments, directives, site safety rules and emergency evacuation, working hours, use of PPE and managing use of equipment/vehicles to minimise dust/emission impacts).
Monitoring:	Daily inspections and Maintain Daily Site Register.
Response:	Report (first responsibility rests with person undertaking and/or observing incident) to Site Manager and/or Safety Officer. Site Manager to report to relevant authorities if required.
Corrective Action:	Remove offending equipment/vehicle/worker from site. Ensure management measures are implemented and maintained. Observations and complaints shall be used to guide implementation of additional measures, if and when required.

7.5.3 Vibration

Commitment:

- Take all reasonable precautionary measures to minimise vibration from construction.

Issue:	Impulsive vibration from equipment and construction processes including road and service trench compaction, scrapers/dozers, trucks and other heavy machine movements and heavy duty screening of larger material, amongst others, affecting surrounding environment.
Objectives:	To ensure vibration impacts are minimised and managed appropriately.
Management Procedure:	Adhere to working hours between 7:00am and 7:00pm and no work on Sundays or public holidays. Restrict high vibration activities to least sensitive times. Inform surrounding communities about nature of vibration generating activities and use alternatives to impact piling where and if required. Schedule similar activities such as earthmoving and ground impacting operations so as not to occur at the same time. Minimise the effects of vibration from all mechanical equipment and construction processes. Ensure equipment is operated to minimise vibration. Manage frequency and duration of operation of equipment producing vibration to minimise any effects. Ensure workers are trained in the use of equipment to minimise vibration. Reduce wherever practical vibration out of the horizontal or vertical planes.
Performance Indicators:	Observation of excessive vibrations on site. Complaints pertaining to vibration.
Responsibility:	Site Manager and Safety Officer.
Critical Dates:	Prior to commencement of construction safety inductions (to include awareness of commitments, directives, working hours and managing use of equipment to

	minimise vibration impacts).
Monitoring:	Daily inspections when vibration producing equipment and construction processes are in use.
Response:	Report (first responsibility rests with person undertaking and/or observing incident) to Site Manager and/or Safety Officer. Site Manager to report to relevant authorities if required.
Corrective Action:	Where vibration is an intrinsic part of the design of equipment, minimise the effects of vibration through source, transmission or receiver reduction techniques. Where vibration indicates a defective state of equipment; repair or remove offending equipment from site. Observations and complaints shall be used to guide implementation of additional measures, if and when required. Undertake consultation and education processes with affected parties.

7.6 Land and Water

7.6.1 Vegetation

Commitment:

- Remove and conserve vegetation in accordance with approved plans.

Issue:	Weeds and clearance of vegetation Disturbance/damage to existing vegetation.
Objectives:	To undertake removal of weeds in accordance with the suggested removal strategies outlined in the *ATA Foreshore Environmental Management Plan* (2005). To protect from damage all trees and other plants which: - are shown or specified to be retained; or - need not be removed or damaged for construction operations. To contain the extent of vegetation clearing to the limits specified.
Management Procedure:	Ensure that all site workers are aware of commitments and specific directives. Undertake all activities to minimise damage to vegetation. The Conservation Category Wetland boundary will be marked out, such that Earthworks do not encroach into the Wetland boundary. Do not disturb/damage existing remaining vegetation; Maintain all landscape materials, plants, vegetation and watering systems. Recycle (mill, chip or mulch) all felled timber/vegetation where possible and incorporated into landscape features or other approved site works and/or transport from site and dispose in a satisfactory manner. Unless otherwise approved, do not permit on-site disposal or burning of cleared vegetation. Mulched materials may be stockpiled for reuse, where required, or in conjunction with environmental control measures if suitable. Care is to be taken with the use of topsoil and mulch to ensure that these do not contain weed propagules. Whilst some vegetation from the site should be chipped or milled and utilised on site, invasive species identified in the Foreshore Environmental Management Plan (2006) should not be used in mulch and should be disposed of at an appropriate green waste facility. Minimising vehicle movement beyond the immediate construction site to prevent excessive disturbance of vegetation and dispersal of weeds.
Performance Indicators:	Reports/complaints pertaining to disturbance/damage to vegetation.
Responsibility:	Site Manager.
Critical Dates:	Prior to commencement of work/construction safety induction (include training, awareness of commitments, directives, working hours and approval conditions for vegetation clearing/retention).
Monitoring:	Daily inspections.
Response:	Report disturbance/damage to Site Manager.

Corrective Action:	Immediately repair damage. Observations shall be used to guide implementation of additional measures, if and when required.

7.6.2 Storm Water

Given the location of the site, stormwater management should focus on works that will not interfere, alter or pollute any wetland, watercourse, surface water expression or groundwater in the area, or alter water quality of such waters. This section will concentrate on the potential increase in pollutant values as a result of the proposed development, and in turn the required treatment to mitigate potential increases (refer to the VDM Drainage Nutrient management Plan for detailed information pertaining to Stormwater Management).

Commitment:

- Stormwater discharge from the site will be conveyed as channel flow through the Public Open Spaces and collected in a Basin located within the Public Open Reserve where the water will be treated prior to discharge to the Canning River.

Issue:	Runoff: stormwater management measures (quantity and quality): flooding and contamination of surface water. Sediment and erosion control.
Objectives:	To control stormwater runoff and protect receiving waterways. To minimise sediment loss from the site and pollution of natural waterways and/or municipal drainage systems. To comply with specific Local Authority requirements in addition to governing statutory requirements. To prevent sediment from being deposited on public streets and roads. To implement appropriate sediment and erosion controls (refer approved VDM Environmental Integrated Urban Water Management Plan). To mitigate any increase in flooding on downstream property.
Management Procedure:	During construction 1 in 1 year 12 hour storm is to be retained on site, some storage is achieved in pipes and drainage system. All stormwater above a 1in 1 year 12 hour storm from stage one will discharge through the reserve for recreation, sediments captured by sedi-fence along boundary, as per the agreement between the developer and the Swan River Trust. Construction of foreshore works will be during summer, therefore chances of significant storm event is low. Stormwater from future stages will be conveyed within a stormwater swale to the dampland basin within the Public Open Reserve. Gross pollutant traps (GPT) have been installed to remove trash and reduce litter, oil and greases, suspended solid and nutrients concentrations in stormwater prior to discharge into the foreshore drainage system. Vegetated swales are to be used to convey stormwater in lieu of pipes and to provide removal of coarse to medium sediment and nutrients through biological uptake. **Construction (Mitigation of Water Quality):** • Progressive re-vegetation of filled and disturbed areas. • Regular inspections as soon as practicable after storm events to check and maintain controls. • Sediment fences to be erected at the edge of the reserve for recreation to prevent sediment laden stormwater from flowing from the road surface into the canning River and wetland area. Sediment fence detail is provided in Appendix E). • Sediment to be removed from fences and basins when controls are 40% full and at the completion of construction. All material to be re-used or stored on-site in a controlled manner or taken off-site for re-use or disposal at a licensed waste disposal facility. • All workers and sub-contractors to be inducted in these sediment and erosion control measures.
Performance Indicators:	Visual evidence of deterioration of baseline water quality of downstream water

	courses directly attributable to the site construction. Pollutant concentrations that exceed the water quality objectives as set out by the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Visible erosion. Failure of control measures.
Responsibility:	**Construction:** Site Manager assisted by Environmental Consultant. **Operation:** Site Owner/Operator.
Critical Dates:	**Owner/Site Manager:** responsibility for environmental management.
Monitoring:	**Monitoring Programme:** To be undertaken by Environmental Consultant. Rain to be measured daily by Contractor. **Location:** Entry point (into sediment basin) and Exit point (to Canning River). **Frequency:** Quarterly, or rainfall events greater than 10mm/d. **Analytes:** Turbidity, Suspended Solids, Dissolved Oxygen, Total Nitrogen, Total Phosphates, pH and Electrical Conductivity. **Procedure:** In accordance with procedures set out by the City of Swan and the Department of Water. **Analysis:** NATA registered laboratory. **Reporting:** Post-sampling reports (to be submitted to council upon request).
Response:	Report incidents to Site Manager. Site Manager to report to relevant authority.
Corrective Action:	All corrective actions shall be agreed upon, dependent upon the severity of non-conformance and parameter concerned, between Golden Group, VDM Environmental and relevant authority. Remove sediment from fences when controls are 40% full and at completion of construction. Observations and monitoring data shall be used to guide implementation of additional measures, if and when required. The triggering of a performance indicator will require: - Locate source of water quality deterioration. - Prevent continuing deterioration by repairing existing measures, construct additional measures or modify procedures. - Review strategies/management plans in consultation with relevant authority.

7.6.3 On-Site Storage, Spills and Leaks

Commitment:

- Take all reasonable precautionary measures to ensure safe storing and handling.
- Take all reasonable precautionary measures to prevent spillages of chemicals, fuels and/or lubricants.

Issue:	Contamination of land and water.
Objectives:	To not interfere, alter or pollute any wetland, watercourse, surface water expression or groundwater in the area, or alter water quality of such waters and storm water systems. To store/handle materials/equipment to prevent damage to the site and minimise hazards to persons, materials/equipment and the environment.
Management Procedure:	Ensure that all site workers are aware of commitments and specific directives, Site Safety Rules, Emergency Plan and the storing/handling/disposal of products used in undertaking relevant construction tasks. Obtain/file/comply with relevant approved Material Safety Data Sheets (MSDS) for all relevant products. Do not permit use of any chemical without approved MSDS. Store chemicals/fuels/lubricants in suitable packaging/containers in designated areas in lock-up containers (to be recorded in the Site Safety Plan) and in accordance with relevant Australian Standard for storage/handling requirements. Refuelling of equipment is to be carried out at one designated location on site to be determined in liaison with the Site Manager and Environmental Consultant. At the completion of the construction work all contaminated soil are to be removed from site and disposed of appropriately. Keep storage areas neat and tidy. Do not permit equipment maintenance on site unless essential repairs by an approved facility/person. Collect contaminated materials and/or service materials and dispose of in a designated bin or remove from site for disposal at an approved facility. Employ appropriate measures (in terms of MSDS) to clean up spills and treat affected/injured workers. Refuelling of equipment to be undertaken in one location. Refuelling area to be adequately bunded to prevent contamination of soil and/or groundwater in the event of a spill. Maintenance of equipment is to occur in a single location as set by the Site Manager. The maintenance area is to be adequately bunded to prevent contamination of soil and/or groundwater in the event of a spill.
Performance Indicators:	Compliance with relevant MSDS and Australian Standard. Independent audit findings.
Responsibility:	Safety Officer. Site Manager.
Critical Dates:	Prior to commencement of work/construction safety induction (to include training, awareness of commitments and specific directives, working hours, Site Safety Rules, Emergency Plan and storing/using/handling of relevant products).
Monitoring:	Daily inspections by Site Manager. Quarterly site inspections by Environmental Consultant to assess the site for possible chemical/hydrocarbon contamination.
Response:	Report spills and non-compliances to Site Manager. Report relevant authority in the event of spill and/or leak

Corrective Action:	Immediately invoke safety and precautionary measures and impact assessment. Observations and monitoring data shall be used to guide implementation of additional measures, if and when required. Review strategies/management plans in consultation with relevant authority.

7.6.4 Waste Management

Commitment:

- To maintain a clean site to meet environmental regulations and in the interests of safety.

Issue:	Contamination of environment: water and air; land management and conservation hazards and loss of amenity.
Objectives:	To maximize conservation of resources through effective avoidance and diversion of wastes.
Management Procedure:	Dispose of all construction wastes, site refuse and any solid/liquid contaminants resulting from construction and related activities in accordance with statutory and local authority requirements. Where practical, sort materials prior to disposal. Liaise with local authorities and commercial recycling organisations and community groups where the potential for recycling is evident. Make all site workers aware of commitments and specific directives including waste recycling/disposal system. Provide/inspect/maintain bins for the disposal of waste. Place construction wastes and minor rubbish in the designated areas/locations to be removed when required. Putrescible and effluent waste is to be disposed of in accordance with the Health Regulations of the relevant local authority.
Performance Indicators:	Untidy site conditions and inspections.
Responsibility:	All site workers are responsible for the environmentally sound management of the operation, and reporting any observed incidents to the Site Manager.
Critical Dates:	Prior to commencement of work/construction safety induction (to include training, awareness of commitments, directives, working hours and waste disposal).
Monitoring:	Daily inspections; quarterly inspections by Environmental Consultant.
Response:	Report waste (first responsibility rests with person undertaking and/or observing incident) to Site Manager.
Corrective Action:	Direct (as per conditions of contract) clean ups (applicable to all site workers) as and when required.

8.0 Summary and Monitoring Requirements

The following tabulation provides a summary of the monitoring required during the Construction of the Subdivision of Lots 173-177 Burslem Drive, Maddington.

Issue	Activity/Location	Frequency	Responsibility	Additional Requirements
Noise	Site Inspections	Daily	Site Manager	Maintain daily site register. Submit reports to Council for review (only upon request)
Dust	Site Inspections	Daily	Site Manager	
Vibration	Site Inspections	Daily when vibration producing equipment and construction processes are in use	Site Manager	
Vegetation	Site Inspections	Daily	Site Manager Environmental Consultant	
Stormwater – sediment and erosion control	Entry point (into sediment basin) and Exit point (to Canning River)	Rainfall daily; water quality when rainfall event exceeds 10mm/d and quarterly	Site Manager Environmental Consultant	
On site Storage/Spills/ Leaks	Site Inspections	Daily and quarterly	Site Manager Environmental Consultant	
Waste Management	Site Inspections	Daily	Site Manager Environmental Consultant	

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Section 7:
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Section 8:
APPENDICES

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APPENDIX A: Decision Process for Stormwater Management in WA *(DoE and SRT, 2005)*

Decision Process for Stormwater Management in WA (DoE and SRT, 2005)

1. Stormwater management systems shall be designed in accordance with the objectives, principles and delivery approach outlined in the *Stormwater Management Manual for Western Australia* (DoE, 2004). This includes: minimising risk to public health and amenity; protecting the built environment from flooding and waterlogging; implementing systems that are economically viable in the long term; and ensuring that social, aesthetic and cultural values are maintained.
2. Prior to design, developers shall consult with the Department of Environment (DoE), local government authorities and other relevant stakeholders. Maintenance requirements should be considered at this stage.
3. Adequate field investigations shall be undertaken to determine the appropriate hydrologic regime for the site and potential site constraints, such as contaminated sites, acid sulfate soils or highly elevated nutrient levels in groundwater. Baseline and/or ongoing monitoring of groundwater and surface water quality and quantity may be required.
4. Stormwater management systems may be subject to additional design and performance criteria if they have the potential to impact on sensitive receiving environments. Sensitive receiving environments include (but are not limited to) conservation areas or reserves, wetlands and waterways with conservation values, Waterways Management Areas, the Swan River Trust Management Area, Environmental Protection Policy areas, and some areas of native vegetation. Sensitive native vegetation includes (but is not limited to) Declared Rare Flora, Priority Species, Threatened Ecological Communities, Threatened Fauna Habitat and vegetation identified in *Bush Forever* (WAPC, 2000), including vegetation located east of the Southern River Vegetation Complex on the Swan Coastal Plain.

Water quantity management

1. Is the proposal completely or partly within a known contaminated site (i.e. a contaminated site listed on the contaminated sites register, or identified through adequate field investigations) or high acid sulfate soil risk area?
2. Does the soil or groundwater contain *highly elevated* nutrient levels? A definition for highly elevated nutrient levels has not been provided, as nutrient breakthrough is highly variable and is dependent on the soil type (e.g. organic, clay and iron oxyhydroxide content) and local wetting and drying cycles.

Yes (to either question)

Avoid mobilisation or disturbance of the in-situ contaminants

If yes to question 1 - seek further advice from the DoE.

If yes to question 2 - consult with the DoE about best management practices to minimise nutrient leaching through the soil profile (i.e. structural and non-structural controls suitable to the site conditions).

No (most situations)

1. Maintain the pre-development hydrologic regime and meet the ecological water requirements of the receiving environment.
2. Hydraulic requirements shall be determined by ecosystem requirements and the hydrologic form of the local and downstream environment. Physical survey measurements and a biological survey should be undertaken.
3. Hydrologic and hydraulic analyses, modelling and design shall incorporate the recommendations and methodology of *Australian Rainfall and Runoff, A Guide to Flood Estimation* (IEA, 2001).
4. The effective imperviousness of a development shall be minimised. The process for achieving this is outlined below:

Less than and up to 1 year ARI events

Generally, rainfall from 1 year average recurrence interval (ARI) events should be retained or detained on-site (i.e. as high in the catchment and as close to the source as possible), unless it can be clearly demonstrated that achievement of this objective is impractical due to site conditions.

Generally, for detention systems, preserve the pre-development 1 year ARI peak discharge rate. Use best management practices (structural and non-structural) to treat water quality.

Greater than 1 year and up to 100 year ARI events

Mitigate runoff from constructed impervious areas for greater than 1 year ARI events, in landscaped retention or detention areas in public open space or linear multiple use corridors. Any overflow of runoff towards waterways and wetlands shall be by overland flow paths across vegetated surfaces.

Design for greater than 1 year and less than 10 year ARI events

Minor system conveyance (i.e. swales and pipes).

Design for 10 year to 100 year ARI events

Major system conveyance (i.e. via overland flow).

Water quality management

1. On-site field investigations are required to determine the appropriate water quality management measures for the site, including consideration of potential pathways of nutrients towards receiving water bodies. Receiving water bodies are defined as waterways, wetlands, coastal marine areas and groundwater aquifers.
2. The components of the water quality treatment train must be designed so that their combined effect meets the water quality management objectives as specified in the relevant regional water quality management targets (e.g. local government stormwater management plans, the Regional Natural Resource Management Strategy, *Swan-Canning Cleanup Program Action Plan* (SRT, 1999) and the *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992* (EPA, 1992)). The requirements for demonstration of compliance shall depend upon the scale of the proposed land development. Demonstration of compliance may be achieved by the use of appropriate assessment methods, to the satisfaction of DoE.

Protect waterways and wetlands

1. Retain and restore waterways and wetlands. For waterways, the approach should be consistent with the *River Restoration Manual* (WRC, 1999-2003), *Draft Waterways WA - A Policy for Statewide Management of Waterways in Western Australia* (WRC, 2000), *Foreshore Policy 1 - Identifying the Foreshore Area* (WRC, 2002) and, in the Swan and Canning Catchments, the *Environmental Protection (Swan and Canning Rivers) Policy 1998* (EPA, 1998). For wetlands, the approach should be consistent with the *Environmental Protection of Wetlands Position Statement No. 4* (EPA, 2004) and the *Wetlands Conservation Policy for WA* (Government of WA, 1997). On the Swan Coastal Plain, the approach to managing wetlands should also be consistent with the *Environmental Protection (Swan Coastal Plain Lakes) Policy, 1992* (EPA, 1992) and the *Position Statement: Wetlands* (WRC, 2001).
2. There shall be no new constructed stormwater infrastructure within Conservation category wetlands and their buffers, or other conservation value wetlands and their buffers, or within a waterway foreshore area (e.g. no pipes or constructed channels within these wetlands and their buffers, or within waterway foreshore areas), unless authorised by the DoE or the Environmental Protection Authority. For Resource Enhancement and Multiple Use category wetlands, stormwater management shall be consistent with the objectives outlined in the *Position Statement:Wetlands* (WRC, 2001).
3. The creation of artificial lakes or permanent open water bodies generally will not be supported when they involve the artificial exposure of groundwater (e.g. through excavation, or lined lakes that require groundwater to maintain water levels in summer) or the modification of a wetland type (e.g. converting a dampland into a lake). Where water conservation (e.g. summer water supply) and environmental and health concerns (e.g. hydrology, water quality, mosquitoes, midges, algal blooms, acid sulfate soils and iron monosulfide minerals) can be adequately demonstrated to be addressed through design and maintenance, consideration may be given to the creation of artificial lakes/ponds. Seasonal wet infiltration areas or approved constructed waterways (i.e. ephemeral 'Living Streams') are preferred options.

Management of groundwater levels

1. Any proposals to control the seasonal or long-term maximum groundwater levels through a Controlled Groundwater Level (CGL) approach shall demonstrate through adequate field investigations, to the satisfaction of the Department of Environment, that local and regional environmental impacts are adequately managed.
2. The CGL may be defined as the controlled (i.e. modified) groundwater level (measured in metres Australian Height Datum) at which the DoE will permit drainage inverts to be set. The CGL must be based on local and regional environmental water requirements, determined in accordance with the *Environmental Water Provisions Policy for Western Australia* (WRC, 2000) and the *Urban Development and Determination of Ecological Water Requirements of Groundwater Dependent Ecosystems* (DoE, in preparation).
3. Where appropriate, field investigations must be undertaken to identify acid sulfate soils (ASS). Any reduction in groundwater level should not expose ASS to the air, as this may cause groundwater contamination. Refer to the ASS Guideline Series, including *Identification and Investigation of Acid Sulfate Soils* (DoE, 2004). If field investigations identify ASS, seek further advice from DoE.

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Water & Rivers Commission 1999-2003, *River Restoration Manual,* Water and Rivers Commission, Western Australia. Available via <waterways.environment.wa.gov.au> or by telephoning (08) 9278 0300.

Western Australian Planning Commission 2000, *Bush Forever,* WAPC, Western Australia. Available via <www.wapc.wa.gov.au> or by telephoning (08) 9264 7777.

Department of Environment

SWAN RIVER TRUST

Swan-Canning Cleanup Program

APPENDIX B: LANDSCAPE DRAWINGS *(Urban Landscaping, 2007)*








Legend

- Street Trees
- Irrigated Turf
- Dry Grass
- Wetland revegetation
- Dryland revegetation
- Shrub and ground cover landscaping
- Access controlled fencing

Existing Jacaranda street trees extended along Burslem Drive verge

Bus Stop

Entry treatment

Irrigated Verge

3m

303 GROUP HOUSING

Playground

Orange & ornamental plum / pear grove

Turf

305 GROUP HOUSING

Covered seating area

Irrigated Verge

307 GROUP HOUSING

306 GROUP HOUSING

308 GROUP HOUSING

311 GROUP HOUSING

312 GROUP HOUSING

Existing river bank to be cleared of debris and weeds and revegetated using native species

Dry Grass

Wetland Revegetation

Turf

Ground cover and shrub mass planting to form a buffer to adjacent wetland revegetation

Lookout / Shelter with retaining walls and grassed terraces to lower levels

Boardwalk links over wetland

Dryland Revegetation

Turf

Proposed carpark

Entry landscape treatment to include decorative walls and signage with low planting

Heritage Development Site

Heritage House possible site for interpretative centre

Existing Pumphouse

Pathway defines edge of POS at crest of embankment

3m wide

Wetland Revegetation areas

Ground cover and shrub mass planting to enclose linear park and form buffer to adjacent bushland










0 10 20 30 40 50 60 70 80 90 100

Scale 1:1000

MADDINGTON ESTATE
LANDSCAPE SKETCH DESIGN

Golden Group

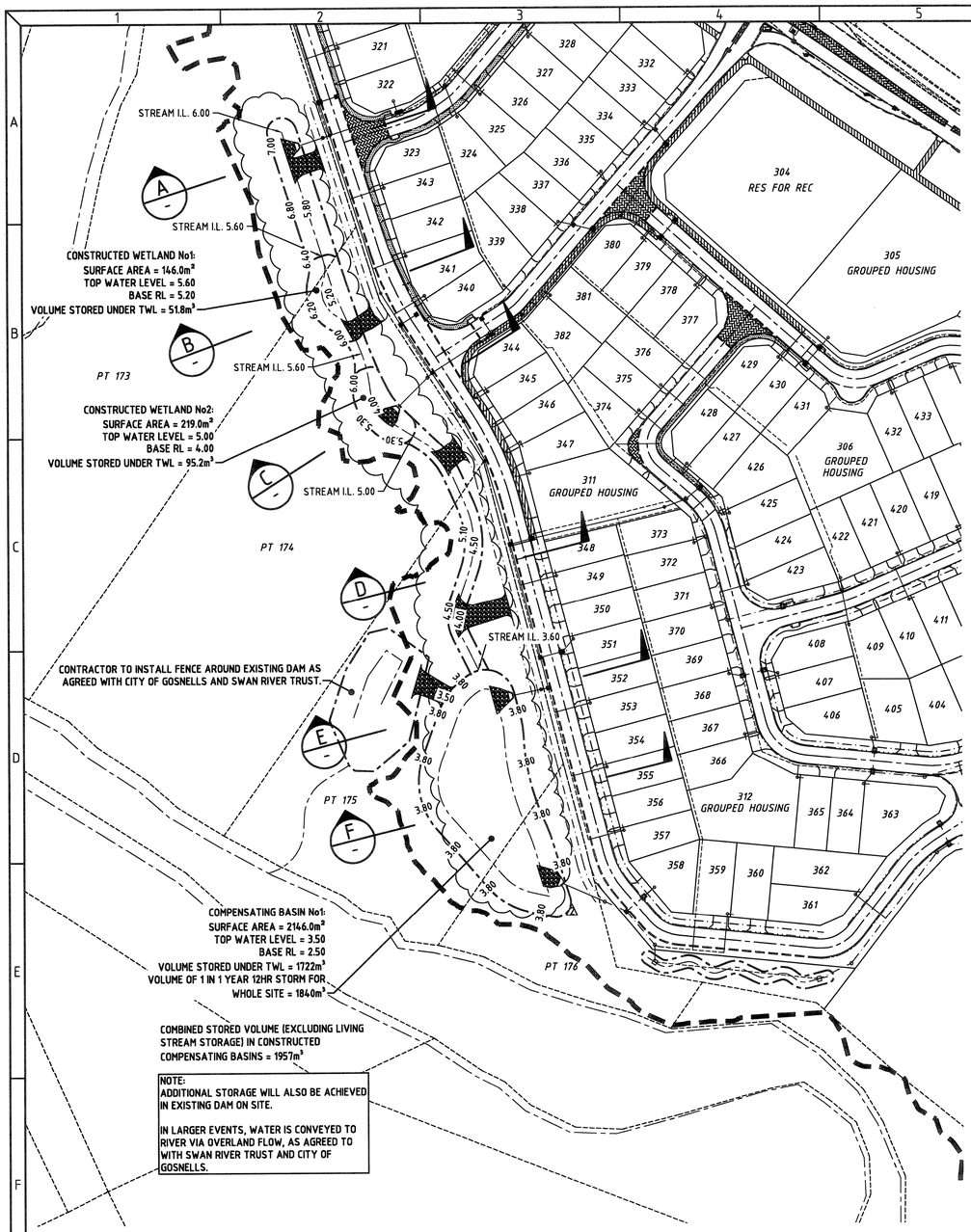
VAN DER MEER

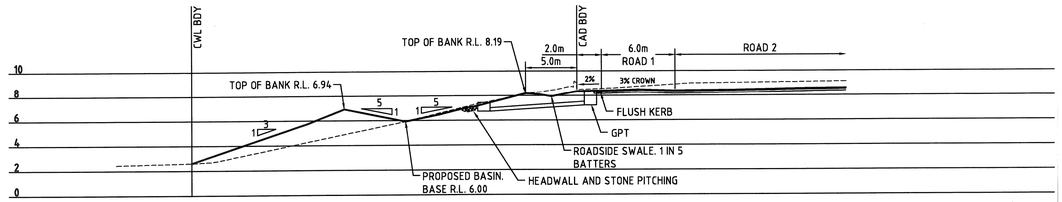
www.vandermeer.com.au

URBAN LANDSCAPING

BRINGING LAND TO LIFE, LIFE TO LAND

APPENDIX C: CIVIL DRAINAGE DRAWINGS *(EWING VDM, 2007)*





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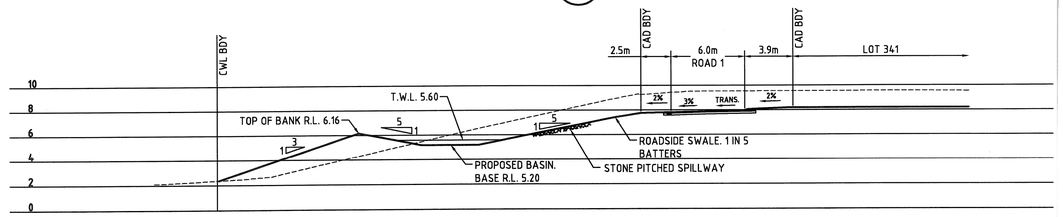

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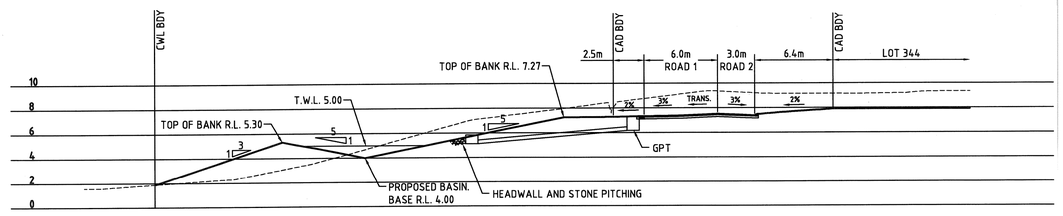

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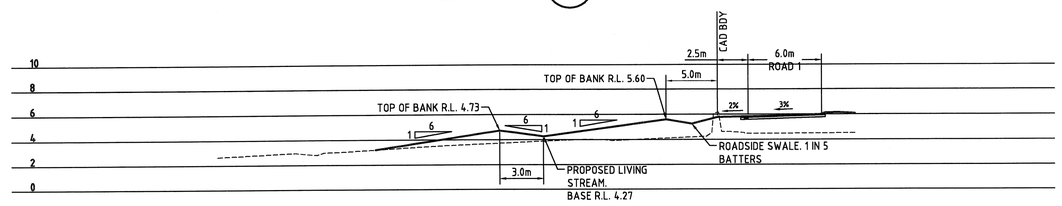

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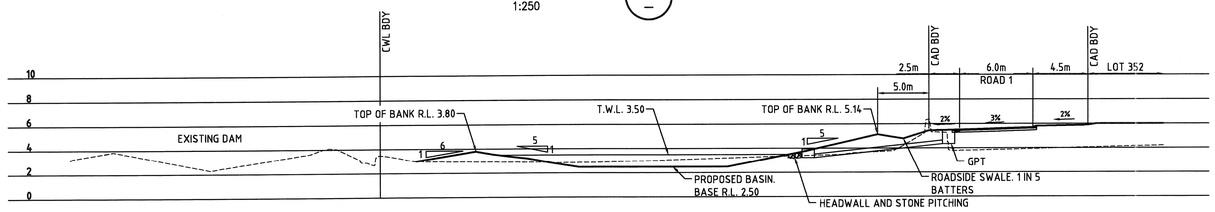

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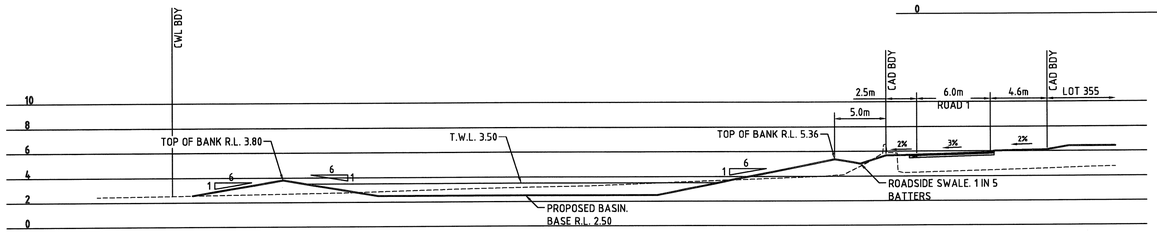

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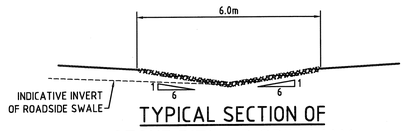
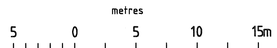


TYPICAL SECTION OF STONE PITCHED SPILLWAY



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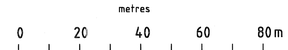

SCALE 1:1000

ISSUED FOR CONSTRUCTION

REFERENCE DRAWINGS:

REVISION:

No.	REVISION DESCRIPTION	DRAWN	CHECKED	APPROVED	DATE
2	DRAINAGE BASIN PLAN AND SECTIONS AMENDED	DA			12.12.07
1	DRAINAGE LAYOUT AMENDED	DA	CTB	CTB	10.07.07
0	ISSUED FOR CONSTRUCTION	DA	CTB	CTB	26.04.07
D	RE-ISSUED FOR COUNCIL APPROVAL	DA	CTB	CTB	02.03.07
C	AMENDED AS PER COUNCIL COMMENTS	DA	CTB	CTB	13.12.06
B	ISSUED FOR COUNCIL APPROVAL	JB	CTB	CTB	06.09.06
A	ISSUED FOR TENDER	CTB	–	–	02.08.06

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CONSULTING
VAN DER MEER & ASSOCIATES - A.C.N. 009 351 400
63 Burswood Road, Burswood W.A. 6100
Telephone: 61-8-6250 9900 Fax: 61-8-6250 9999

CLIENT: WELLINGTON PARKLAND PTY. LTD.

PROJECT: PT LOTS 173-177 (INC.) BURSLEM DRIVE - STAGE 1

DRAWING TITLE: FORESHORE DRAINAGE MANAGEMENT PLAN

ORIGINAL DRAWING SIZE: A1	SCALE: AS SHOWN
PROJECT LEADER: ENZO BIAGIONI-FROUDIST	DATUM: AHD
DESIGNER: CRAIG BENFIELD	WAPC No: 129247
DRAFTSPERSON: CRAIG BENFIELD	DATE: MARCH 2006
JOB No.: CE03-0090	DRAWING No.: C105 REVISION: 2

APPENDIX D: CLEANING & MAINTENANCE GUIDELINES FOR GROSS POLLUTANT TRAPS (GPT's)

SMARTSTREAM
TECHNOLOGY

CLEANING AND MAINTENANCE GUIDELINES

eco-*BITE* Multi Pollutant Traps (MPT's)

Introduction

Gross pollutants (litter and debris) in urban waterways are unattractive, disturb the physical habitat, degrade the water, attract pests and vermin, can cause marine animal deaths, and can promote littering and reduce amenity values.

(Extract from "From Roads To Rivers-Gross Pollutant Removal From Urban Waterways" Allison, Walker, Chiew, O'Neill, McMahon, May 1998.)

These guidelines have been prepared in accordance with the principles of Best Management Practice (BMP) as it relates to stormwater quality and is only applicable for eco-*BITE* MPT's.

The guidelines assume that the appropriate pollutant trap has been selected based upon the type of pollutants that the unit is expected to trap, and it is fit for the engineering and hydraulic requirements for the chosen location. (i.e. flow rates, pipe size, capacity, cover type etc.)

eco-*BITE* MPT's trap gross pollutants, sediments and hydrocarbons (refer to Glossary), before they enter a waterway, wetland, pond, or other stormwater treatment device, thereby preventing unsightly litter and pollutants entering these water bodies whilst also preserving capacity and pond / wetland shape.

eco-*BITE* MPT's concentrate litter at a single location for easy removal and are appropriate for greenfields sites and retrofitting into existing urban / rural residential and industrial areas.

The effectiveness of eco-*BITE* MPT's like any pollutant trap, is dependent to a large degree upon the cleaning and maintenance program put into place for each unit. The two primary characteristics that determine long-term effectiveness of a gross pollutant trapping system are the trapping efficiency and the maintenance program.

The trapping efficiency of any pollutant trap can be negatively impacted upon by lack of a regular cleaning and maintenance program specifically tailored to the particular requirements of the catchment area it is located in.

Gross pollutants are defined as material that would be retained by a five millimetre mesh screen.
Independent testing has proven that a range of pollutants including nutrients and hydrocarbons are also trapped due to their adherence to coarser trapped litter such as leaves and sticks and trapped sediments. Additionally, the vortex action attributable to the 'V' shaped solids in flow splitting nose piece causes sediments to be deposited in the base of the eco-*BITE* MPT.

Access & Cleaning Methods

LITTER TRAPS AND GROSS POLLUTANT TRAPS

Litter trapping devices require regular clearing of trapped material to minimise their impact on upstream hydraulics, especially during high flow periods, and to optimise capture of gross solids.

(Extract from "A Manual for Managing Urban Stormwater Quality in Western Australia" Water & Rivers Commission, August 1998)

eco-*BITE* MPT's are designed to be cleaned using vacuum eduction trucks.

In areas where accessibility for these trucks may be difficult due to poor surrounding ground conditions (i.e. waterlogged soils, spongy parklands etc.) the option of a removable stainless steel basket is available. Custom made units can be manufactured to suit.

Consideration needs to be given to these issues at the design stage and selection of appropriate unit and location. Units installed in roadside and car park locations should present little access difficulties, as opposed to units located away from hard pavement surfaces.

There may be a need to provide a purpose made hardstand and / or access road for allowing cleaning and maintenance vehicles to park adjacent to the MPT.

Access to the units is via one or more surface lids, which can be easily removed with appropriate lifting devices. Once removed these lids allow the eduction truck operator to insert the vacuum hose into the MPT to remove any trapped pollutants.

Care must be taken to ensure that the stainless steel screens are not damaged by the movement of the eduction hose inside chamber one.

Normally human access to the inside of eco-*BITE* MPT's is not required. If large blocking items are observed within the system, which need to be removed manually, normal safety precautions for working in a confined space should be observed. Maintenance personnel can use the peak flow bypass channel as a working platform if required. Deeper eco-*BITE* MPT's (i.e. greater than 3 metres) may require a portable ladder if access to base of the MPT is necessary.

Although eco-*BITE* MPT's feature unique non-blocking stainless steel screens, it is recommended that the screens are also visually inspected to ensure they don't become

clogged with algae or detritus. In the unlikely event that the screens require cleaning, they should preferably be jet cleaned with a high pressure hose. Alternatively a stiff bristled broom brushed back and forth across the surface is recommended to unclog the screens.

Cleaning and Inspection Frequency

MANAGING FIRST FLUSH POLLUTANTS

The first flush of pollutants conveyed by storm events during the early periods of autumn in the months of March and April has been identified as of significance and requiring special treatment.

(Extract from "A Manual for Managing Urban Stormwater Quality in Western Australia" Water & Rivers Commission, August 1998)

eco-*BITE* MPT's should be cleaned after the first flushing rains occur.

Cleaning frequency will depend upon the size and type of catchment area with pollutant types and volumes differing according to land-use categories.

For example a greenfields project in early stages of development would be expected to have a higher proportion of sediments, with a mature, well established residential land development expected to have a higher proportion of floatables, and in particular leaf litter.

An eco-*BITE* MPT servicing a commercial shopping centre would be expected to have a higher proportion of plastic bags and paper, whilst industrial areas would be expected to have a higher proportion of hydrocarbons.

The eco-*BITE* MPT should be inspected at practical completion, as there is a strong likelihood of heavy loads of sediment being deposited in the trap attributable to construction work in the surrounding site, particularly on sandy or clayey sites. Severe storm events that occur whilst the site is undergoing construction would also be expected to increase the volume of sediments entering the trap. If these inspections confirm that there is a significant build-up of sediment, a clean out should be programmed as soon as practicable prior to hand over.

Quarterly inspections of eco-*BITE* MPT's are recommended. Depending upon local conditions, more frequent inspections may be required.

Likewise, frequency of clean outs may vary depending upon local conditions and rainfall volume and frequency. As a maintenance program is implemented and a number of cleanouts have been carried out, which provide a track record of pollutant types and volume being trapped, it may be possible to alter the frequency of inspections and cleanouts accordingly, either more frequent or less frequent as the case may be.

Easy access from the surface for visual inspections is afforded by removal of the access covers with appropriate lifting equipment.

Dipsticks or a Surveyor's staff used in conjunction with a strong flashlight should provide for efficient visual assessment as to the volume of sediment build-up and hydrocarbons present on the water surface. Volumes of floatable litter will be readily apparent floating on the surface.

More detailed inspections can also be carried out using a sediment depth measurement device.

When the sediment depth has reached the bottom level of the stainless steel screens, and/or hydrocarbons are present in excess of 25mm in depth on the water surface, it is advisable to program an eduction clean out as soon as practicable.

CONCLUSIONS FROM STORM EVENT MONITORING

Observations from limited data suggest that:

- *Organic material (leaves and twigs) contribute at least two thirds of gross pollutants in all areas except light industrial areas where figures are inconclusive;*
- *There are higher amounts of litter (paper and plastics) transported from commercial areas than residential and light industrial areas;*
- *The composition of gross pollutants during events appears to remain relatively constant compared to the concentration and load fluctuations; and*
- *Gross pollutant concentrations are generally highest during early stages of runoff, but the most load is transported during times of high discharge*

GROSS POLLUTANT COMPOSITIONS AND LOADS

Data from the monitoring program indicate that urban areas contribute approximately 30 kilograms per hectare per year of dry gross pollutants to the stormwater system.

(Extracts from "From Roads To Rivers-Gross Pollutant Removal From Urban Waterways" Allison, Walker, Chiew, O'Neill, McMahon, May 1998.)

Disposal

Pollutants trapped in eco-*BITE* MPT's should be removed by a suitably qualified waste disposal company in accordance with local authorities' waste management requirements.

Large Scale Spills

In the event of a large scale spill of pollutant occurring, the eco-*BITE* MPT should be cleaned as soon as practicable after the surface clean up has been completed or if the trap is observed to be full. The appropriate authorities should also be notified in the case of a major spill occurring, with disposal effected using a licensed waste management company.

Glossary

Gross pollutants: *trash, litter and vegetation larger than five millimetres;*

Coarse sediment: *contaminant particles between 5 and 0.5 millimetres;*

Medium sediment: *contaminant particles between 0.5 and 0.062 millimetres;*

Fine sediments: *contaminant particles smaller than 0.062 millimetres;*

Attached pollutants: *those that are attached to fine sediments-specifically nutrients, heavy metals, toxicants, and hydrocarbons; and / or*

Dissolved pollutants: *typically, nutrients, metals and salts.*

~Taking the market by storm~

SMARTSTREAM
TECHNOLOGY

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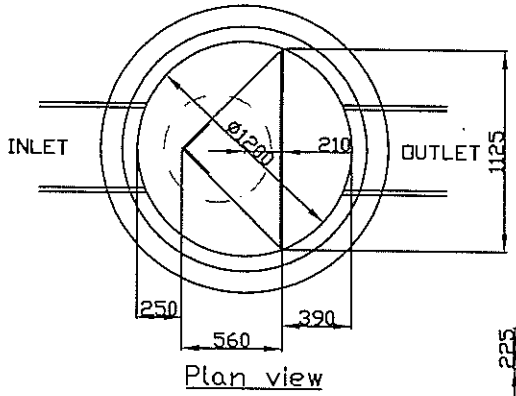
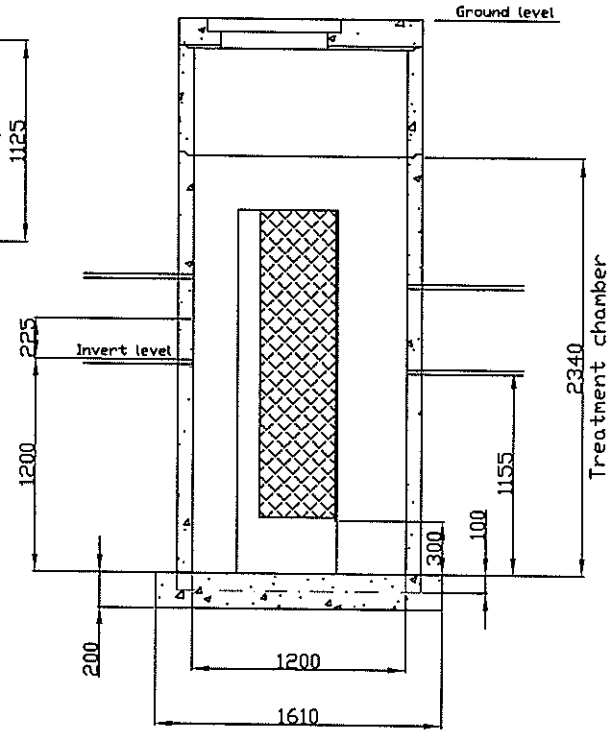
21-23 Eva Street, Maddington Western Australia 6109 Telephone +61 8 9493 2288 Facsimile +61 8 9493 2626
Email: office@wormall.com.au Website: www.wormall.com.au
Regional Office
Unit 4, 32 Sway Street, Coopers Plains Queensland 4108 Telephone +61 7 3274 2422 Facsimile +61 7 3274 2455
Email: officeQLD@wormall.com.au Website: www.wormall.com.au

Revised 07-04-04



Plan view



Side elevation

Settleable Solids Storage Volumes

Volume chamber 1 (upstream of screen) below invert of inlet		
Diameter of Treatment chamber =	1.2	Metres
Width of Hydrocarbon weir screen =	1.125	Metres
Distance of Hydrocarbon screen from centre of treatment chamber =	0.21	Metres
Distance bow nose screen from weir screen =	0.56	Metres
Depth between top of base and invert of Inlet =	1.2	Metres

Volume in cubic meters of settleable solids storage **0.594**

Volume of Chamber 1 and 2 between top of hydrocarbon weir screen opening but below invert of down stream outlet

Distance between invert of down stream invert and top of base =	1.155	Metres
Distance between top of base and top of opening in hydrocarbon weir screen =	0.3	Metres

0.692

Volume in Litres of Oil and Floatable orage Volume **692**

eco-BITE PRODUCTION SCHEDULE

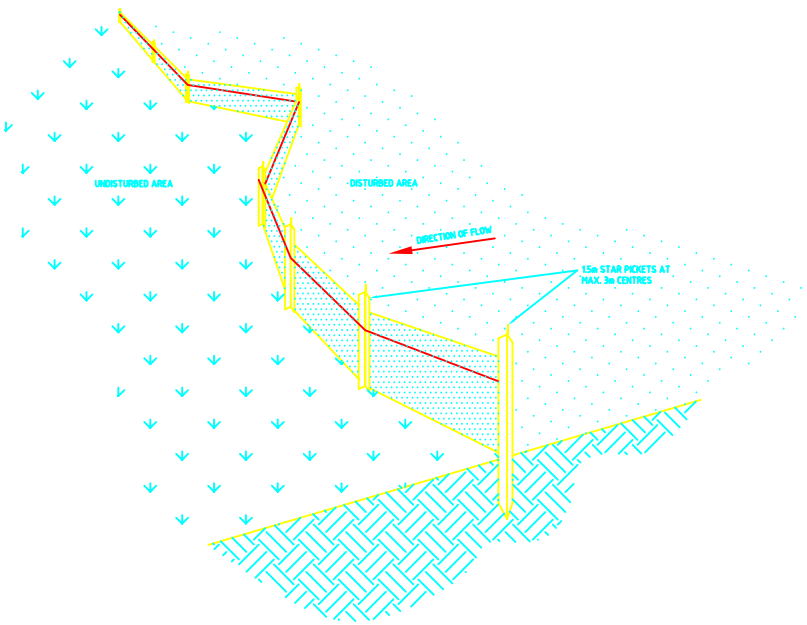
JOB No (ECO)	B0000-03
CONTRACT NAME/ADDRESS	Tender
CLIENT	City Council
REQUIRED DELIVERY DATE	TBA
DRAWING REVISION NUMBER	REV 0 16-07-2003
TANK SIZE (dia)	1200
GPT No	SITE A
GROUND LEVEL (A)	39.68
INVERT LEVEL OF INLET (B)	34.48
TOTAL PIT DEPTH	6940mm
INLET SIZE & TYPE	900 RCP
Manufacturer of Inlet/outlet Pipe/Class	
INVERT LEVEL OF OUTLET	
OUTLET SIZE & TYPE	
OUTLET ANGLE (CLOCKWISE FROM INLET)	180 deg.
TOP OF BASE TO INLET I.L.	1740mm
TOP OF BASE TO OUTLET I.L.	1650mm
No LINERS (including treatment chamber)	2
No OF SEALS	40 (5 rings)
HEIGHT OF TREATMENT CHAMBER (typ 2340mm)	1100mm
HEIGHT OF RISER 1	900mm
HEIGHT OF RISER 2	0mm
HEIGHT OF RISER 3	0mm
HEIGHT OF RISER 4	0mm
LADDER LENGTH (if required)	N/A
CONVERSION SLAB YES/NO	NO
CONVERSION RISERS (mm)	N/A
COVER LD/HD	HD SPECIAL

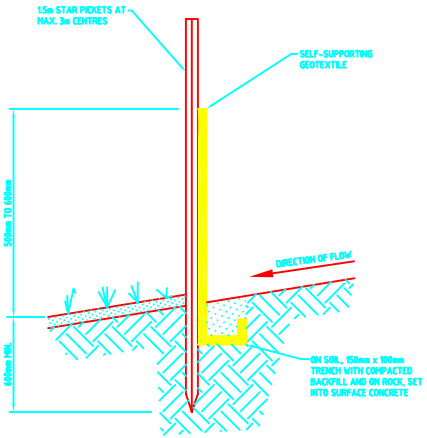
PRE-GALV		PRE-DISPATCH (TANK)	
TOTAL HEIGHT		INLET IL HEIGHT	
OPENING HEIGHT		OUTLET IL HEIGHT	
WIDTH ACROSS BACK		INLET HOLE dia	
ID WELDED		OUTLET HOLE dia	
SCREEN FAB BY:		CHAMBER dia	
SCREEN FITTED BY:		ANGLE BETWEEN HOLES	
TANK FAB BY:		LOGO MARKED	
CHECKED BY:		MASS MARKED	
SS Mesh FIXED BY			
BOLT CHECK BY			
WEI TE FITTED			

Drawn By: CD Checked By:SF
16.07.2006

Approved for Construction By Name:
Signature: Date:

APPENDIX E: SEDIMENT CONTROL FENCING





SECTION DETAIL

CONSTRUCTION NOTES:

1. CONSTRUCT SEDIMENT FENCE AS CLOSE AS POSSIBLE TO PARALLEL TO THE CONTOURS OF THE SITE.

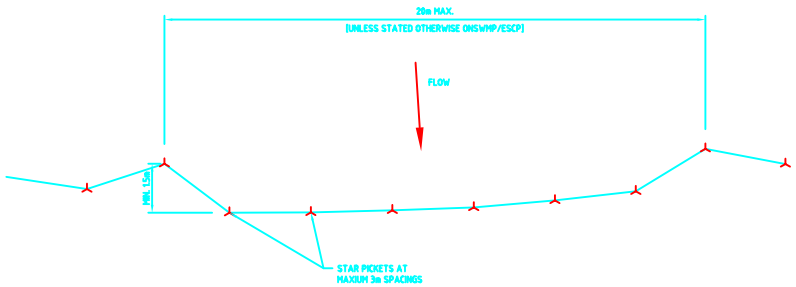
2. DRIVE 1.5 METRE LONG STAR PICKETS INTO GROUND, 3 METRES APART.

3. DIG A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.

4. BACKFILL TRENCH OVER BASE OF FABRIC.

5. FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEO-TEXILE MANUFACTURER.

6. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.



SEDIMENT FENCE PLAN

PRELIMINARY - NOT FOR CONSTRUCTION

REFERENCE DRAWINGS:

REVISION

DRAWING No.	DESCRIPTION	No.	REVISION DESCRIPTION	DRAWN	CHECKED	APPROVED	DATE
		A	ISSUED FOR REVIEW	LT			

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CONSULTING
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63 Burswood Road, Burswood W.A. 6100
Telephone: 61-8-6250 9900 Fax: 61-8-6250 9999

CLIENT: Golden Group

PROJECT: Lot 173-177 Burslem Drive Maddington

DRAWING TITLE: EROSION AND SEDIMENT CONTROL PLAN

ORIGINAL DRAWING SIZE: A1 SCALE: NOT TO SCALE

PROJECT LEADER: RHYS HOULIHAN DATUM:

DESIGNER: LEIGH TREVASKUS VAPC No:

DRAFTSPERSON: LEIGH TREVASKUS DATE: MAY 2006

JOB No.: E6036 DRAWING No.: C101 REVISION: A

APPENDIX F: COMPLAINTS REGISTER

WELLINGTON PARKLANDS LOTS 173-177 BURSLEM DRIVE, MADDINGTON COMPLAINTS REGISTER
For the recording of any complaint pertaining to construction and the environment.

Date:	**Time:**
Name and Contact Details of Complainant: ……	
Details of Complaint:…… …… … …… …	
Action Taken:…… …… …	
Responsible Person:	
Resolution/Notes:	
Site Manager:	**Date:**

Date:	**Time:**
Name and Contact Details of Complainant: ……	
Details of Complaint:…… …… ……	
Action Taken:…… ……	
Responsible Person:	
Resolution/Notes:	
Site Manager:	**Date:**

Date:	**Time:**
Name and Contact Details of Complainant: ……	
Details of Complaint:…… …… ……	
Action Taken:…… ……	
Responsible Person:	
Resolution/Notes:	
Site Manager:	**Date:**

Appendix 3
CIVIL ENGINEERING

JDSi CONSULTING ENGINEERS

Certified System Quality ISO 9001 SAI GLOBAL

P: 08 9227 0595
F: 08 9227 8617
Workzone,
Level 6, 1 Nash Street,
Perth WA 6000
PO Box 8523
Perth BC WA 6849
ABN 67 138 876 203
jdsi.com.au

01 October 2015 **JDSi Reference:** JDS15849

Mr Ricky Wijaya
Golden Group
236 Adelaide Terrace
Perth WA 6000

RE: LOT 9002 PANOZZA CIRCLE MADDINGTON (HERITAGE SITE)

Dear Mr Wijaya,

This letter report presents a summary of the civil engineering concept for the heritage site. This report has been prepared in aid of the development application for the first phase of development.

1.1 Earthworks

The existing ground levels at the heritage site are elevated relative to the proposed verge levels of the adjacent road reserve. A maximum level difference of 1.2m has been determined, at the northern corner of the site. As part of the adjacent residential development, battering into the heritage site is proposed due to potential exposure of the public to unsafe (near vertical) batter slopes (refer to Figure 1). Batters are typically 1:6 (V:H), with localised steepened batters of up to 1:2 (V:H) in proximity to the former kitchen.

Figure 1 – Existing batter slopes.

Lowering of the buildings on site is understood to be problematic due to the heritage nature of these buildings. The level differences between the verge and buildings will therefore need to be addressed by:

- **Grading finished surface levels.** However, given the proposed predominant land use of car parking between the verge and heritage buildings where gradients are steepest, in conjunction with limitations on maximum gradients permissible for car parking, the capacity for grading out level differences is limited. Consideration will need to be given to the use of retaining walls.

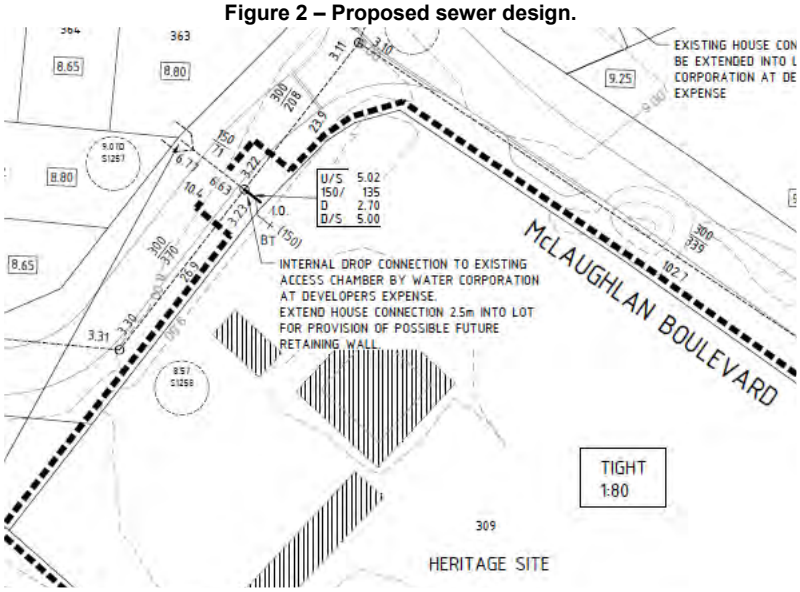
- **Construction of retaining walls.** The use of retaining walls in proximity to the existing buildings is limited by the requirement to construct footings for the retaining walls and excavation for the footings, which may result in undermining of the buildings. Retaining walls, if adopted, are therefore likely required to be located along the boundary of the lot.

1.2 Sewer

The Water Corporation owns and maintains the existing sewerage reticulation system servicing the area. The proposed sewer connection point for the development site has been designed in consultation with the Corporation.

The proposed sewer service for the site comprises a DN150 junction with a boundary trap, located at the Kawana Avenue interface. This will connect to the existing DN300 gravity sewer adjacent to the site via a DN150 IO sewer to existing access chamber S1257 with an internal drop connection, in accordance with discussions with Water Corporation. Figure 2 shows a plan of the proposed sewer.

Figure 2 – Proposed sewer design.

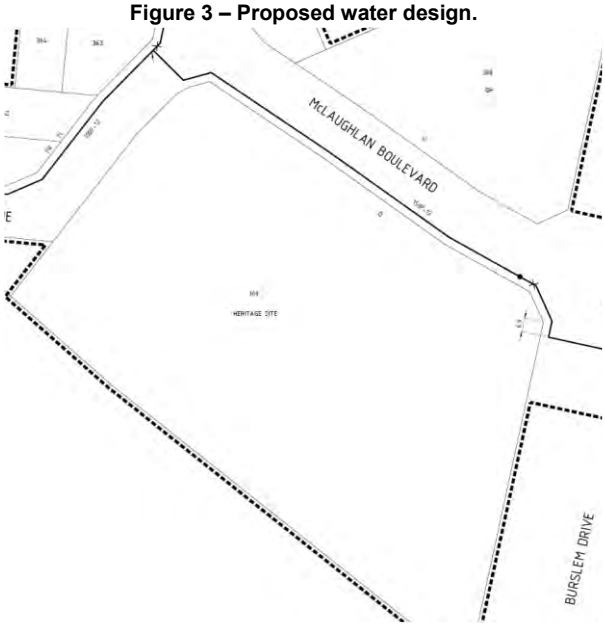


The existing northern access chamber at Kawana Avenue was selected for connection for ease of routing sewer services for future buildings on the heritage site (minimising bends). A tight 1:80 gradient across the site has been noted to service future buildings due to the potential length of run of sewer pipework for these buildings.

1.3 Water

The Water Corporation owns and maintains the water reticulation system in the area. The proposed water reticulation system servicing the adjacent residential development comprises a DN150 watermains within the verge of the heritage site along McLaughlan Boulevard. A direct connection off the watermains is expected to be adequate for the proposed development. Figure 3 shows a plan of the proposed water design.

Figure 3 – Proposed water design.



1.4 Power Supply

Western Power owns and maintains the power distribution and reticulation assets in the area. The proposed underground power reticulation system servicing the adjacent residential development will include provision of a uni-pillar for the heritage site. The capacity of the transformer on lot 307 is 315kVA, with approximately 100kVA expected to be available for the heritage site, subject to no additional loading from residential customers. Expected loads from the initial phase of the heritage site are estimated to be 75kVA (based on AS3000) and hence adequate capacity will be available for initial development of the site.

Subsequent phases of development may necessitate upgrading of the existing transformer and the surrounding Western Power network supporting the site. Alternatively, a new transformer may be installed on the heritage site.

1.5 Gas

The adjacent residential development is expected to include the extension of ATCO Gas' existing medium pressure gas network along Kawana Ave and McLaughlan Boulevard. ATCO Gas have been requested to provide a design for gas reticulation of the residential development. Additionally, there is a medium pressure gas line located along Burslem Drive, which may potentially also service the site.

1.6 Telecommunications

Information provided by Telstra indicates that the heritage site is serviced by existing infrastructure owned and operated by Telstra, with the connection point at the intersection between McLaughlan Boulevard and Burslem Drive (refer to Figure 4).

Figure 4 – Existing Telstra infrastructure.

1.7 Drainage

The storm water drainage for the development area will need to be designed and constructed in accordance with City of Gosnells' engineering guidelines and the existing Drainage and Nutrient Management Plan for the catchment.

Based on discussions with the City of Gosnells, flows would need to be detained on site utilising a combination of subsurface storage units and overland storage. The volume of flow required to be detained would be equivalent to the 100 year average recurrence interval 5 minute duration event. Flows exceeding the design storm capacity would be discharged from site by overland flow. Restricted piped discharge to the drainage network servicing the adjacent residential development will be required.

Detailed design of the storm water system and further consultation with Council is required in order to establish definitive details on storm water drainage, due to various factors including the complexity of the site and age of the existing drainage management plan.

1.8 Closure

We trust the information provided adequately addresses the aspects of civil services required. If additional information is required, please do not hesitate to contact the undersigned.

Regards

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