Lot 51 Porongurup Road, Mt Barker Structure Plan

PART ONE: IMPLEMENTATION

May 2018
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ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the Shire of Plantagenet Local Planning Scheme No. 3.

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

7 June 2018

Signed for and on behalf of the Western Australian Planning Commission:

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

Witness

8 June 2018 Date

7 June 2028 Date of Expiry

TABLE OF AMENDMENTS

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

Local Structure Plan

Part One – Implementation

Lot 51 Porongurup Road, Mount Barker

March 2018

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1. PROPOSAL

This Structure Plan seeks to facilitate the subdivision of the site into 44 rural residential lots, which would support equestrian activities. The existing 31 lots at the eastern part of the site all remain but will be converted from strata to freehold.

The proposal represents the highest and best use of a former bluegum plantation that is no longer required for use for that purpose. The site is relatively unencumbered and is located in close proximity to the Mount Barker townsite, community services and infrastructure and it is for this reason that the Shire's Local Planning Strategy identifies it as a suitable site for rural residential subdivision to support equestrian themed lifestyle lots.

Refer to Plan 1 - Structure Plan.

Key components of the Structure Plan are described in further detail.

1.1 Structure Plan Area

This Structure Plan relates to Lot 51 Porongurup Road, Mt Barker and existing 31 strata lots as identified on Plan 1 – Structure Plan.

1.2 Land Use

The proposed rural residential lots are intended to cater for lifestyle lots to accommodate a single house alongside equestrian uses such as horse stable and paddocks for grazing of a horse/s. Stocking rates would be in accordance with the requirements of the Department of Agriculture.

Other uses that may be supported on the site include 'Home Occupation', 'Home Business', 'Bed and Breakfast' and 'Cottage Industry'. These uses are deemed to be complimentary uses and would permit a landowner to run a small residential scale business from their property, should they seek this opportunity.

1.3 Movement Network

The proposed Structure Plan will rely on the upgrade of Sounnes Street and Ormond Road to sealed standard to facilitate access to the new rural residential lots.

Access for six of the proposed rural residential lots (Lots 21, 22, 35, 34, 33 and 37) as proposed on the Structure Plan will rely on access onto Porongurup Road. In this regard, it is respectfully requested that Council write to Main Roads WA to request that the posted speed limit on this section of Porongurup Road be reduced from 110km/h to 80km/h in order to maintain the safety for all road users.

This is considered a reasonable request as the subdivision of the subject site effectively represents an extension to the Mount Barker townsite.

With respect to the internal road layout of the proposed subdivision, it is proposed to retain the general formation of the existing strata lot arrangement with the exception of creating an additional local road linkage which will improve the connectivity between the existing estate, which is currently serviced by a cul-de-sac arrangement, and the new subdivision estate. This will improve accessibility for these existing landowners in the event of a bushfire by providing more than one exit.

The internal roads are proposed to be contained within 15 metre wide road reserves and will be constructed to a sealed standard. This is sufficient width to accommodate the carriageway, underground reticulated services and drainage infrastructure. Alongside the road reserve it is proposed to create a network of bridle trails to be located on private property within a reciprocal rights of access easement. A cross section of this proposed arrangement is provided below.

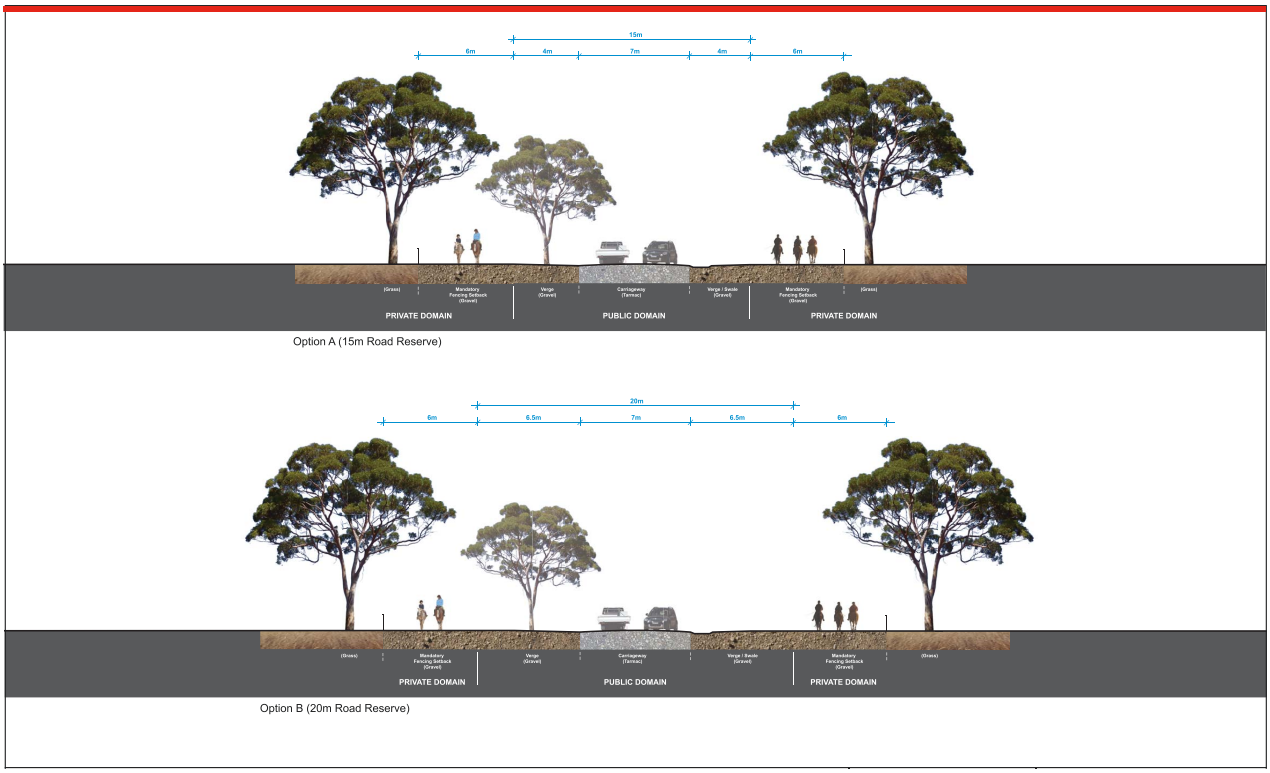

Figure 1 – Cross Section of Typical Road Reserve

Bridle trails would be managed by a management committee that would be established as a condition of subdivision approval. This management committee would be responsible for ongoing maintenance of the bridle trails.

1.4 Termination of the Existing Strata Plan

As part of delivery of the overall subdivision envisaged by the Structure Plan, the existing strata plan is proposed to be terminated pursuant to Section 30 of the *Strata Titles Act 1985* in order to allow for the common property associated with the former bluegum plantation area to be excised from the strata title lots as a separate green title lot. The strata lot boundaries relating to the existing 31 strata lots are to be retained in their current configuration.

2. JUSTIFICATION

The proposed scheme amendment and Structure Plan is supported by the following investigations:

1. Local Water Management Strategy;
2. Vegetation Assessment;
3. Land Capability Assessment;
4. Fire Management Plan; and
5. Discussion on Land Use Buffer Requirements.

These investigations are summarised further below.

2.1 Local Water Management Strategy

Typically a Local Water Management Strategy (LWMS) is guided by the principles and requirements of an overarching District Water Management Strategy (DWMS). However, a DWMS does not exist for the Mount Barker district. The LWMS has been prepared at the request of the Shire of Plantagenet to inform this scheme amendment and Structure Plan. The LWMS provides baseline data for groundwater levels, strategies for efficient use of potable and non-potable water and a detailed examination of the proposed approach to effluent disposal and managing storm water at the site.

The primary design elements recommended by the LWMS are summarised as follows:

1. Installation of rainwater tanks (92,000L for domestic water supply and 50,000L for supplementary uses (stock watering, orchards, firefighting and gardens));
2. Effluent treatment will occur on site as reticulated sewer is not available. Site conditions indicate that conventional septic tanks will not be suitable and that alternative systems capable of removing phosphorus, (approved by the Department of Health) will be required to adequately treat waste water;
3. Due to relatively large lot sizes proposed (in excess of 1ha), water from storm events will be retained on individual lots for 1 year annual recurrence interval (ARI) events;
4. Treatment of stormwater from the road system generated in 1 year ARI events will be achieved through the use of side entry pits, swales and detention basins in the road reserves and/or drainage reserves. Treatments are subject to detailed design;
5. Swales and basins will also be incorporated into the road and drainage reserves to detain and treat high flows (exceeding 1 year ARI);
6. Infrastructure will be designed to promote diffuse flow of water from roads to road reserves and adjacent areas, reduce pipework and prevent erosion;
7. Management of 5 year ARI events to the Shire of Plantagenet's requirements will be achieved using pipework and temporary detention to attenuate stormwater flows prior to discharge from the site;
8. 100 year ARI flood events will be routed through the road network and detained in structures in the road and drainage reserve network;
9. As there is not likely to be any incoming surface water flow from upstream of the subject land, no offline treatment is necessary; and
10. Water leaving the site will be treated in a suitably sized basin prior to discharge.

Refer to Appendix A – Local Water Management Strategy

2.2 Vegetation Assessment

A Vegetation Assessment has been prepared by Aurora Environmental to support this scheme amendment and Structure Plan. A representative from Aurora Environmental undertook an inspection of the site on the 22 November 2013 to determine the value of remnant vegetation remaining on the site. It was observed that the site is substantially cleared with a few pockets of remnant vegetation remaining.

The Vegetation Assessment has found that most of the pockets of vegetation are degraded, with one pocket of vegetation located in the central northern portion of the site being of good condition.

It is proposed to retain and require the ongoing protection of the pocket of vegetation identified as being in good condition. The Scheme Amendment proposes the following development provisions within Schedule 5 of the Scheme to ensure protection:

"6.1 No clearing of vegetation shall occur except for:

a) Clearing to comply with the requirements of the Bush Fires Act 1954 (as amended) and the Shire of Plantagenet Annual Fire Break Notice;

b) Clearing required to establish a low fuel buffer;

c) Clearing that may reasonably be required to construct an approved building and cartilage;

d) Clearing to gain vehicular access to a dwelling approved by the Council;

e) Trees that are dead, diseased or dangerous;

f) Removal of woody weeds or blue gum plantation."

"6.2 Vegetation within the area identified as 'Conservation Area' on the subdivision Guide Plan shall not be cleared or removed without the prior written consent of the Council."

"6.3 The owner shall be responsible for the construction and maintenance of stock proof fencing to protect remnant vegetation and areas identified for 'Conservation' on the Subdivision Guide Plan."

It is recommended that native vegetation, paddock trees and other planted vegetation be retained on site, where possible. Implementation of the following provisions will assist in protecting the values of vegetation:

- Protect vegetation and paddock trees from livestock by fencing;
- Reduce clearing of vegetation by ensuring adequate separation distances to dwellings and outbuildings through establishment of building envelopes;
- Reduce the incidence of property boundaries/ fencelines cutting through native vegetation; and
- Delineate property boundaries in native vegetation using marker pegs rather than fencing.

If revegetation works are undertaken on the site, preference should be given to planting of local native species. This will build on the values of existing native vegetation for flora and fauna, while improving local amenity.

Should the development require the clearing of native vegetation, it is recommended that consideration be given to the need for a clearing permit under Part V the *Environmental Protection Act 1986* or referral to the Commonwealth Department of the Environment under the *Environment Protection and Biodiversity Conservation Act 1999*.

Retention of habitat trees (Jarrah and Marri) with a diameter of greater than 50cm to be retained. Qualified environmental assessor to diagnose (for hollows for nesting) before any tree removal.

At the time of subdivision property boundaries and fence lines cutting through native vegetation to be delineated with marker pegs/bollards.

The vegetation assessment is contained at Appendix B.

2.3 Land Capability

Identification of soil and landform types and on-site investigations for the subject land have been undertaken so land capability can be assessed as per the requirements of the guidelines for Land Capability Assessment (WAPC, 1989) for the proposed rural residential land use.

The land capability assessment has found that the subject land is capable of supporting rural residential development, with consideration given to the location of building envelopes and to the location and type of on-site effluent disposal systems. This capability is enhanced because of the large lot sizes which are proposed (1 to 2 ha) and the ability to utilise approved alternative effluent disposal systems.

Late winter site testing of winter groundwater levels required as part of any development proposals.

2.4 Fire Management Plan

FirePlan WA have been engaged to prepare a Fire Management Plan which aims to reduce the occurrence of and minimize the impact of bush fires thereby reducing the threat to residents, adjoining landowners, fire fighters and the environment in relation to the proposed Structure Plan.

The Fire Management Plan includes a Bushfire Hazard Assessment of the subject site. The Assessment identifies areas of 'Extreme' bushfire hazard for the blue gum plantation to the north of the subject site and the area of blue gum plantation located within the subject site.

Existing remnant vegetation located in the eastern portion of the site has been categorised as 'Extreme' bushfire hazard. The majority of the subject site is cleared and has been categorized as 'Low' bushfire hazard.

A summary of some of the key responsibilities identified by the plan to manage risk of bush fire is provided below.

Property Owner's Responsibilities

- Maintain internal firebreaks clear of flammable material on their property. Maintain in good order and condition all property fencing and gates ensuring that vegetation does not encroach over the firebreak.
- Ensure all dwellings have Building Protection Zones, Hazard Separation Zones, Hazard Reduction. Planting of trees/shrubs and re-vegetation are implemented and maintained as detailed in the Fire Management Plan.
- The area identified as 'Conservation Area' on the Fire Management Plan shall be fenced and retained within the lot and adequate separation to the bushfire hazard shall be achieved through siting dwellings located within the nominated building envelopes.
- Owners of land that include areas identified as 'Bushland to meet fire and environmental management requirements' on the Fire Management Plan shall ensure that identified 'habitat trees' are suitably retained and protected. Understorey vegetation and non-habitat trees may be cleared to reduce the fuel loading and BAL rating.
- Bluegum plantation may be cleared to reduce or remove the threat of bushfire as a result of the bluegums.
- Dwellings are constructed to AS 3959.

Developers Responsibilities

- Lodging a Section 70A 'Notification' on each Certificate of Title proposed by this subdivision. The Notification shall alert purchasers of land and successors in Title of the responsibilities of this Fire Management Plan.
- Construct and fill the three (50,000L) fire tanks in accordance with the Structure Plan on land to be ceded to the Shire of Plantagenet or created as part of the road reserve.
- Construct all internal roads to the required standards.
- Construction of Emergency Accessways, internal firebreaks and install gates as detailed within the Fire Management Plan.
- Planting of trees and vegetation as detailed in the Fire Management Plan.

Shire of Plantagenet Responsibilities

The responsibility for compliance with the law rests with individual property owners and occupiers and the following conditions are not intended to unnecessarily transfer some of the responsibilities to the Shire of Plantagenet. In developing and maintaining District Fire Fighting Facilities, the Shire of Plantagenet shall be responsible for the following:

- Provide advice on appropriate techniques to achieve bush fire hazard reduction for individual properties.
- Maintaining in good order the condition of the water tanks and the apparatus for firefighting purposes; and the tanks are maintained full at all times.
- Ensure that dwellings are designed to the appropriate AS 3959 BAL rating at the Building permit application stage.
- Ensure revegetation design is carried out in accordance with the Fire Management Plan.

The Fire Management Plan is contained at Appendix C.

2.5 Buffer Requirements

2.5.1 Rifle Range and Speedway

The Environmental Protection Authority (EPA) has prepared the document Guidance for the Assessment of Environmental Factors: Separation Distances between Industrial and Sensitive Land Uses to establish generic buffer requirements for specific land uses.

There are a number of land uses that have the potential to generate omissions (noise) in relation to the subject site, including a rifle range and speedway, which are located to the south of the site. The document does not specify a generic buffer distance to rifle ranges, however in relation to 'Raceways for motor vehicles', the document specifies that buffers are to be determined on a case by case basis.

Additionally, the document does not specify a generic buffer distance for rifle ranges. The Speedway typically runs events on a Saturday on a monthly basis and the gun club also operates on an infrequent basis. The noise generated by these premises will therefore be on an

infrequent basis and it is considered that rather than imposing a buffer to restrict dwellings within proximity to these premises that a Section 70A notification be placed on titles located within 1 kilometre of either venue, which will notify prospective purchasers of the proximity of these and potential for infrequent nuisance due to noise generated from the premises. Therefore, it is proposed to include the following provision within Schedule 5 of this proposed amendment:

"Council will request the Commission impose a condition at the time of subdivision requiring the placement of a notification on the titles of lots in accordance with S165 of the Planning and development Act 2005, notifying land owners of the existence of the active speedway to the south of the land; the potential for infrequent nuisance of noise as a result of speedway activities; and development on the lot may require inclusion of noise mitigation measures."

And;

"At the time of lodgement of a subdivision or development application of lots as identified on the approved Structure Plan, the proponent shall submit a suitable Speedway Noise Management Plan in accordance with the Environmental Protection Act 1986, in consultation with the local government and Mount Barker Speedway Club Inc."

In addition, building envelopes for proposed Lots 21 to 23 have been identified on the SGP and are located at the northern end of the lots to ensure maximum separation to the speedway and gun club.

Refer to the Acoustic Report contained at Appendix D.

2.5.2 Separation distances for horse stables

The Shire's Health Local Law specifies that horse stables must be located a minimum of 30 metres from a dwelling. The (then) Waters and Rivers Commission has also released a document entitled Environmental Guidelines for Horse Facilities and Activities in December 2012, which contained the following additional separation guidelines:

1. *200 metres from the boundary of wetlands, lakes and estuarine dependent vegetation, determined by soil type, wetland category and management practices used to minimize pollution risk;*
2. *30 metres from private water supply wells and farm dams;*
3. *30 metres from the banks of permanent and ephemeral streams and rivers which have a slope less than 1 in 4, and 50 metres for streams and rivers whose banks have slopes greater than 1 in 4;*
4. *1.2 metres above the highest annual groundwater table level. A sand pad may be used to increase the distance from the groundwater table provided it is acceptable to the local government authority, and it is not located where stormwater runoff can erode the pad; and*
5. *The minimum distance from residences, as required by local authorities (usually 30 metres).*

The subject site contains a number of farm dams and consideration also needs to be given to the requirement for separation distances to the groundwater. It is therefore proposed to include the following development provision within Schedule 5 relating to the land:

- *"Horse stables and yards must be located a minimum distance of 30 metres from any dwelling or dam".*
- *"The finished floor level for horse stables must be located at least 1.2 metres above the highest annual groundwater table level. A sand pad may be used to increase the distance from the groundwater table provided it is acceptable to the local government authority, and it is not located where stormwater runoff can erode the pad".*

There are no identified water courses within proximity of the subject site that would require consideration in sighting horse stables on the land. However it is noted that the groundwater level is typically high in relation to the ground levels on the western portion of the site. Therefore consideration may need to be given to raising the pad associated with future horse stables in the western portion of the subject site.

3. CONCLUSION

This request to initiate a Scheme Amendment to the Shire of Plantagenet Town Planning Scheme No. 3 seeks to rezone Lot 51 Porongurup Road, Mount Barker from 'Special Site' to 'Rural Residential' in line with the recommendations of the Shire's Local Planning Strategy. This Scheme Amendment is supported by a planning assessment of the site, a local water management strategy, vegetation assessment, land capability assessment and fire management plan, which combined demonstrate how the subject site can be subdivided in accordance with the Structure Plan.

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Plan 1

Structure Plan

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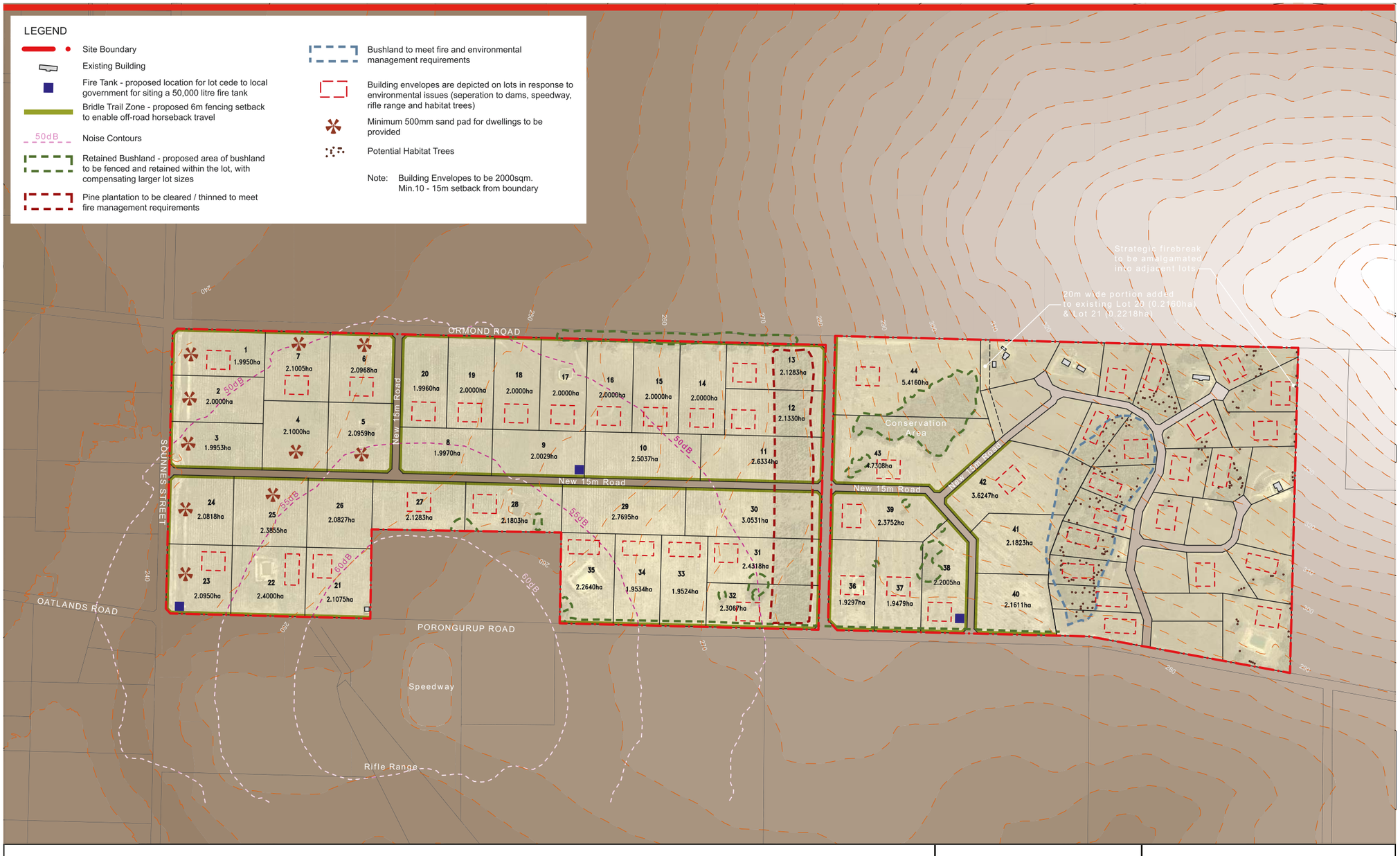
PLAN 1 - STRUCTURE PLAN



Structure Plan

Lot 51 Porongurup Road, Mount Barker

0 75 150m

Project Manager: MD Date: 7 March 2018
Drawn: OP Scale: 1:7,500 @ A3
Checked: MD Drawing No. 714-046 CP 1 A

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Appendix A

Local Water Management Strategy

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LOCAL WATER MANAGEMENT STRATEGY
LOT 51 PORONGURUP ROAD
MOUNT BARKER, WA

Prepared For:	Hambley Farm Landowners
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Report Number:	AA2013-018
Report Version:	Version 3
Report Date:	6 July 2015

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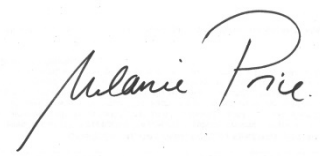
Author:	Melanie Price Associate Environmental Scientist		6 July 2015
		Signature	Date
Reviewed by:	Paul Zuvela Manager Environmental Impact Assessment		6 July 2015
		Signature	Date

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HAM2013-001-REPT_001_mp_V1	Version 1	14 February 2014	Hambley Farm Landowners	pdf
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HAM2013_001_REPT_001_mp_V3.docx	Version 3	6 July 2015	Hambley Farm Landowners Shire of Plantagenet The Planning Group	pdf

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LIST OF ABBREVIATIONS

AHD	Australian Height Datum
ARI	Annual Recurrence Interval
ASS	Acid Sulfate Soils
BGL	Below Ground Level
BOM	Bureau of Meteorology
^{o}C	Degrees Centigrade
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DLR	Design Loading Rate
DoH	Department of Health
DoW	Department of Water
FAWB	Facility for Advancing Water Biofiltration, Monash University
ha	Hectare
km	Kilometres
KSAT	Permeability Coefficient
L	Litre
LWMS	Local Water Management Strategy
m^2	Square metre
Mg/L	Milligrams per Litre
mm	Millimetre
POS	Public Open Space
PRI	Phosphorus Retention Index
PVC	Polyvinyl Chloride
SPP	Statement of Planning Policy
TPS	Town Planning Scheme
WAPC	Western Australian Planning Commission
WELS	Water Efficiency Labelling Standards
WSUD	Water Sensitive Urban Design

EXECUTIVE SUMMARY

This Local Water Management Strategy (LWMS) has been prepared for the landowners of Hambley Farm and summarises the attributes of the study area which comprises Lot 51 Porongurup Road, Mount Barker, with respect to water resource management (Figures 1 and 2). The 143.37ha lot is zoned 'Special Site R12' under the Shire of Plantagenet Town Planning Scheme No. 3 (Figure 3).

No regional or district water management plans exist for the Mount Barker area. This LWMS has been prepared as requested by the Shire of Plantagenet and Department of Water during the scheme amendment request process to guide the planning and implementation of sustainable water management measures during development of the subject land.

It is proposed to develop Lot 51 as rural residential lots. Subdivision design for the property incorporates the objectives of the Western Australian Planning Commission's (WAPC) Better Urban Water Management (2008a) as summarised in Table A.

The design elements summarised in this LWMS include:

- Installation of rainwater tanks (92,000L for domestic water supply and 50,000L for supplementary uses (stock watering, orchards, firefighting and gardens));
- Effluent treatment will occur on site as reticulated sewer is not available. Site conditions indicate that conventional septic tanks will not be suitable and that alternative systems capable of removing phosphorus, approved by the Department of Health will be required to adequately treat waste water;
- Due to relatively large lot sizes proposed (in excess of 1ha), water from storm events will be retained on individual lots for 1 year annual recurrence interval (ARI) events;
- Treatment of stormwater from the road system generated in 1 year ARI events will be achieved through the use of swales and treatment zones in the road reserves. Treatments are subject to detailed design;
- Infrastructure will be designed to promote diffuse flow of water from roads to road reserves and adjacent areas, reduce pipework and prevent erosion;
- Management of 5 year ARI events to the Shire of Plantagenet's requirements will be achieved using open swales to attenuate and transport stormwater flows prior to discharge from the site;
- 100 year ARI flood events will be routed through the road network and detained in swales in the road reserve network;
- As there is not likely to be any incoming surface water flow from upstream of the subject land, no offline treatment is necessary; and
- Water leaving the site will be treated in treatment zones (swales) prior to discharge.

TABLE A: LOCAL WATER MANAGEMENT STRATEGY CHECKLIST

LOCAL WATER MANAGEMENT STRATEGY ITEM	DELIVERABLE	INCLUDED Y/N	NOTES
EXECUTIVE SUMMARY			
Executive Summary: Summary of the development design strategy, outlining how the design objectives are proposed to be met	Design elements and requirements for the best management practices and critical control points	Y	Executive Summary
INTRODUCTION			
Total water-cycle management - principles and objectives Planning background Previous studies		Y	Section 1
PROPOSED DEVELOPMENT			
Conceptual subdivision plan, zoning and land use. Key landscape features. Previous land use	Conceptual subdivision plan to be based on this LWMS. Key landscape features identified.	Y	Section 2. Figures 1 - 6
Landscape - proposed public open space (POS) areas, public open space credits, water source, bore(s), irrigation areas (if applicable)	POS not required for Rural Residential development. Landscaping of road and drainage reserves addressed.	Y	Section 4.8
DESIGN CRITERIA			
Agreed design objectives and source of objectives		Y	Section 5.5
PRE-DEVELOPMENT ENVIRONMENT			
Existing information and more detailed assessment (monitoring). How do the site characteristics affect the design?	Ground and surface water monitoring undertaken.	Y	Section 2 and 3
Site conditions - existing topography/contours, aerial photo underlay, major physical features	Site conditions plan	Y	Section 2; Figures 1 to 6
Geotechnical- topography, soils including acid sulfate soils and test pit locations	Soil profiles, permeability testing, PRI results	Y	Section 2 and 3; Figures 4 and 6; Appendices 3, 4 and 5.

LOCAL WATER MANAGEMENT STRATEGY ITEM	DELIVERABLE	INCLUDED Y/N	NOTES
Environmental - areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental plan plus supporting data where appropriate	Y	Section 3, Figure 5
Surface water - topography, 100 year floodways and flood fringe areas (if applicable)	Surface-water plan	Y	Sections 3.1 and 4; Figure 6
Groundwater - topography, pre-development groundwater levels and water quality, test bore locations	Groundwater plan plus site investigations	Y	Sections 3.1; Figures 4 and 6
WATER SUSTAINABILITY INITIATIVES			
Water efficiency measures - private and public open spaces including methods of enforcement		Y	Section 4.7
Water supply (fit-for-purpose) strategy, agreed actions and implementation		Y	Section 4
Water Management		Y	Section 5
STORMWATER MANAGEMENT STRATEGY			
Flood protection - peak flow rates, volumes and top water levels at control points, 100 year flow paths and 100 year detention storage areas	100 year-event-plan	Y	Section 4.6
Manage serviceability - storage and retention required for the critical 5 year ARI storm events. Minor roads should be passable in the 5 year ARI event	5 year-event plan	Y	Section 4; Figures 4 and 6
Protect ecology - detention areas for the 1 year 1 hour ARI event, areas for water quality treatment and types of agreed structural and non-structural best management practices and treatment trains (including indicative locations). Protection of waterways, remnant vegetation and ecological linkages	1 year-event plan	Y	Section 5; Figure 6
GROUNDWATER MANAGEMENT STRATEGY			
Post-development groundwater levels, existing and likely final surface levels, outlet controls, and subsoil drain areas/exclusion zones	Groundwater/subsoil plan	Y	Section 3.1 and 4.4
Actions to address acid sulfate soils or		Y	Sections 2

LOCAL WATER MANAGEMENT STRATEGY ITEM	DELIVERABLE	INCLUDED Y/N	NOTES
contamination			and 2.4
THE NEXT STAGE - SUBDIVISION CONDITIONS AND URBAN WATER MANAGEMENT PLAN			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required before detailed design		Y	LWMS provides strategic direction for detailed design at the subdivision stage. Section 4.11
MONITORING			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		Y	Section 5
IMPLEMENTATION			
Developer commitments		Y	Section 6
Roles, responsibility, funding for implementation		Y	Section 6
Review		Y	Section 5

1 INTRODUCTION

1.1 BACKGROUND

Aurora Environmental has been commissioned to prepare this Local Water Management Strategy (LWMS) on behalf of landowners of Hambley Farm, in support of the proposed development of Lot 51 Porongurup Road, Mount Barker into a rural residential estate with an equestrian theme (Figures 1 and 2). In addition, Wood and Grieve Engineers have developed a stormwater management plan, outlining treatments related to applicable design criteria outlined in this LWMS.

The subject land comprises 143.37ha of land in the locality of Mount Barker, on the eastern edge of the Mount Barker townsite which is located within the Shire of Plantagenet (Figure 1).

Lot 51 Porongurup Road (the subject land) is currently zoned 'Special Site R12' under the Shire of Plantagenet Town Planning Scheme (TPS) No. 3 (Figure 3). The Special Site R12 zoning allows for the following uses:

1. Strata Lots

(i) Grouped dwelling subject to prior approval of the Council;

(ii) Home occupation subject to the prior approval of the Council;

(iii) Rural use ancillary to the use of the strata lot for residential purposes but excluding the keeping of pigs or any commercial rural activity.

2. Common Property

(i) Rural use

The eastern portion of the subject land contains strata lots, and allows for subdivision of up to 30 lots within the area shown in Figure 5. The common property (western portion) has until recently been used as a blue gum plantation. However, since harvest of the blue gums, the common property has remained vacant.

It is proposed to develop Lot 51 as rural residential lots to support equestrian activities, with lot sizes to cater for rural residential pursuits such as keeping horses (minimum lot size 2ha), depending on land capability.

1.2 PURPOSE AND SCOPE

The Western Australian State Water Plan (Government of WA, 2007) identifies the need for an increased focus on total water cycle management and Water Sensitive Urban Design (WSUD) to improve the management of storm water (particularly nutrients), and increase the efficiency of the use of water. Total water cycle management supported by WSUD is considered the most effective way to manage water resources in a development context.

This LWMS has been developed to support the TPS amendment process by demonstrating how the property functions in terms of water management and will guide subdivision design so that it complies with the Better Urban Water Management Guidelines (WAPC, 2008a).

The purpose of this LWMS is to provide information about the site, including baseline data for groundwater levels, strategies for efficient use of potable and non-potable water and a detailed examination of the proposed approach to effluent disposal and managing storm water at the site. To achieve this, the following scope has been undertaken:

- Documentation of pre-development site conditions and hydrological information;
- Identification of water management opportunities and constraints;
- Identification of potential alteration to the water balance as a result of development of the site;
- Development of strategies for the protection of water quality;
- Preliminary treatments for water quality and quantity for rainfall events; and
- A summary of the key responsibilities and a timeline for implementation of each strategy.

1.3 LOCAL WATER MANAGEMENT STRATEGY OBJECTIVES

The objective of this LWMS is to provide the following information for the proposed development of the site:

- Identify the environmental outcomes to be achieved through the implementation of this LWMS;
- Demonstrate that best practice and WSUD principles are incorporated in the development; and
- Provide contingency plans in the event that the performance criteria specified in the LWMS are not achieved.

1.4 WATER POLICY DOCUMENTS

The following documents have been consulted to define the design principles and objectives for this LWMS:

1.4.1 Statement of Planning Policy 2.9-Water Resources

Statement of Planning Policy (SPP) 2.9, Water Resources (WAPC, 2006) is made under Section 26 of the *Planning and Development Act 2005*. The objectives of SPP 2.9 are to:

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

1.4.2 Stormwater Management Manual for Western Australia

The Department of Water's (DoW) current position on stormwater management in Western Australia is outlined in Chapter 2: Understanding the Context of Stormwater Management Manual for Western Australia (DoW, 2004-2007) which details the management objectives, principles and a stormwater delivery approach for Western Australia.

The principal objectives for managing stormwater in Western Australia are:

- Water Quality: To maintain or improve the surface and groundwater quality in the development areas relative to pre-development conditions;
- Water Quantity: To maintain the total water cycle balance in the development area relative to the pre-development conditions;
- Water Conservation: To maximise the re-use of stormwater;
- Ecosystem Health: To retain natural drainage systems and protect ecosystem health;
- Economic Viability: To implement cost effective and easily maintained stormwater management systems that are economically viable in the long term;
- Public Health: To minimise risks, including risk of injury or loss of life, to the community;
- Protection of Property: To protect the built environment from flooding and waterlogging;
- Social Values: To ensure that social, aesthetic and cultural values are recognised and maintained when managing stormwater; and
- Development: To ensure the delivery of best practice stormwater management through planning and development of high-quality developed areas in accordance with sustainability and precautionary principles.

1.4.3 Decision Process for Stormwater Management

DoW (2009) has formulated a Decision Process for Stormwater Management in Western Australia which provides a framework for the planning and design of storm water management systems and assists in meeting the objectives outlined above. A copy of the Decision Process is provided in Appendix 1. This process has been used in the formulation of this document and design criteria for events and treatments.

1.4.4 Shire of Plantagenet- Town Planning Scheme and Policies

Town Planning Scheme No.3

The Shire of Plantagenet Town Planning Scheme No. 3 (Shire of Plantagenet, 1991 as updated) outlines requirements for development of rural residential zones and outlines provision that apply to these areas, including how natural features (including water resources) will be managed and how facilities such as potable water and liquid and solid waste will be catered for.

Town Planning Scheme Policy No. 18.1 – Planning Vision

Clause 3.5.3 of TPS Policy No 18.1 *Planning Vision* (Shire of Plantagenet, 2014) requires analysis of existing conditions and consideration of the possible impacts of development on water management, particularly for areas prone to inundation and/or flooding. Management of water quality and stormwater runoff is viewed as essential for the long term sustainability of land use intensification and health of water systems.

Town Planning Scheme Policy No. 21 – Water Efficiency in Residential Development

This policy encourages new development to incorporate rainwater tanks which are plumbed into the house to supplement water supply from the reticulated system. The policy also encourages use of grey water reuse systems and water wise practices.

1.4.5 Australian Standard 1547:2012

Australian Standard 1547:2012 (Standards Australia, 2012), considers permeability values calculated from field results and other factors including groundwater separation distances, to determine suitability and setbacks for on-site effluent disposal (as appropriate). This Standard is used when considering the application of the Draft Country Sewerage Policy (Department of Health (DoH), 2003) which sets out the wastewater disposal requirements for areas where reticulated sewer is not available.

1.4.6 Guidelines for Land Capability Assessment for Local Rural Strategies

The WAPC (1989) *Guidelines for Land Capability Assessment for Local Rural Strategies* requires consideration of land qualities such as for wind erosion hazard, waterlogging hazard and ease of excavation. Analysis of these factors will allow for the development of the most suitable management strategies to address the risks associated with land constraints.

1.4.7 Country Rainwater Collection

Rainwater collection provides potable water for many residences where reticulated drinking water supplies are not available. The Department of Health (DoH) provides information regarding the safe collection and storage of rainwater for potable use (DoH, 2004 and 2011). To ensure that adequate volumes of water are available for residential consumption, consideration needs to be given to annual rainfall, collection area, tank size and the amount of water used by the household.

1.4.8 Grey Water Recycling

Grey water recycling is a useful strategy to enhance water reuse and is guided by a Code of Practice (DoH, 2010). The code outlines acceptable methods for recycling grey water to ensure that health and pollution risks are avoided. Grey water reuse systems need to be approved by local government prior to installation as outlined in the Shire of Plantagenet Water Efficiency Policy (Shire of Plantagenet, 2013). Grey water systems are usually not necessary where approved alternative effluent disposal systems are used for treatment of effluent as these systems treat wastewater to a higher standard than grey water systems.

1.5 SITE VISITS AND DATA COLLECTION

The following data collection has been undertaken for the site and has been considered in the preparation of this document:

- Drilling to determine soil profiles to a depth of 3m below ground level (BGL);
- Installation of piezometers where groundwater was detected;
- Collection of data from the piezometers to determine groundwater levels;
- Collection of soil samples to test for phosphorus retention ability; and
- Testing for soil permeability.

Field work was undertaken by Aurora Environmental personnel on the following dates:

22 November 2013: Initial site inspection and evaluation

- No standing water observed, except for dams. However there was evidence that standing water had been present in some low lying areas. No evidence of creeks or streams (permanent or ephemeral). A minor drain had been dug in the vicinity of HAM02. Some water gaining areas indicate areas prone to inundation and direction of water flow across and from the subject land.
- Drilling to 3m BGL for soil logging (locations HAM 1 to 4 shown in Figure 6), collection of soil samples for phosphorus retention index (PRI) analysis and permeability testing. Installation of two piezometers at HAM 1 and HAM 2, where groundwater was detected, deployment of data loggers to measure groundwater levels. Site was trafficable i.e. no standing water.

13 December 2013: Ground water level testing and water quality in dams

- Measurement of standing water levels in piezometers and collection of loggers. Water quality monitored in dams (pH, electrical conductivity and total dissolved solids).

Drilling and installation of the piezometers was undertaken with assistance from Barker Trenching Services, which used a bobcat fitted with an auger to drill the holes and install the piezometers. All holes were drilled to 3.0m BGL, and where piezometers were installed, casings were constructed using 2m long Class 9, 50mm polyvinyl chloride (PVC) slotted screens. The soils encountered during the drilling process were logged by Melanie Price of Aurora Environmental.

At each borehole location a 0.5m deep hand auger hole was also installed to measure soil permeability using a permeameter. Once augured, the hole was saturated with water and the permeameter was set up to conduct measurements in accordance with Australian Standard 1547 4.1F 4.1(a). Measurements of the constant head were recorded at 10 second intervals and the data used to calculate the permeability of the soil.

Soil was collected from the 0.3-0.5m interval of each hand auger hole to undertake phosphorus retention index (PRI) testing. Samples were sent to a laboratory for analysis.

Photos of site conditions were taken on 22 November 2013 and are included in Appendix 2.

2 PRE-DEVELOPMENT ENVIRONMENT

2.1 CLIMATE

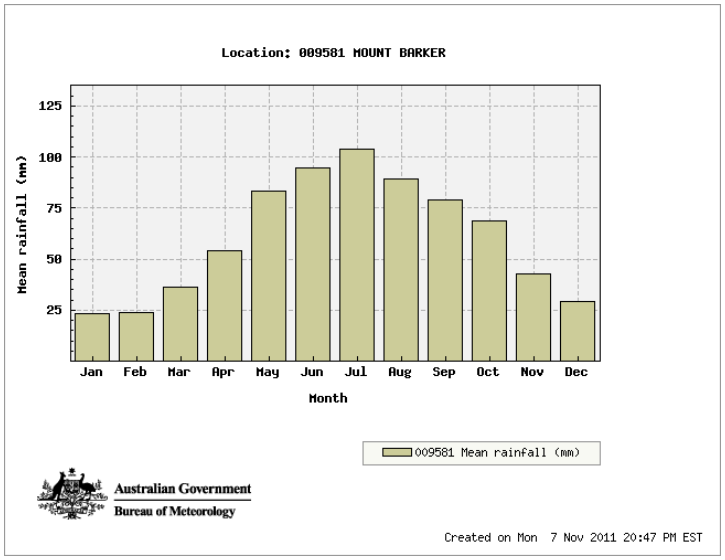
Mount Barker has a Mediterranean climate with generally hot summers and cool, wet winters. The area's proximity to the south coast means that the progression of winds from east through north, west, south and returning to east over periods of several days to a week or more during summer can bring a large variation in weather from fine and mild, to hot with thundery showers, to cool and cloudy with drizzle. When the ridge moves north in the cooler months, the moisture-laden westerly winds south of the ridge deliver much of the area's annual rainfall. Atmospheric disturbances embedded in the westerly winds are common in the winter months with sometimes several cold fronts passing through southwest Western Australia in a week.

2.1.1 Rainfall

The closest rainfall measurement station to the subject land is Mount Barker (Bureau of Meteorology (BOM) site number 9581; Chart A) which is approximately 4km west-northwest of the site. Mt Barker's long-term median annual rainfall is approximately 729 mm however there can be considerable variation in the total rainfall from year to year. The maximum annual rainfall recorded in Mount Barker was 1094.6mm in 1917 with a minimum annual of 430.5mm in 1940. The highest rainfall in one day was 139.2mm recorded on 7 April 1947.

On average, approximately 40% of the annual rainfall occurs in winter between June and August. Although cold fronts are responsible for much of the recorded rainfall total, a moist onshore flow can occur in any season and bring showers or drizzle. Mount Barker records rainfall on 101 days annually. July is the wettest month, with a long-term average of over 103mm. The driest month is January with a mean of 23.5 mm. Like other parts of south-west WA, winter rainfall has decreased in the region during the latter half of the twentieth century, which is thought to be due to natural variability and climate change.

CHART A:
AVERAGE MONTHLY RAINFALL (MOUNT BARKER)



2.1.2 Temperature

The closest temperature measurement station to the subject land is Mount Barker (BOM site number 9581). Average maximum temperatures peak in January and February in Albany, with monthly means of 26°C, although considerably hotter temperatures (above 35°C) often occur when hot, dry northerly winds blow from the interior of Western Australia (Chart B). Overnight the highest average minimum temperature occurs in February at 13°C, with the lowest in July and August (at 6°C) (Chart C). Frosty conditions are sometimes experienced during the winter months. Winter daily maximum temperatures drop to around 14°C in July (Chart B).

CHART B:
MAXIMUM TEMPERATURE AVERAGES (MOUNT BARKER)

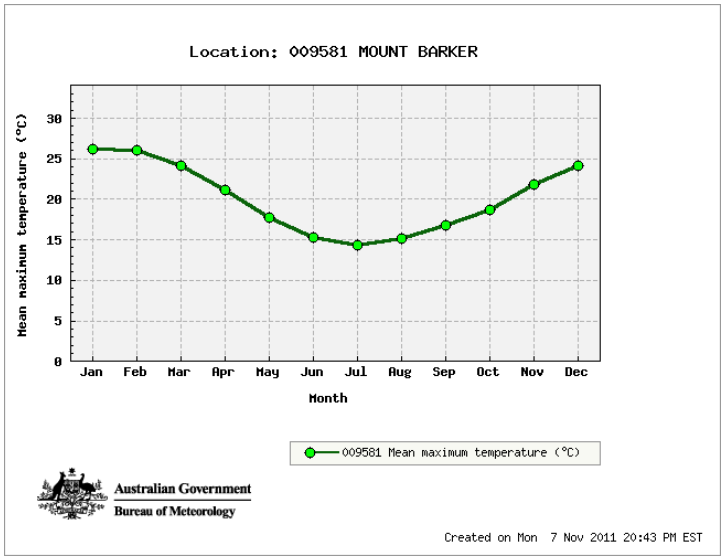
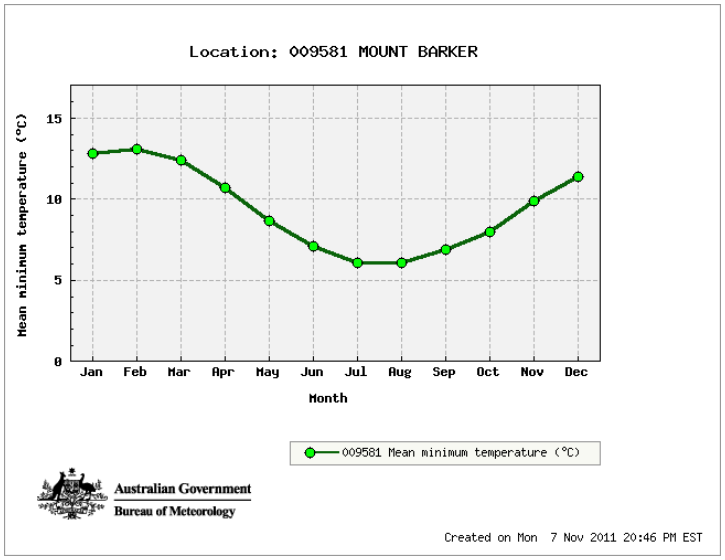


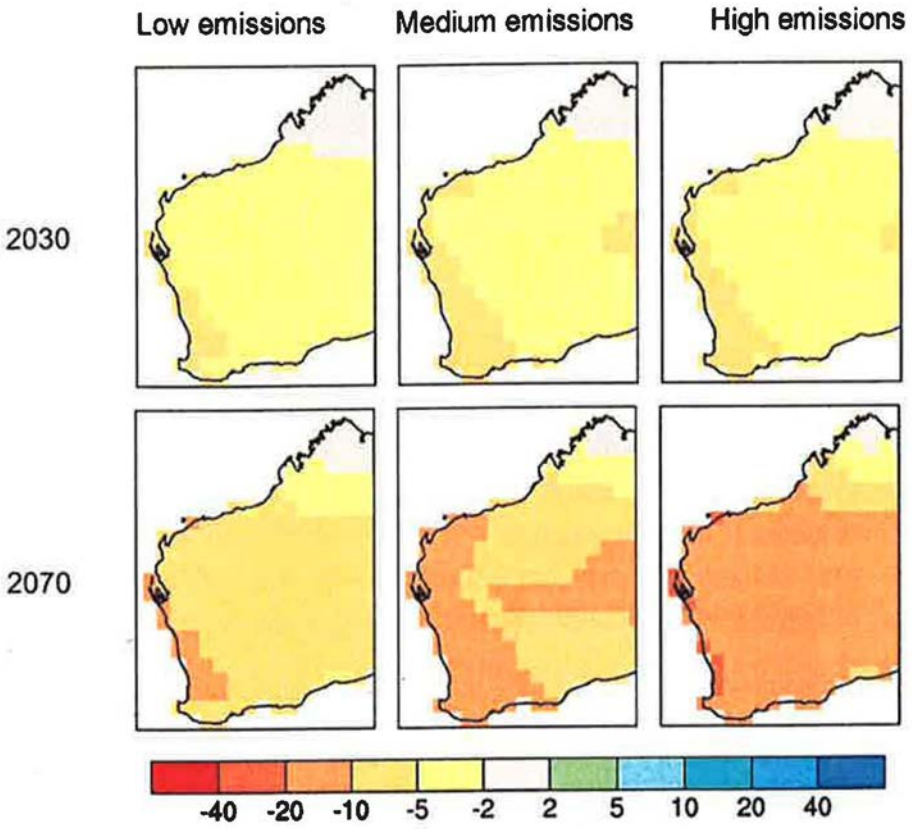
CHART C:
MINIMUM TEMPERATURE AVERAGES (MOUNT BARKER)



2.1.3 Climate Change

Projections for the future suggest the influence of increasing concentrations of greenhouse gases will cause further decline in rainfall due to higher barometric pressures and fewer storms (IOCI, 2005). Projections for changes in the annual rainfall in the south west lie in the range of -20% to +5% by 2030 and -60 to +10% by 2070 (Pittock, 2003). The range in the predicted changes in rainfall is relatively large. Natural variability in precipitation is comparable in magnitude to the changes projected by CSIRO and Australian BOM (2007) and may therefore mask, or alternatively significantly enhance, the greenhouse-forced changes (CSIRO and Australian BOM, 2007). This has implications for the Mount Barker area as rainfall and therefore water supply from this source is likely to decline (Plate A). If rainfall decreases significantly, additional sources and/or storage area for rainfall may eventually be required.

PLATE A: PREDICTED CHANGES IN ANNUAL AVERAGE RAINFALL FOR 2030 AND 2070 AS A PERCENTAGE CHANGE FROM 1981-2000 AVERAGE FOR WESTERN AUSTRALIA



Projected change in annual average rainfall (% change from 1981-2000 average) for Western Australia (source: www.climatechangeinaustralia.gov.au)

Table B shows that rainfall for Mount Barker has been variable over the last 13 years and this is likely to be the case in the future.

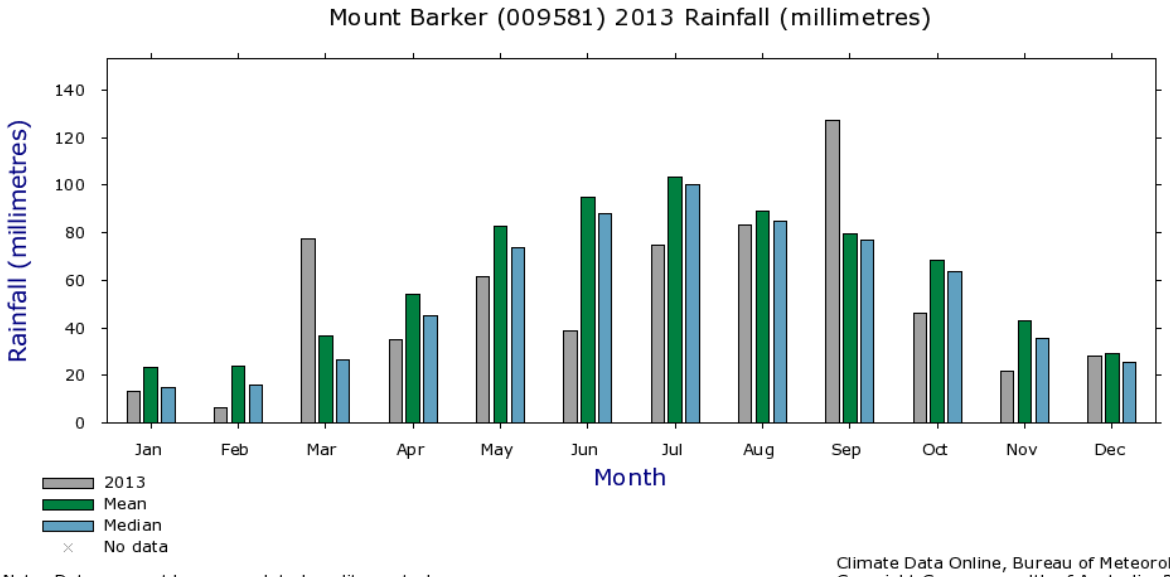
TABLE B: ANNUAL RAINFALL (AVERAGE AND LAST 13 YEARS)

YEAR	MOUNT BARKER ANNUAL RAINFALL (mm)
Average – 1886 to 2013 Average – 1981 to 2010	727.5 652.4
2013	613.6
2012	593.6
2011	749.3
2010	500
2009	648.9
2008	Not available
2007	Not available
2006	Not available
2005	860.0
2004	583.6
2003	Not available
2002	537.5
2001	628.8
2000	651.4

Note: Annual rainfall for Mount Barker not available for 2003, 2006, 2007, 2008.

The 2013 rainfall recorded at Mount Barker was 613.6mm (Table B; Bureau of Meteorology, 2014), which is close to the average rainfall (average is 652.4mm - 1981 to 2010). September 2013 rainfall was significantly higher than the historic September average (127.2mm in 2013 vs 70.7mm) which indicates that groundwater levels recorded in November 2013 are likely to reflect average to above average levels.

CHART D: RAINFALL 2013



Note: Data may not have completed quality control

Climate Data Online, Bureau of Meteorology
Copyright Commonwealth of Australia, 2014

Source:
http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_display_type=dataSGraph&p_stn_num=009581&p_nccObsCode=136&p_month=13&p_startYear=2013

2.2 TOPOGRAPHY

Available topographic contours (Figure 2) indicate that the highest point on the subject land is on the north-eastern boundary, at approximately 350mAHD. The land slopes gently down to the south west from this point with the lowest point of the property on the western boundary at around 241mAHD.

2.3 LANDFORM, GEOLOGY AND SOILS

The subject land lies on the western flank of Mount Barrow, a granite based hill. Mapping by Churchwood *et al.* (1982) indicates the presence of the following landforms associated with the subject land (Figure 4):

- Plateau element on the western portion of the subject land comprising Perillup Plains (PP) with some swamps. Yellow duplex soils on long slopes. Podsols on drainage floors. Yellow solonetzic soils in swamps.
- Plateau element on mid portion of the subject land comprising Bevan (BEy) landform with gently undulation terrain and minor valleys. Gravelly or sandy yellow duplex soils.
- Hills and hilly terrain on eastern portion of the subject land comprising Barrow (BAf) hills and ridges greater than 60m relief, crests of granite, gently sloping flanks with yellow duplex soils, sands and gravels.
- Hills and hilly terrain on the north eastern portion of the subject land comprising Barrow (BAg) with granite outcrop.

Geomorphology and soil types are described in Table C.

TABLE C: GEOMORPHOLOGY AND SOILS

Soil Type	254KePP	254KeMW	242PrBAf	242PrBAg
Geomorphology	Very gently undulating plain with some swamps	Undulating rises with broad, flat, swampy depressions	Hills and hilly terrain, gently sloping	Granite outcrop
Soil Description	Duplex sandy gravels, wet and semi-wet soils with grey and yellow/brown deep sandy duplexes. This soil type occurs on the low-lying western portion of the subject land	Duplex sandy gravel, shallow gravel with semi-wet soil, deep sandy gravel and grey deep sandy duplex	Yellow duplex soils, sand and gravels	Granite outcrop

Source: Department of Agriculture (2004).

During fieldwork carried out on 22 November 2013, the four pits were dug to characterise the soil profile at the site as described in Table D at the locations shown in Figure 6. The profiles generally support the Department of Agriculture (2004) descriptions. Soil profiles for each pit are also described in Appendix 3.

TABLE D: GENERALISED SOIL PROFILES

LOCATION	HAM01	HAM02	HAM03	HAM04
Description of profile (in metres below ground level, mBGL)	**Soil type: 254 KePP: wet and semi wet soils with grey and yellow/brown deep sandy duplexes:** Ground surface to 0.6m BGL: Dark brown silty sand with some clay content and organic matter. 0.6 to 2m BGL: Transition to grey sticky clay with green quartz and weathered granite. 2m to 3m BGL Hard, dry white clay with quartz, weathered granite	**Soil type: 254 KePP: wet and semi wet soils with grey and yellow/brown deep sandy duplexes:** Ground surface to 0.1m BGL: Dark brown fine sand with organic matter – root zone. 0.1 to 0.5m BGL Medium brown sand, fine grained with some silt. 0.5 to 0.9m BGL Transition to coarse, creamy coloured sand with quartz/weathered granite. 0.9 to 1.5m BGL	**Soil Type 254KeMW: Duplex sandy gravel:** Ground surface: Massive laterite forming pavement in some areas. Ground surface to 0.1m BGL: Light brown to grey sandy gravel with trace organic matter, root zone. 0.1m to 1.3m BGL: Grey brown sandy gravel, fine to coarse grained with some silt. Pisolitic gravel (1-1.5cm diameter) and lateritic gravel (0.5	**Soil Type: 242PrBAf: Yellow duplex soils, sand and gravels:** Ground surface to 0.5m BGL: Light brown to yellow sandy gravel (0.5cm to 1.5cm diameter) with some clay content. Little organic matter. 0.2m to 0.5m BGL: increasing clay content with weathered granite/ quartz. Large gravel. 0.5m to 1.0m BGL: Sandy white clay

	transition to sandy white clay with light brown mottling from lateritic gravel	Transition to plastic grey clay with some sand plus weathered gravel, orange and brown mottling. 1.5 to 2.5m BGL White clay with green quartz, weathered granite and orange/brown mottling transitioning to increased orange and brown mottling and less sand in clay. 3m BGL White clay with weathered granite.	to 5cm diameter). 1.3m to 1.8m BGL Orange sandy clay with gravel. 1.8m to 2.5m BGL White clay with weathered granite/quartz, mottled red. 2.5m to 3.0m BGL: Sandy grey clay with brown and orange mottling from gravel.	with orange mottling from laterite gravel. 1.0m to 2.0m BGL Sandy white clay with red mottling and weathered granite/ quartz. 2.0m to 3.0m BGL: Sandy white clay with red mottling from laterite gravel.

2.4 ACID SULFATE SOILS

Acid sulfate soils (ASS) are wetland soils and unconsolidated sediments that contain iron sulfides which, when exposed to atmospheric oxygen in the presence of water, form sulfuric acid. ASS commonly occurs in low-lying coastal lands such as Holocene marine muds and sands. When disturbed, these soils may produce sulfuric acid which can mobilise iron, arsenic, aluminium, manganese and other heavy metals. The release of these reaction products can be detrimental to biota, human health and built infrastructure.

The Department of Environment Regulation (DEC, 2009a and 2009b) and the WAPC (2008b) have released guidance notes on ASS, covering the requirement for assessing sites and the management of sites where ASS are identified. ASS investigations are commonly required as part of the conditions of subdivision or as a requirement for a dewatering licence application.

Available mapping indicates that the soils in the subject area are likely to be of 'low to no risk' of ASS occurring generally at depths of more than 3m (ASRIS, 2014; Landgate, 2013). In addition, testing indicated that the groundwater was close to neutral (pH of 6.1) which suggests a low risk of acidity.

2.5 VEGETATION

The majority of the site has been cleared of native vegetation for agricultural purposes (Figure 5). Vegetation mapping by Beard (1979) for the Albany and Mount Barker areas indicates that the vegetation associated with the site comprises:

Narrikup 3: Medium forest, Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*).

A vegetation assessment was undertaken on 22 November 2013 by Melanie Price of Aurora Environmental for vegetation in the 'common property' area which is the subject of investigation for

future development. Native vegetation in the area already subdivided (Figure 5) was not inspected as building envelopes and other controls have already been established.

Vegetation types and conditions are shown in Figure 5. A 2.5ha area of native vegetation on the flank of Mount Barrow comprises Jarrah Marri forest with a sparse understory dominated by *Taxandria theiformis* with occasional *Hakea amplexicaulis*, *Banksia grandis* and *Xanthorrhoea preissii.* This area of vegetation is in Good Condition (after Keighery, 1994).

Other scattered paddock trees do not contain an understorey and while they are in a Completely Degraded condition, may provide other values such as shade, shelter and foraging habitat for birds and other animals.

Along the northern property boundary, in the Ormond Street road reserve there are a number of large, mature Marri and Jarrah trees which may be of value to fauna, including Black Cockatoos.

2.6 CATCHMENTS, DRAINAGE AND WATER FEATURES

2.6.1 Catchment and Subcatchments

The northern and western portion of the subject land is in the subcatchment of the Kalgan River (Figure 2). Water moving through this catchment ultimately discharges into Oyster Harbour and King George Sound near Albany, 45km to the south. The balance of the subject land (south east portion) is in the catchment of the Hay River and Wilson Inlet which discharges to the coast at Denmark (51km to the south west).

2.6.2 Surface Water and Wetlands

The subject land contains eight dams which have been placed in areas where surface water can be captured or in water gaining areas where water is likely to perch on clayey subsoils (Figure 6). There are no wetlands or defined water courses on the property. Water gaining areas and the general direction of water flow is indicated in Figure 6.

2.7 HYDROLOGY AND GROUNDWATER

Smith (1995) describes the hydrology in the area as comprising fractured and weathered rocks with local aquifers, with very minor or no groundwater resources and existing groundwater often saline. Mapping by Smith (1995) indicates that the western and lowest portion of the property is likely to experience groundwater at approximately 240m AHD (within 1m of ground surface). The flanks of Mount Barrow are likely to experience groundwater at 280m AHD (where ground level is approximately 350m AHD), indicating that groundwater is approximately 70m BGL.

September and October are generally the best times to assess peak groundwater levels as there is a lag between winter rainfall and the highest groundwater levels. However, Mount Barker experienced significantly higher than average rainfall in September 2013 which indicates that winter maximum groundwater levels were likely to persist into November. Two piezometers were installed on the subject land (Figure 6) on 22 November 2013 to measure the groundwater levels and to determine if peak winter ground water levels had already occurred. Piezometers were not installed at HAM03 or HAM04 as groundwater was not detected within 3m of the ground surface. Capacitive

groundwater level data loggers were installed to record groundwater levels over several weeks (loggers were retrieved on 13 December 2013). There was evidence of pooling of water on the ground surface around HAM01, possibly after heavy rains in September.

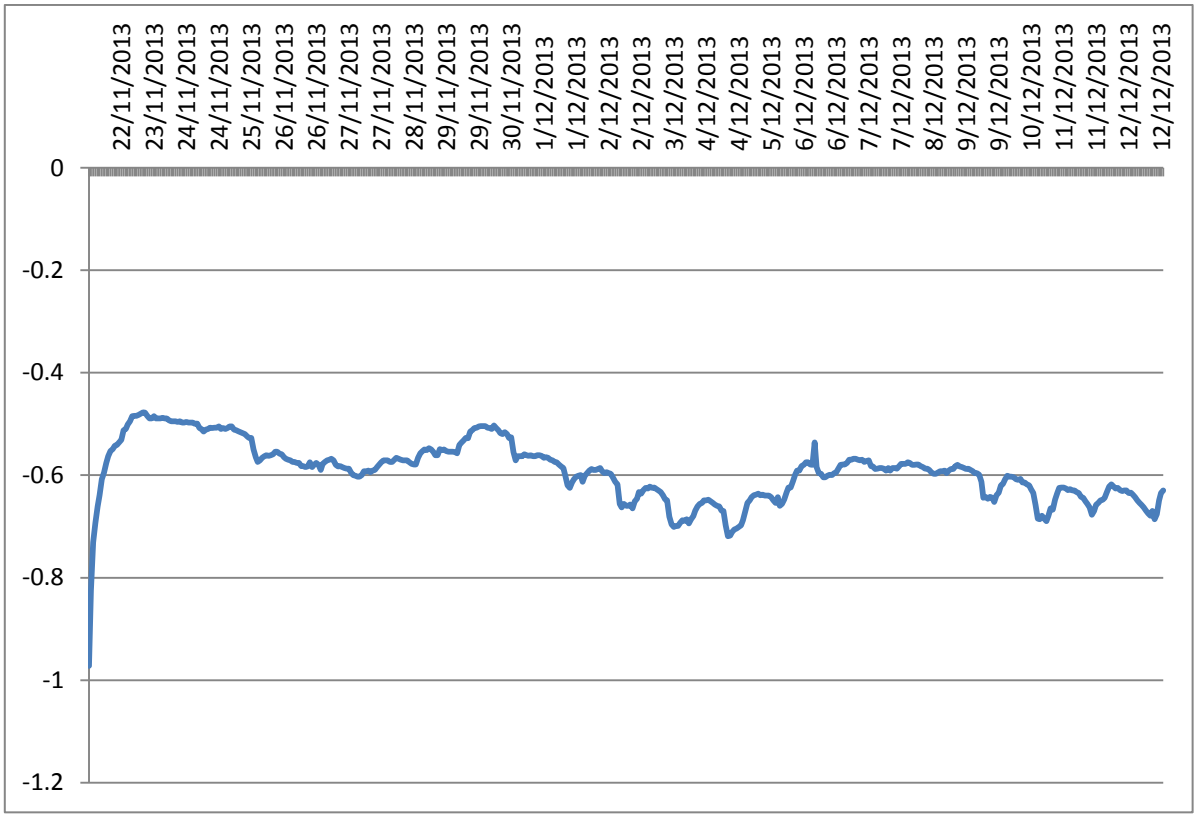
Ground water data collected manually (Table E) and via the loggers (Chart E) indicates that groundwater recharge is relatively slow and that groundwater reached a maximum level of 0.47mBGL at HAM01 and 0.9m BGL at HAM02. While these levels were recorded in late spring and early summer, they are likely to represent maximum winter groundwater levels as 2013 had a relatively wet winter when compared with recent years and there was a significant rainfall event in September 2013 (Chart D).

TABLE E: GROUNDWATER LEVELS (MBGL)

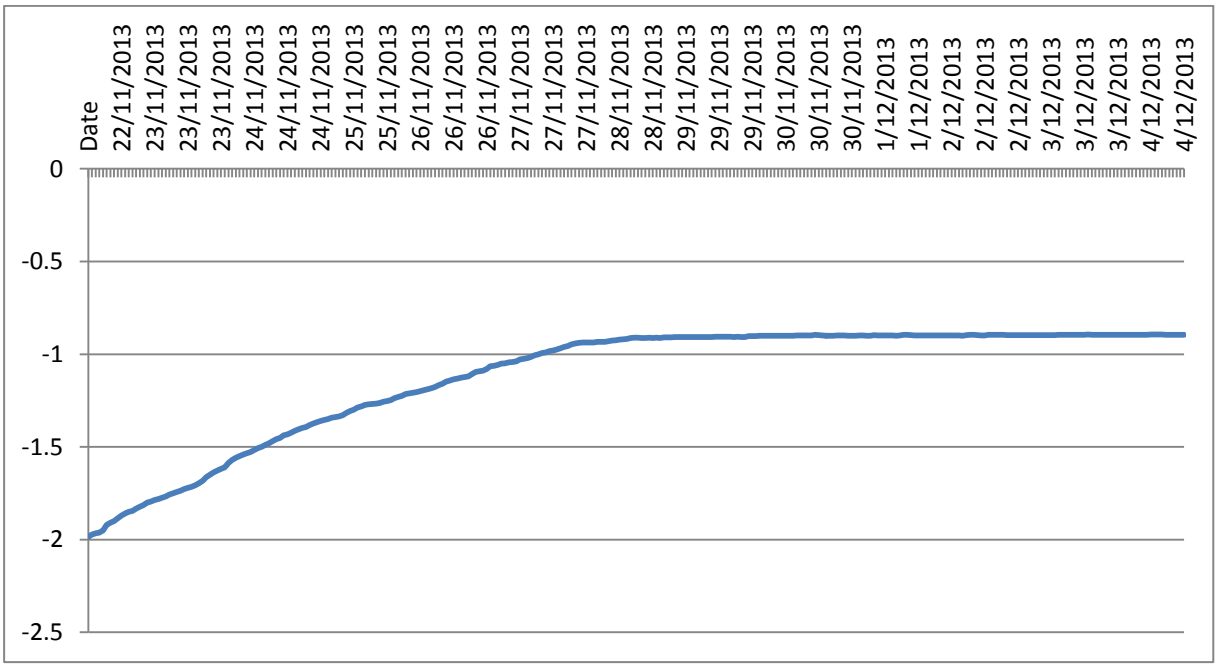
	STANDING WATER LEVEL - METRES BELOW GROUND LEVEL (MBGL)	
Location	**HAM01**	**HAM02**
Approximate ground level (mAHD)	241mAHD	256mAHD
Manual Measure: Depth to Ground Water: 13 December 2013 (m BGL)	0.47	0.9
Depth of bore (m BGL)	2.99	3.21

CHART C: GROUNDWATER LEVELS – LOGGER DATA

HAM01 – Groundwater Maximum around 0.47m BGL



HAM02 – Maximum Groundwater around 0.9m BGL



The data logger information suggests that the lowest part of the subject land (soil type 254KePP) experiences maximum groundwater levels within 0.5m BGL following winter saturation and high

rainfall events (Figures 4 and 6; Chart B). This is partly due to the flat nature of the area and the fact that the soil comprises a duplex of shallow, gravelly sands over clay. The Shire of Plantagenet (Environmental Health Officer, 9 January 2014) has advised that engineering solutions such as construction of sand pads and use of amended soils are acceptable to achieve separation distances. This is supported in the Draft Country Sewerage Policy (DoH, 2003), which states that correctly engineered drainage solutions may be used to increase the clearance between the natural ground surface and the highest known groundwater level, subject to such drainage works being environmentally acceptable. In this case, use of a sand pad with amended soils for approved alternative effluent treatment systems and irrigation area will provide adequate separation for lots in the area shown to have the highest groundwater levels. In addition, the provision of drainage infrastructure such as swales is likely to assist in the management of water flow in a post development situation.

The subject land is not within any *Rights in Water and Irrigation Act 1914* proclaimed areas for surface water, groundwater, rivers or irrigation district. Licences are not required to use surface or groundwater in this area. There are no Public Drinking Water Source Areas within close proximity to the subject land (the closest being the Priority 1 Bolganup Creek Catchment Drinking Water Source Protection Area 13.8km to south east).

2.8 WATER QUALITY

Groundwater quality parameters, including pH, electrical conductivity and total dissolved solids were recorded from groundwater at HAM01, HAM02 and dams SW1 to SW8 as shown in Table F. The results indicate that groundwater has a close to neutral, but slightly acidic pH and is moderately to highly saline. Dam water has a slight to moderately basic pH (8.23 to 9.93) with variable salinity. The variability of the dam water quality is likely to reflect the source of the dam water (e.g. more saline if from groundwater, less saline if from surface water). The presence of groundwater with a TDS level above 1000ppm may result in a deterioration of soil structure and reduce water infiltration, if used for irrigation. The upper limit for salinity for watering horses is TDS - 6,000ppm (or 11,000 µS/m) (DAFWA, 2007) which means that most water across the site is likely to be acceptable for this use except groundwater from HAM02.

Table F: Water Quality Parameters

Location (See Figure 6)	**Parameter**		
Date: **13 December 2013**	**pH**	**Electrical Conductivity (EC) micro siemens per metre (µS/m)**	**Total Dissolved Solids (TDS) parts per million (ppm)**
HAM01 (Groundwater)	6.35	11,710	5,870
HAM02 (Groundwater)	5.85	16,020	8,010
SW1 (Dam)	Dry	Dry	Dry
SW2 (Dam)	9.35	7,140	3,560
SW3 (Dam)	8.96	2,550	1,270

Location (See Figure 6)	Parameter		
SW4 (Dam)	9.93	280	140
SW5 (Dam)	8.71	120	60
SW6 (Dam)	8.50	550	280
SW7 (Dam)	8.23	2,160	1,080
SW8 (Dam)	8.43	2,250	1,120

2.9 LAND CAPABILITY

Identification of soil and landform types and on-site investigations for the subject land have been undertaken so land capability can be assessed as per the requirements of the guidelines for Land Capability Assessment (WAPC, 1989) for the proposed rural residential land use. Desktop assessment (Table G) and on-site testing indicates that the following points need to be considered for rural residential development:

- Ease of excavation – Massive lateritic pavement is likely to be difficult to excavate. However, pavement can be broken up with appropriate equipment. Previous ripping for the blue gum plantation has already broken up some areas of pavement;
- Foundation stability – High capability for most soils, subject to geotechnical investigations. Parts of 254KePP may require removal of organic matter;
- Phosphorus export risk – Soil types have variable phosphorus retaining capability with 254KeMW having the lowest due to its sandy and gravelly nature;
- Wind erosion hazard – Low risk for 242PrBAf and 242PrBAg and low to moderate risk for 254KePP and 254KeMW;
- ASS within 3m of ground surface – No known risk in the area (supported by near neutral pH of groundwater);
- Water logging – Moderate risk in 254KePP;
- Soil salinity – Moderate risk in 254KePP; and
- Water pollution hazard – Low or no risk with use of approved alternative effluent disposal systems and appropriate irrigation areas.

In broad terms, the subject land is capable of supporting rural residential development, with consideration given to the location of building envelopes and to the location and type of on-site effluent disposal systems. This capability is enhanced because of the large lot sizes which are proposed and the ability to utilise approved alternative effluent disposal systems.

Table G: Summary of Land Capability Assessment

Soil Type	Land Capability													
	Workability - % of unit with excavation limitations	Instability Risk - % of unit with moderate to high risk	Phosphorus Export Risk – Combined % of high, very high or extreme risk of export	Microbial Purification - % of unit with low to very low capability	Surface Salinity - % of unit with negligible risk	Salinity Risk – Combined % of unit at moderate to high risk of salinity	Soil Structure Decline Risk - % of unit low risk	Subsurface Acidification Risk – Combined % of high risk or acidity present	Water Erosion Risk – Combined % of unit at high, very high and extreme risk	Flood Risk - % of unit with medium to high risk	Waterlogging Risk – Combined % of unit with high to very high risk	Wind Erosion Risk – Combined % of unit with high, very high or extreme risk	Septic - % with low capability for septic tanks (Classes 3, 4 and 5)	Grazing - Overall capability (Classes 1 and 2)
254KePP	20	0	13	76	87	26	89	18	8	8	26	21	92	Moderate
254KeMW	10	0	0	74	91	11	96	11	0	0	2	32	92	High
242PrBAf	33	0	19	45	100	0	76	30	19	0	0	15	92	Moderate
242PrBAg	81	2	28	86	100	0	56	5	28	0	0	0	95	Moderate

Key: Low capability | Medium capability | High capability

Source: DAFWA, 2005

3 ONSITE EFFLUENT DISPOSAL

The Draft Country Sewerage Policy (DoH, 2003) sets out under what conditions it is possible to develop sites which are not able to be connected to reticulated sewerage. There is a discretionary provision under this policy to allow development of lots without reticulated sewer connection where the lots are at least 2,000m^2 in area. However, it is necessary to demonstrate that the site has the following characteristics:

- At least 0.5m separation between the natural ground surface and maximum annual groundwater levels;
- Soil capable of receiving and infiltrating wastewater generated on site, including a permeable topsoil and a slope of less than one in five in the proposed disposal area; and
- Appropriate buffer distances to sensitive features.

Where these capabilities can be demonstrated, development with onsite wastewater disposal may be approved. The suitability of the site for the proposed development under the Draft Country Sewerage Policy (DoH, 2003) is discussed below.

3.1 GROUNDWATER LEVELS

As discussed in Section 2.7, the western portion of the property (Figure 4) experiences winter groundwater levels in the vicinity of 0.5m BGL which indicates that some areas may not meet the 0.5m separation and engineering solutions may need to be used to achieve adequate separation.

3.2 SOIL PERMEABILITY

Soil permeability is a measure of the rate at which water flows through a soil profile and is important in land capability investigations as it provides an indication of whether stormwater will infiltrate readily into the soil, or if it will potentially cause ponding and/or surface runoff.

Infiltration tests were undertaken at four test pits excavated at the site to determine the general permeability of the soil types across the subject land (Figure 6). A CL26100 well permeameter which is designed to meet the requirements set out in AS/NZS 1547:2012 (Standards Australia, 2012) was used for the investigation. This method is a constant head test, whereby water that infiltrates an unlined test hole is replenished at the same rate from a reservoir, keeping the level of water in the hole constant (i.e. constant head). Field records are taken to measure the loss of water from the reservoir over time, which are then used to calculate the coefficient of permeability (KSAT) for the particular soil profile. The 0.5m deep test holes were created using a hand auger at each location. The permeability calculations, based on field measurements are detailed in Appendix 4. The KSAT results and interpreted soil categories are summarised in Table H.

TABLE H: CALCULATED KSAT VALUES AND DRAINAGE CLASSIFICATION

LOCATION	K_{SAT} (M/DAY)	SOIL CATEGORY*	DRAINAGE CLASS	SOIL TYPE	SOIL TEXTURE/UNIT	PERMEABILITY
HAM01	0.9	4	Imperfectly drained	High to moderately structured - Massive	Clay loams, 254KePP	Low permeability
HAM02	0.55	4	Imperfectly drained	High/moderately structured - Massive	Clay loams, 254KePP	Low permeability
HAM03	1.99	1, 5	Moderately well drained (need to consider massive laterite in places)	Structureless to strongly structured	Gravels and sands with light clays, 242PrBAf	Low permeability
HAM04	2.23	1, 5	Moderately well drained	Structureless to weakly structured	Gravels and sands with light clays, 254KeMW	Low permeability

* Soil Category as per AS 1547:2012.

Based on the infiltration testing results, calculated KSAT values range from 0.55m/day to 2.23m/day which equates to 'low permeability'. Based on field observations and permeability, the soils at the site fall into categories 4, a clay loam (imperfectly drained), and 1 – 5 gravels and sands with light clays (moderately well drained) (Standards Australia, 2012). The recommended Design Loading Rates (DLRs) for disposal of wastewater to land are based on the calculated KSAT values and interpreted soil category as presented in AS1547:2012 (Standards Australia, 2012). These rates are given for conventional absorption trenches and beds, evapo-transpiration/absorption/seepage, mounds and irrigation. The DLRs for soil categories found on the subject land are summarised in Table I. The soil categories present on site, as determine through site testing, provide a number of options for the onsite disposal of effluent. That is, trenches, beds, evapo-transpiration and absorption, mounds and irrigation are appropriate means for waste water disposal.

TABLE I: RECOMMENDED DESIGN LOADING RATES

SOIL CHARACTERISTICS					DISPOSAL METHOD			
SOIL CATEGORY	STRUCTURE	SOIL TEXTURE	SOIL UNIT	INDICATIVE PERMEABILITY (K_{SAT} METRES/ DAY)	TRENCHES AND BEDS	EVAPO TRANSPIRATION-ABSORPTIONE	MOUNDS	IRRIGATION
4	High/ moderately structured	Clay loams	254KePP	0.5 – 1.5	10 mm/ day	12 mm/ day	16 mm/ day	25mm/ week
1,5	Structureless to strongly structured	Sandy gravel with light clay duplex	242PrBAf, 254KeMW	0.12-0.5	6-10 mm/ day	8 mm/ day	8 mm/ day	20mm/ week

* Source: AS 1547:2012.

3.3 PHOSPHORUS RETENTION

The treatment capacity of the soil, as well as its hydraulic capacity determines the effluent loading rate (Standards Australia, 2012). To determine the treatment capacity of the soil, the PRI for soils present at the site was determined for eight samples collected on 22 November 2013. A PRI result provides a measure of the phosphorus-holding capacity of a soil, which is important as it provides an indication of whether phosphorus discharged in effluent will be bound to soils and held in the soil profile or leached directly to the environment. High PRI scores indicate a high phosphorus retention capability.

Soil from four auger holes was sampled between 0.3 and 0.5m BGL (Figure 6). These depths are considered appropriate levels for testing the potential to dispose of treated effluent. The laboratory results of the PRI testing are shown in Table J and Appendix 5.

TABLE J: RESULTS OF PRI TESTS

SAMPLE SITE	DEPTH	PRI Units
HAM01 Soil Type: 254KePP	0 - 0.3m	49.6
	0.5m	25.3
HAM02 Soil Type: 254KePP	0 - 0.3m	14.1
	0.5m	138.0
HAM03 Soil Type: 254KeMW	0 - 0.3m	6.7
	0.5m	11.7
HAM04 Soil Type: 242PrBAf	0 - 0.3m	153.0
	0.5m	569.6

As noted in *Water Quality Protection Note 22: Irrigation with Nutrient Rich Wastewater* (DoW, 2006), soils with PRI ratings higher than 10 have a reduced risk of leaching nutrients through the soil profile and into groundwater. The Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units (DoH, 2001) specifies surface irrigation disposal areas need to contain soils with PRI values greater than 20. If soil PRI is less than 20, use of amended soils is recommended in irrigation areas. As indicated in Table J, the soil samples yielded a range of PRI results, some of which were less than the levels considered to adequately reduce the risk of nutrient leaching. As the soils on the site have a variable ability to adsorb phosphorus, it is recommended that amended soils are used for irrigation of treated waste water to ensure that the phosphorus adsorption is maximised.

3.4 RECOMMENDATIONS FOR ONSITE EFFLUENT DISPOSAL

Catering for on-site effluent disposal requires consideration of a number of factors including soil type, permeability, depth to groundwater, slopes and PRI values. Given the soil categories, permeability, slopes and PRI identified at the site, it is recommended that approved alternative

disposal systems are used for onsite disposal of effluent. These units are an alternative to septic tanks and provide an improved quality of effluent treatment and disinfection.

The Shire of Plantagenet has advised the following for ATUs:

1. An ATU must be located a minimum of 1.8 metres from any buildings or boundaries.
2. Irrigation Disposal System to be located at a minimum of 30.0 metres from dams, bores or water sources available for human or animal consumption.
3. Irrigation Disposal System to be located at a minimum of 1.8. metres from boundaries, buildings, paths, driveways etc...
4. Irrigation system to be located 0.5 metres above highest known water table.
5. Irrigation disposal area to be located 300mm above any impervious layer.
6. Irrigation disposal area to have a minimum of 100mm friable soil and additional 50mm top cover of good quality mulch.
7. All storm and surface water must be diverted away from the irrigation area.
8. Aerobic Treatment Units and irrigation systems must be installed and serviced by an appointed and approved maintenance contractor.
9. Irrigation disposal area shall display two (2) warning signs and be dedicated to non-trafficable areas.
10. To comply with all the conditions for installation and service as approved by the Health Department of WA.

Approved alternative systems have regular service requirements (usually quarterly) and maintenance must be through an authorised person or contractor. Approved alternative systems that incorporate a disinfection mechanism are permitted to irrigate treated effluent to a dedicated irrigation area which allows for reuse of the wastewater. Irrigation areas should:

- Be maintained so that irrigation lines are accessible for maintenance;
- Be planted with nutrient tolerant plants to avoid puddles or run off of effluent; and
- Be a minimum of 150m^2 and require at least 300mm of permeable soils above an underlying limiting layer (such as massive laterite, granite or clay).

The exact specifications for onsite effluent disposal will ultimately depend on the size of the household (determined by number of bedrooms). Final approval is required from the Shire of Plantagenet (for systems approved by DoH) prior to installation of any onsite wastewater treatment and disposal system.

The north western portion of the subject land is likely to experience maximum winter groundwater levels that are within 0.5m of the ground surface due to perched groundwater and/or areas that comprise flat poorly drained land (Figures 4 and 6). It is recommended that ATUs and irrigation areas be incorporated into sand pads to ensure adequate separation to ground water. In addition, amended soils should be incorporated in irrigation areas.

4 PROPOSED DEVELOPMENT

4.1 KEY ELEMENTS OF THE SUBDIVISION PLAN

It is proposed to subdivide the Lot 51 Porongurup Road, Mount Barker to create rural residential lots of sizes that will support the keeping of horses and potentially shared facilities for equestrian activities (Figure 5). Public open space is not required for this development. This LWMS considers the development of the new rural residential component only, as the existing strata area has existing approval to subdivide up to 30 lots.

The proposed development is consistent with the Shire of Plantagenet Planning Vision (Shire of Plantagenet, 2014) as the development will be:

- Contained in a node on appropriately zoned land;
- Within close proximity to the Mount Barker townsite; and
- Designed to protect and enhance water resources.

Currently, reticulated water is not available to the subject land, so potable and ancillary water will need to be collected via rainwater tanks and dams. Reticulated sewer is also not available, so new residents will need to install effluent disposal units which treat water to a high level and have the capacity to irrigate to amended soil areas to prevent the transport of nutrients.

4.2 HYDROLOGICAL OPPORTUNITIES AND CONSTRAINTS

Opportunities associated with the proposed development include:

- The separation distance from groundwater is at least 0.5m under typical winter conditions for the eastern portion of the site. The area which is likely to experience groundwater within 0.5m of the ground surface is shown in Figure 4.
- Soil permeability is ‘low’, but adequate for domestic wastewater disposal. Sand pads and breaking of lateritic pavement may be required in some areas.
- Proposed lot sizes will be large enough to retain rainfall and associated stormwater on site for most rainfall events.
- There is low to no risk of acid sulfate soils.
- Potable water will need to be collected via rainwater tanks.
- The site is suitable for infrastructure such as swales, side entry pits and detention basins.
- Soils have variable capacity to attenuate nutrients such as phosphorus.

Environmental constraints which will need to be managed include:

- An elevated winter ground water table associated with soil type 254KePP (due to perching on clay and a relatively flat, poorly drained area in the western portion of the property).

- On-site domestic wastewater disposal will be required with phosphorus treating approved alternative systems (vs conventional septic systems) considered to provide the best long term management of effluent.

4.3 WATER MANAGEMENT PRINCIPALS AND OBJECTIVES

The principles and objectives for water management at the site include the following:

- Minimise impacts on existing natural features and ecological processes;
- Minimise impact on natural hydrological behaviour of catchments;
- Protect water quality of surface and ground waters;
- Collect, treat, store and/or reuse stormwater (while ensuring natural processes are maintained);
- Increase social amenity in residential areas through landscaping and integrating water into the landscape to enhance visual, social, cultural and ecological values;
- Add value while minimising development costs – minimise the drainage infrastructure cost of the development; and
- Consider the nexus between water use and wider social and resource issues.

4.4 PREDICTED ALTERATIONS TO EXISTING WATER AND NUTRIENT CYCLE

Due to the large lots sizes and the need to collect rainwater for potable use, it will be feasible for stormwater from most rainfall events to be retained within each lot created. In terms of impervious surfaces, additional water runoff generated by the road system, which will be oriented to allow for channelling of water to treatment and detention points within the road and drainage reserve system and therefore manage conveyance of water during large storm events. Swales and basins will be appropriately sized and located to cater for rainfall events and to ensure that discharge from the development is maintained relative to pre-development rates.

The principal sources of nutrients to groundwater and surface water within the proposed development are likely to be from livestock, domestic wastewater disposal, fertiliser application to lawns and gardens and sediments in road runoff.

4.5 DESIGN CRITERIA

The objective for development is to use water efficiently, while treating and retaining water as close to its source as possible. Stormwater systems will be designed to manage minor and major storm events. Management objectives and system performance outcomes related to rainfall design events are as follows.

Up to 1-year ARI event:

- Retain or detain stormwater runoff from constructed impervious surfaces generated by the 1-year ARI event at its source, preferably in lots and road reserves;
- Reduce the area and connection of impervious surfaces;

- Maintain pre-development peak flow rates and total volumes of runoff from the development at outlets from the site at the critical 1-year ARI event;
- Control pollutants at their source;
- Improve water quality, via soil and vegetation filtration; and
- Protect ecological values and maintain hydrological regimes.

Greater than 1-year ARI and up to 5-year ARI events for residential areas:

- Use 'minor system conveyance' (road gutters, overflow pipes, verges, swales and living streams) and detention or retention areas;
- Maintain post development peak flow rates at the pre-development flow rate;
- Provide flow paths to avoid nuisance flooding and mobilisation of trapped pollutants;
- Maintain serviceability of roads and infrastructure; and
- Manage flow rates to prevent erosion.

Up to the 100-year ARI event:

- Identify flow paths during subdivision design;
- Contain flows within 'major system conveyance' - roads, verges, public open space, living streams, waterways and wetlands;
- Protect people and buildings – confirm design flood levels; and
- Reduce risk of flooding and manage flow rates.

The following sections detail how development of the site will be undertaken in order to meet these objectives and design criteria.

4.6 WATER MANAGEMENT PLAN

The majority of the site contains sandy and gravelly soils with clay and laterite duplex soils with gentle slopes. House lots will be large enough to contain rainfall from most events within their boundaries. However, increased runoff is likely to occur in response to the creation of impermeable surfaces associated with roads which will be exacerbated by the presence of clayey soils and poorly drained low lying areas. Application of WSUD principles will ensure that current best practice is used to enhance water use and treatment.

Water management post development will aim to:

- Maintain or enhance water quality with respect to pre-development conditions by:
    - Minimising water borne sediments leaving the development;
    - Minimising export of nutrients to surface or groundwater;
    - Maintaining post-development flows relative to pre-development rates;
    - Applying point source water management treatments; and

    - Encouraging prospective landowners not to use excessive fertilisers on the site.
- Encourage water conservation by:
    - Require the installation of rainwater tanks to supply potable water (92,000L) and water for ancillary uses (50,000L);
    - Promoting groundwater recharge, where practicable; and
    - Reducing irrigation requirements.
- Management of the water regime through:
    - Preventing water damage in proposed development areas;
    - Preventing erosion; and
    - Ensuring pollutants do not enter into downstream waterways/drains.

Wood and Grieve Engineers have developed a stormwater management plan which outlines sub-catchments and conceptual treatments for 1, 5 and 100 year events (Appendix 6). Future planning for the development will include preparation of detailed designs for infrastructure which will ensure the maintenance of pre-development flow rates from the property through installation of appropriate treatments. Indicative treatments will include (Appendix 6):

Up to the 1 in 1 year events:

- Runoff from minor events is expected to be contained within the lots with assistance from rain water tanks to disconnect and retain runoff from impervious roof areas.
- One way cross falls will be used where possible to disconnect the road pavement impervious areas to sheet flow overland for treatment at source.
- Treatment zones consisting of vegetation and filtration in amended soils have been proposed at the end of the proposed swales for additional treatment if required.

1 in 5 year events:

- Open swales (see typical detail in Appendix 6 for dimensions) will be designed to convey storm events up to the 1 in 5 year event and provide protection to the road pavement.
- Geofabric will be utilised for erosion control where slopes exceed 4%.
- Rock pitching around all headwalls.
- Rock riffles may be considered to assist with slowing velocities and sediment control.
- Pre and post development flows are expected to remain similar and not require detention systems.

1 in 100 year events:

- Major storm events will be flood routed primarily through the swales.
- Properties will need to be constructed on raised building pads for flood protection from overland flow.

4.7 WATER CONSERVATION AND EFFICIENCY

The objective for water conservation and efficiency is to minimise use of potable water outside of homes and buildings, with the use of water both in-house and ex-house to be as efficient as possible.

The Mount Barker area has a moderate and relatively reliable rainfall when compared to other areas in Western Australia. However, declining rainfall, a growing population and economic development are putting pressure on water resources with the resultant need to improve water management and ensure efficient use of the resource (DoW, 2010).

In general, residential development results in an increase in demand for water for new residents. Efficient use of water will help to prevent an excessive drain on water resources. Domestic water use can be divided into in-house (e.g. showers) and ex-house (e.g. gardens). The objectives of water supply management for the subject land are to meet the Western Australian State Water Plan (Government of Western Australia, 2007) target of reducing unrestricted annual water consumption to 100 kL/person/year (274L/day), including an aspirational target to achieve not more than 40 – 60 kL/person/year of scheme water use.

The Water Corporation has undertaken a domestic water use study (Loh and Coghlan, 2003) which provides quantifiable indications of water use for single-lot residential households. The Water Corporation has also identified where potential water savings could be made through improved efficiencies, as set out in Table K.

TABLE K: DOMESTIC WATER USE ESTIMATES

AREA	ACTIVITY	CONVENTIONAL APPROACH		WATERWISE APPROACH		
		DAILY L/HOUSE/DAY	ANNUAL KL/HOUSE/YEAR	DAILY L/HOUSE/DAY	ANNUAL KL/HOUSE/YEAR	% OF CONVENTIONAL DEMAND
In House	Bath/Shower	171	-	161	-	94%
	Laundry	139	-	89	-	64%
	Toilet	112	-	75	-	67%
	Tap	83	-	69	-	83%
	Other	18	-	14	-	80%
In-House Subtotal		**523**	**191**	**408**	**150**	**78%**
Ex-House	Garden	687 (peak)	177	425 (peak)	155	88%
TOTAL		**1210 (peak)**	**368**	**833 (peak)**	**305**	**83%**

Source: Loh and Coghlan, 2003.
Note: Annual garden usage was derived prior to the introduction of watering restrictions.

Information in Table K indicates that water reduction can be achieved at the household level by utilising water-efficient fixtures and fittings such as WaterWise taps, showerheads, appliances and WaterWise landscaping. The application of these methods could reduce water consumption by 17% relative to conventional demand.

Incorporation of water-efficient taps, showerheads, and toilet systems, is required by the Building Code of Australia (Australian Building Code Board), to maximise the installation of water efficient fixtures and fittings in new houses. All tap fittings (other than bath outlets and garden taps) must be a minimum of 4-star Water Efficiency Labelling Standards (WELS) rated, all showerheads must be a minimum of 3-star WELS rated, and all toilet systems must be a minimum of 4-star WELS rated dual-flush. This will need to be enforced by the Shire of Plantagenet through the building license process.

The installation of rainwater tanks will have the benefit of not being reliant on the scheme water system and ensure that water is available for emergency purposes (e.g. firefighting).

There are also potential water savings to be made from ex-house irrigation where effluent treatment systems dispose of treated wastewater via irrigation.

4.8 VEGETATION, STREETSCAPING AND PUBLIC OPEN SPACE MANAGEMENT

Existing native vegetation will be retained in private ownership with provisions in the scheme amendment to require its protection (e.g. through fencing). Landscape and streetscaping plantings, where applicable, will include low water use and/or local native species. Where possible, bioretention ('treatment zone') features will be incorporated in road reserves by using vegetated stormwater basins and swales (Appendix 6). This will help to improve water quality and also provide a water source for plantings. Plant species suitable for use in water treatment zones such as swales and basins are shown in Table L, including species most tolerant to saline conditions.

TABLE L: PLANT SPECIES FOR WATER TREATMENT ZONES

SPECIES AND COMMON NAME	USE IN:	DESCRIPTION (FLORABASE, 2014)	COMMENT
Carex appressa - Tall sedge	*Swales and basins*	Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.5-2m high. Fl. brown, Sep to Oct. Sandy peaty loam. Swamps, along watercourses.	Plant and maintain at six plants per m^2. Plant in drier areas (due to lower tolerance for inundation). Good nutrient removal performance (Facility for Advancing Water Biofiltration (FAWB), 2009).
Carex inversa - Knob sedge	*Basins and swales*	Monoecious, rhizomatous, tufted perennial, grass-like or herb (sedge), 0.3-0.75m high. Fl. brown, Sep to Oct. Sandy loam, sand, clay. Along watercourses and in winter-wet depressions.	Plant and maintain at six plants per m^2. Plant in drier areas (due to lower tolerance for inundation).

SPECIES AND COMMON NAME	USE IN:	DESCRIPTION (FLORABASE, 2014)	COMMENT
Ficinia nodosa - Knotted club rush	*Infiltration zones and bioretention basin*	Erect, caespitose rhizomatous, perennial, herb (sedge), to 1m high, to 0.8m wide. Fl. brown/cream, Oct to Dec or Jan. Bare white calcareous sand, dark sandy clay, granite, limestone. Coastal dunes, flats, seasonally-wet swamplands, shores of salt lakes. Local native.	Plant and maintain at five plants per m^2. Salt tolerant, good in sandy conditions (FAWB, 2009).
Juncus kraussii - Sea rush	*Basins and swales*	Rhizomatous, perennial, herb, 0.3-1.2m high. Fl. brown/red, Oct to Dec or Jan. White or grey sand, clay, alluvium. Swamps, brackish estuaries, saline flats. Local native.	Plant and maintain at nine plants per m^2. Salt tolerant.
Juncus pallidus - Pale rush	*Basins and swales*	Rhizomatous, robust perennial, herb, 0.5-2m high. Fl. green, Oct to Dec. Clay. Swamps, watercourses. Local native.	Plant and maintain at nine plants per m^2.
Juncus subsecundus - Finger rush	*Basins and swales*	Colonial perennial, herb, 0.3-1m high. Fl. Oct to Dec or Jan. Clay. Swamps. Local native.	Plant and maintain at nine plants per m^2.
Melaleuca preissiana	*Periphery of basins*	Shrub or tree, 2-9 m high. Fl. yellow-cream-white, Nov to Dec or Jan to Feb. Sandy soils. Swamps.	No recommended density.

Note: Highlighted species are salt tolerant.

Other local native plants suitable for landscaping and rehabilitation include:

Trees: *Eucalyptus marginata*[1]*, Corymbia calophylla*, Banksia attenuata*, B. grandis*, B. sessilis* and Allocasuarina humilis**.

Shrubs (greater than 1m): *Adenanthos cuneatus, A. obovatus, Taxandria marginata, T. theiformis, Banksia grandis, Hakea amplexicaulis, H. ferruginea, H. lissocarpha*, H. trifurcata*,* and *H. undulata*, Kunzea sp. Lambertia inermis, Melaleuca striata, M. preissiana and Callistemon glaucus*.*

4.9 MAINTENANCE AND ONGOING MANAGEMENT

Strategies to maintain or improve water quality and on-going management will be undertaken during the subdivision construction phase and for two years after practical completion of major service infrastructure (roads, services, drainage system), including:

- Erosion, sediment and drainage controls during subdivision construction;
- Street sweeping of hotspots where sediment and debris concentrate (monthly to quarterly during construction phase, quarterly post construction);
- Removal of sediment build-up and litter layer in grassed swales (if required); and

[1] * denotes plant species favoured by the Threatened Carnaby's Cockatoo.

- Use of DoW guidelines for management of turfed areas, including fertiliser application (Department of Environmental Protection and Water and Rivers Commission, 2001).

4.10 MONITORING

Due to the previous rural based land use of the subject land, the proposed rural nature of the development and the recommendation to install approved alternatives to septic tanks for on-site treatment of effluent, ongoing monitoring of nutrients in the water management system is not likely to be necessary. Monitoring of the condition of swales and other water management infrastructure is recommended as part of the ongoing maintenance regime (Table M).

4.11 EDUCATION AND COMMUNITY ENGAGEMENT

Sustainable water management outcomes can be significantly enhanced through raising awareness of future residents of the subject land. Information will be provided to prospective residents (via real estate agents), encouraging the purchasers to be water efficient, plant low water use gardens and minimise the use of fertilisers. Existing information brochures and material will be used where appropriate including WaterWise brochures (Appendix 7).

4.12 PLANNING AT THE SUBDIVISION STAGE

When subdivision conditions have been set, an urban water management plan (UWMP) will be prepared, based on the requirements outlined in this LWMS. The UWMP need only be a simple document which outlines the detailed design of infrastructure and calculations that show that treatments can cater for the design criteria and the various ARI events. The UWMP will need to be reviewed and approved by the Shire of Plantagenet.

5 IMPLEMENTATION

The developer will be responsible for the implementation of the management actions presented in this LWMS, as well as the ongoing management and maintenance to the satisfaction of the Shire of Plantagenet for a minimum of one year following the practical completion of site works and construction of major services (roads, drainage system and lots).

Following this period, the Shire of Plantagenet will be responsible for the management and the ongoing implementation of water management actions as they relate to the road and drainage network. Table M outlines the management actions that have been identified as key components of this LWMS within the subject land.

TABLE M: MANAGEMENT ACTIONS, TIMING AND RESPONSIBILITY

ISSUE	ACTION	TIMING	RESPONSIBILITY
Water Conservation and Efficiency	Ensure water efficiency in new residences through requirement of water efficient fixtures and fittings (including taps and showerheads).	Building licence	Shire of Plantagenet
	For landscaping and planting in water management zones, select plant species that have a low requirement for water.	Post-construction	Initially developer, then Shire of Plantagenet
	Encourage installation of rainwater tanks (with outlets for emergency firefighting).		Developer/ Real Estate Agents Shire of Plantagenet
Planning and Management	Implement contingency actions if the performance of the stormwater management system is not meeting objectives set in this report.	Post-construction	Developer (in consultation with the Shire of Plantagenet)
Water Quality and Quantity	Finalise detailed design and construct water management features (including swales, tree pits, side entry pits, flush kerbs etc.).	Subdivision stage/ Endorsement of subdivision plan	Developer
	Implement the water management system outlined in this plan that ensures all stormwater generated up to at 1 year ARI event is retained within the subject land through the use of swales, side entry pits and similar structures. Locate these features strategically to minimise the extent of underground piping and maximise treatment of water	Subdivision stage	Developer

ISSUE	ACTION	TIMING	RESPONSIBILITY
	close to its source. All lots are expected to retain/dispose of stormwater onsite.		
	Ensure installation of approved alternative effluent disposal systems with phosphorus retention capabilities.	Building licence	Shire of Plantagenet
Maintenance	Sweep streets to reduce particulate build-up on road surface and gutters.	Monthly or quarterly during construction quarterly post construction	Developer and then Shire of Plantagenet
	Removal of sediment build-up, litter layer and debris in the bottom of grassed swales and other infrastructure.	During construction and on-going	Developer and then Shire of Plantagenet
	Mow road reserves and drainage reserves monthly (or as required) and dispose of clippings appropriately.	Monthly/on-going	Developer and then Shire of Plantagenet
Education	Provide information brochures to prospective residents regarding reducing use of fertilisers, planting water wise gardens, minimising pollutant runoff into waterways and reducing water use in households.	Sale of Lots	Developer

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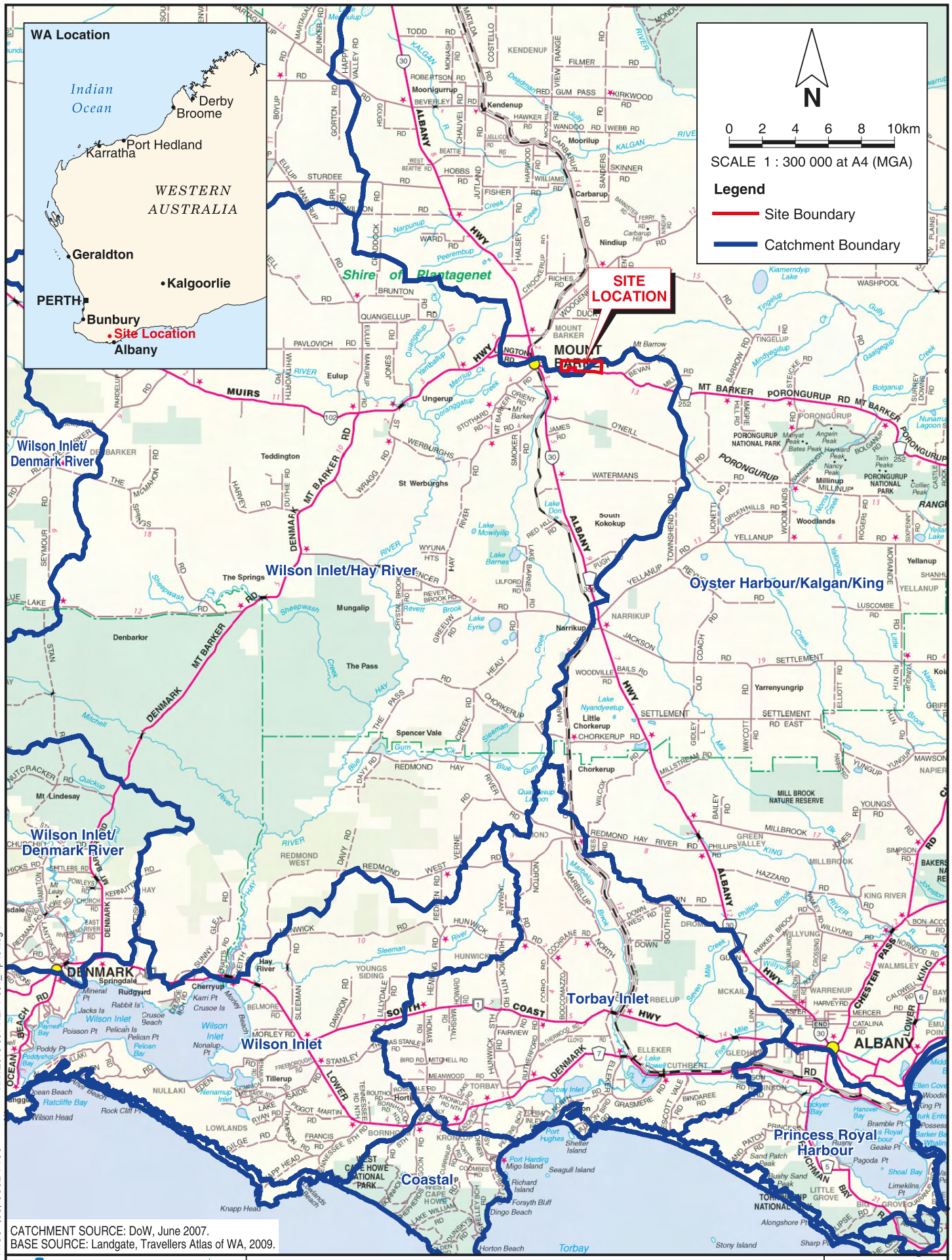
FIGURES



CATCHMENT SOURCE: DoW, June 2007.
BASE SOURCE: Landgate, Travellers Atlas of WA, 2009.

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PINPOINT CARTOGRAPHICS (08) 9562 7136

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Hambley Farm Landowners
LOT 51 PORONGURUP ROAD
MOUNT BARKER

Figure 1

REGIONAL LOCATION AND CATCHMENTS

Drawn: M. Price | Date: 10 Dec 2013 | Job: HAM2013-001

N

0 50 100 150 200 250m

SCALE 1 : 7 500 at A3 (MGA)

Oyster Harbour/Kalgan/King Catchment

Wilson Inlet/Hay River Catchment

Mount Barrow

MOUNT BARKER PORONGURUP ROAD

OATLANDS ROAD

Lot 51

1418.4m

998.9m

594m

613.7m

700.7m

408.9m

192.1m

195.5m

431.1m

558.2m

28.4m

543.4m

440.1m

563 000mE

564 000mE

6 168 000mN

6 167 000mN

R 50527 503

R 16271 504

R 16271 500

R 16447 501

26 100 261 260 130 129 128 127 126 31 46 47 48 277 276 275 349 4561 50 500 272 5082 919 813 4816

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Topographic Contour
- Watercourse
- Watergaining Area
- Catchment Boundary

CATCHMENT SOURCE: DoW, June 2007.
CADASTRE SOURCE: Landgate, November 2013.
AERIAL PHOTOGRAPH SOURCE: Microsoft Virtual Earth, flown November 2010.
WATERCOURSE AND CONTOUR SOURCE: Landgate 1:50 000 Topographic Mapping.

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LOT 51 PORONGURUP ROAD
MOUNT BARKER

AERIAL PHOTOGRAPH AND TOPOGRAPHY

Figure 2

Drawn: M. Price | Date: 10 Dec 2013 | Job: HAM2013-001

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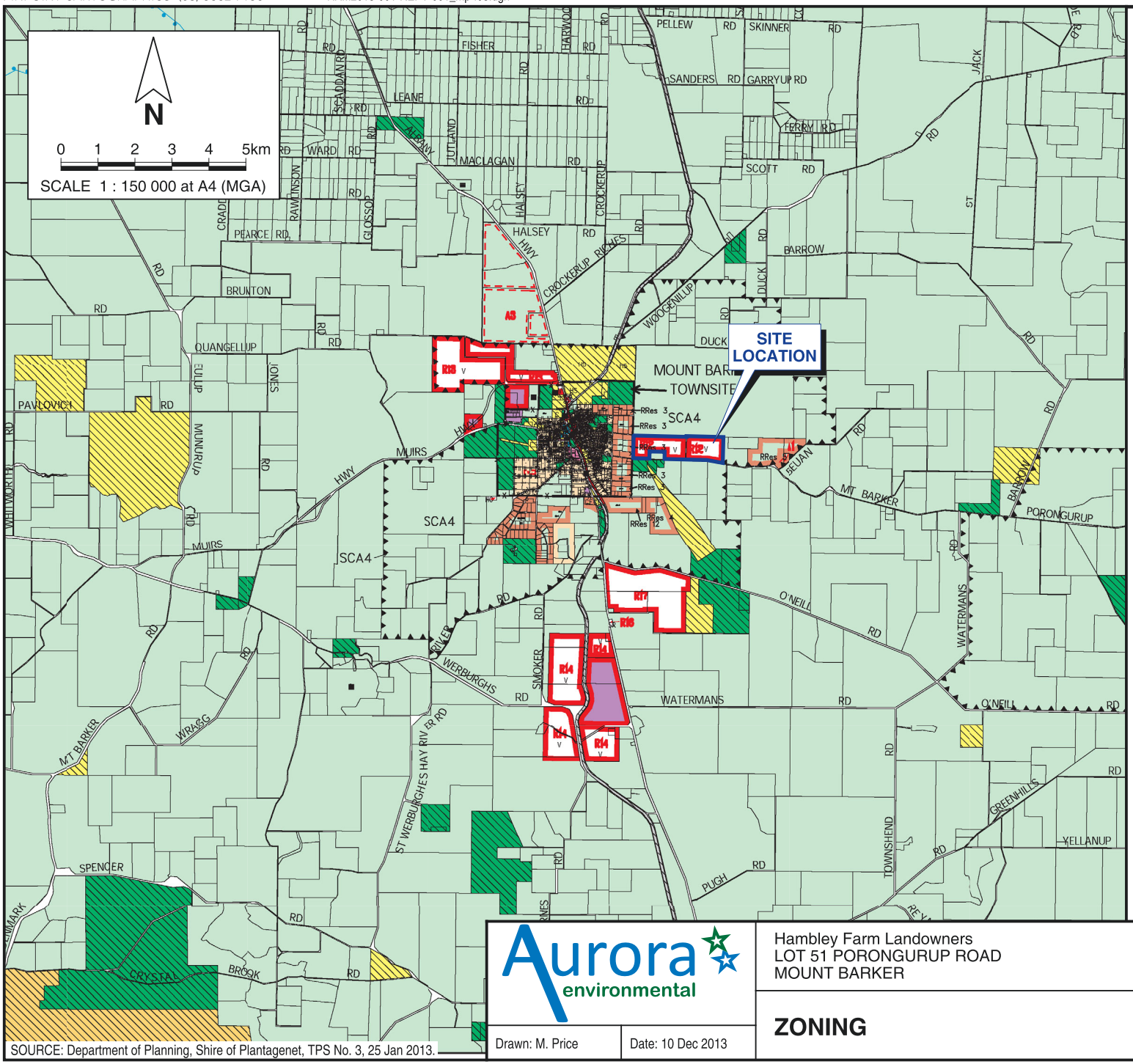
PINPOINT CARTOGRAPHICS (08) 9562 7136



SOURCE: Department of Planning, Shire of Plantagenet, TPS No. 3, 25 Jan 2013.

LEGEND

LOCAL SCHEME RESERVES

- FORESTRY
- MAIN ROAD
- PUBLIC PURPOSE
- PUBLIC PURPOSE DENOTED AS FOLLOWS:
  - A AMBULANCEDEPOT
  - BD BUSHFIRE BRGADE DEPOT
  - C CLUB
  - CD COUNCIL DEPOT
  - CE CEMETERY
  - CO COUNCIL
  - DH DISTRICT HALL
  - GC GOLF CLUB
  - H HOSPITAL
  - HA HALL
  - HS HIGH SCHOOL
  - I INFANT HEALTH
  - K KINDERGARTEN
  - P POLICE
  - PO POST OFFICE
  - PS PRIMARY SCHOOL
  - PWD PUBLIC WORKS
  - R REST ROOM
  - S SCOUT HALL
  - W CHURCH
- RAILWAY
- RECREATION

ZONES

- RESIDENTIAL
- SPECIAL RESIDENTIAL
- COMMERCIAL
- ENTERPRISE
- SPECIAL SITES
- SPECIAL SITES DENOTED AS FOLLOWS:
  - A ABATTOIR AND ASSOCIATED USES
  - HC HOLIDAY TIME-SHARE CHALET
  - LT LOW TRAFFIC GENERATING CAPACITY
  - M MOTEL
  - OC OTHER COMMERCIAL
  - R RESTAURANT
  - RA RABBIT ABATTOIR
  - SLT SERVICE STATION OR LOW TRAFFIC GENERATING
  - SR SERVICE STATION / ROAD HOUSE
  - SS SERVICE STATION
  - T SHOP / TEA ROOM / ACCOMMODATION - TOURISM
  - V VARIOUS - SIE SCHEME TEXT
- SPECIAL SITES
- SPECIAL SITES DENOTED AS FOLLOWS:
  - W WINE DISPLAY / STORAGE / RETAIL / MANUFACTURE
- INDUSTRIAL
- SERVICE INDUSTRIAL
- SPECIAL INDUSTRIAL
- LANDSCAPE PROTECTION
- RURAL
- RURAL RESIDENTIAL
- RURAL SMALLHOLDING
- RURAL VILLAGE

OTHER

- R CODES (R20)
- ADDITIONAL USES (A1)
- RESTRICTED USES (R1)
- SCHEME BOUNDARY
- LOCAL GOVERNMENT BOUNDARY
- TOWNSITE -- LAND ACT
- RURAL RESIDENTIAL AREAS (SEE SCHEME TEXT) (RRes 3)
- CATCHMENT AREAS
- LANDSCAPE PROTECTION AREAS (SEE SCHEME TEXT) (LP 1)
- KENDENUP SCA (SEE SCHEME TEXT) (SCA1)
- ROCKY GULLY SCA (SEE SCHEME TEXT) (SCA2)
- NARRIKUP SCA (SEE SCHEME TEXT) (SCA3)
- MT BARKER SCA (SEE SCHEME TEXT) (SCA4)
- PORONGURUP SCA (SEE SCHEME TEXT) (SCA5)
- STRUCTURE PLAN AREA (SEE SCHEME TEXT) (SPA1)
- PLACES OF HERITAGE VALUE - BUILDINGS (SEE SCHEME TEXT)
- NO ZONE

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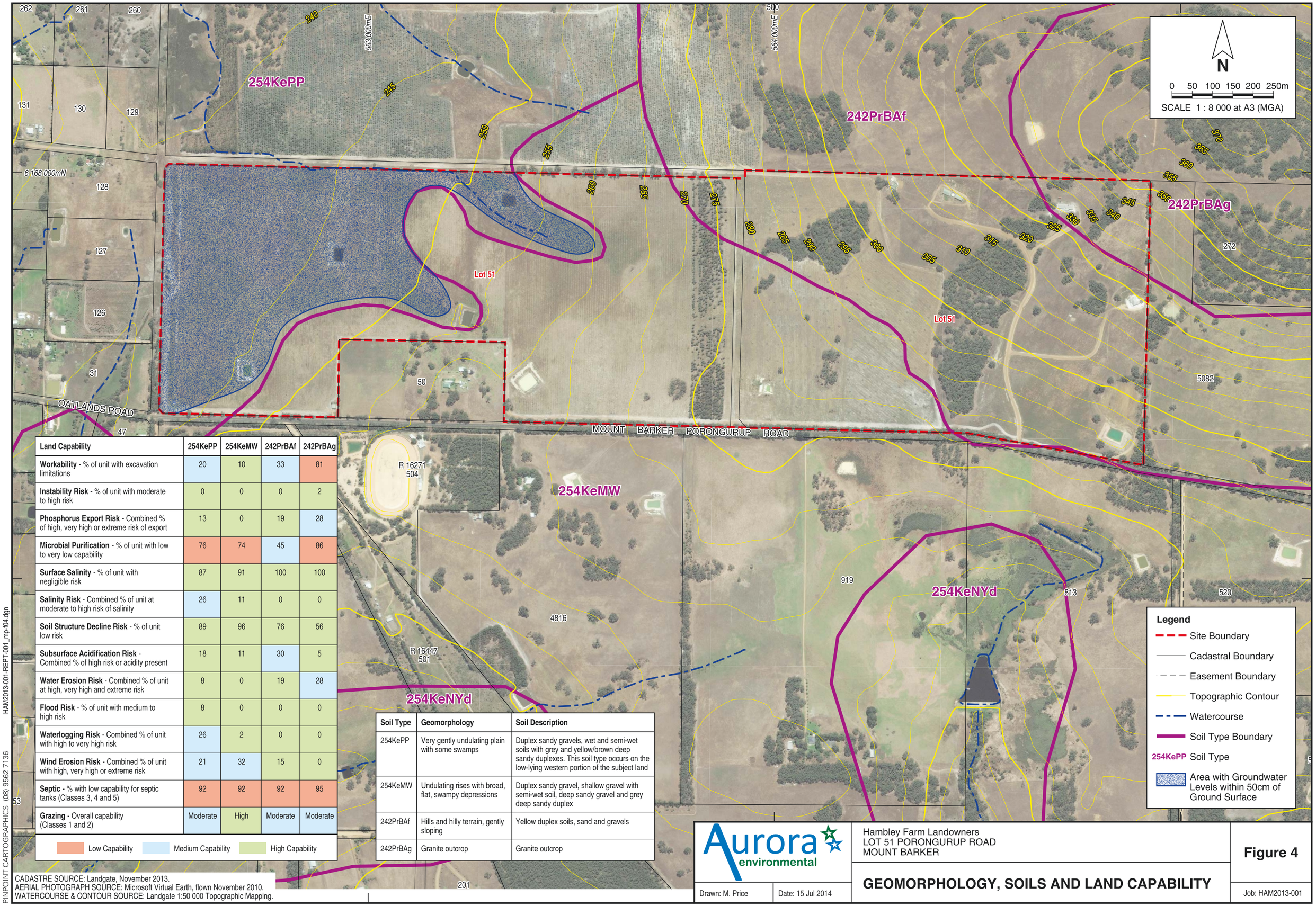
Hambley Farm Landowners
LOT 51 PORONGURUP ROAD
MOUNT BARKER

ZONING

Figure 3

Drawn: M. Price | Date: 10 Dec 2013 | Job: HAM2013-001



Land Capability	254KePP	254KeMW	242PrBAf	242PrBAg
Workability - % of unit with excavation limitations	20	10	33	81
Instability Risk - % of unit with moderate to high risk	0	0	0	2
Phosphorus Export Risk - Combined % of high, very high or extreme risk of export	13	0	19	28
Microbial Purification - % of unit with low to very low capability	76	74	45	86
Surface Salinity - % of unit with negligible risk	87	91	100	100
Salinity Risk - Combined % of unit at moderate to high risk of salinity	26	11	0	0
Soil Structure Decline Risk - % of unit low risk	89	96	76	56
Subsurface Acidification Risk - Combined % of high risk or acidity present	18	11	30	5
Water Erosion Risk - Combined % of unit at high, very high and extreme risk	8	0	19	28
Flood Risk - % of unit with medium to high risk	8	0	0	0
Waterlogging Risk - Combined % of unit with high to very high risk	26	2	0	0
Wind Erosion Risk - Combined % of unit with high, very high or extreme risk	21	32	15	0
Septic - % with low capability for septic tanks (Classes 3, 4 and 5)	92	92	92	95
Grazing - Overall capability (Classes 1 and 2)	Moderate	High	Moderate	Moderate

Low Capability | Medium Capability | High Capability

Soil Type	Geomorphology	Soil Description
254KePP	Very gently undulating plain with some swamps	Duplex sandy gravels, wet and semi-wet soils with grey and yellow/brown deep sandy duplexes. This soil type occurs on the low-lying western portion of the subject land
254KeMW	Undulating rises with broad, flat, swampy depressions	Duplex sandy gravel, shallow gravel with semi-wet soil, deep sandy gravel and grey deep sandy duplex
242PrBAf	Hills and hilly terrain, gently sloping	Yellow duplex soils, sand and gravels
242PrBAg	Granite outcrop	Granite outcrop

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Topographic Contour
- Watercourse
- Soil Type Boundary
- 254KePP Soil Type
- Area with Groundwater Levels within 50cm of Ground Surface

CADASTRE SOURCE: Landgate, November 2013.
AERIAL PHOTOGRAPH SOURCE: Microsoft Virtual Earth, flown November 2010.
WATERCOURSE & CONTOUR SOURCE: Landgate 1:50 000 Topographic Mapping.

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Hambley Farm Landowners
LOT 51 PORONGURUP ROAD
MOUNT BARKER

GEOMORPHOLOGY, SOILS AND LAND CAPABILITY

Figure 4

Drawn: M. Price | Date: 15 Jul 2014 | Job: HAM2013-001

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NOTES:

- Beard Vegetation Description: Medium forest: Jarrah (*Eucalyptus marginata* and *Corymbia calophylla*)

- IBRA Subregion "Southern Jarrah Forrest" (Commonwealth of Australia, 2004.)

N

0 50 100 150 200 250m

SCALE 1 : 7 500 at A3 (MGA)

563 000mE

564 000mE

6 168 000mN

Mount Barrow

Jarrah/Marri Woodland with *Taxandria theiforniis, Banksia grandis, Hakea amplexicaulis* and *Xanthorrhoea preissii*
G

Significant Mature Marri/ Jarrah in Road Reserve
CD

Cleared

Lot 51

Mature Marri Paddock Trees
CD

Blue Gums

Marri/Jarrah
CD

Vegetation Not Assessed in this Area (Previous Subdivision)

Marri Paddock Trees
CD

Marri/Jarrah
CD

OATLANDS ROAD

MOUNT BARKER PORONGURUP ROAD

Planted Local and Non-local Trees (Including Jarrah, Marri, *Eucalyptus cornuta*)

R 50527
503

R 16271
504

R 16271
500

Definition of Vegetation Condition Scale

Condition scale used in Bush Forever Volume 2 from B.J. Keighery (1994)

P - Pristine (1)
Pristine or nearly so, no obvious signs of disturbance

Ex - Excellent (2)
Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

VG - Very Good (3)
Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

G - Good (4)
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Deg - Degraded (5)
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

CD - Completely Degraded (6)
The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Watercourse
- Vegetation Type Boundary
- Marri — Vegetation Type
- CD — Vegetation Condition

CADASTRE SOURCE: Landgate, November 2013.
WATERCOURSE SOURCE: Landgate 1:50 000 Topographic Mapping.
AERIAL PHOTOGRAPH SOURCE: Microsoft Virtual Earth, flown November 2010.

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Hambley Farm Landowners
LOT 51 PORONGURUP ROAD
MOUNT BARKER

VEGETATION

Figure 5

Drawn: M. Price | Date: 10 Dec 2013 | Job: HAM2013-001

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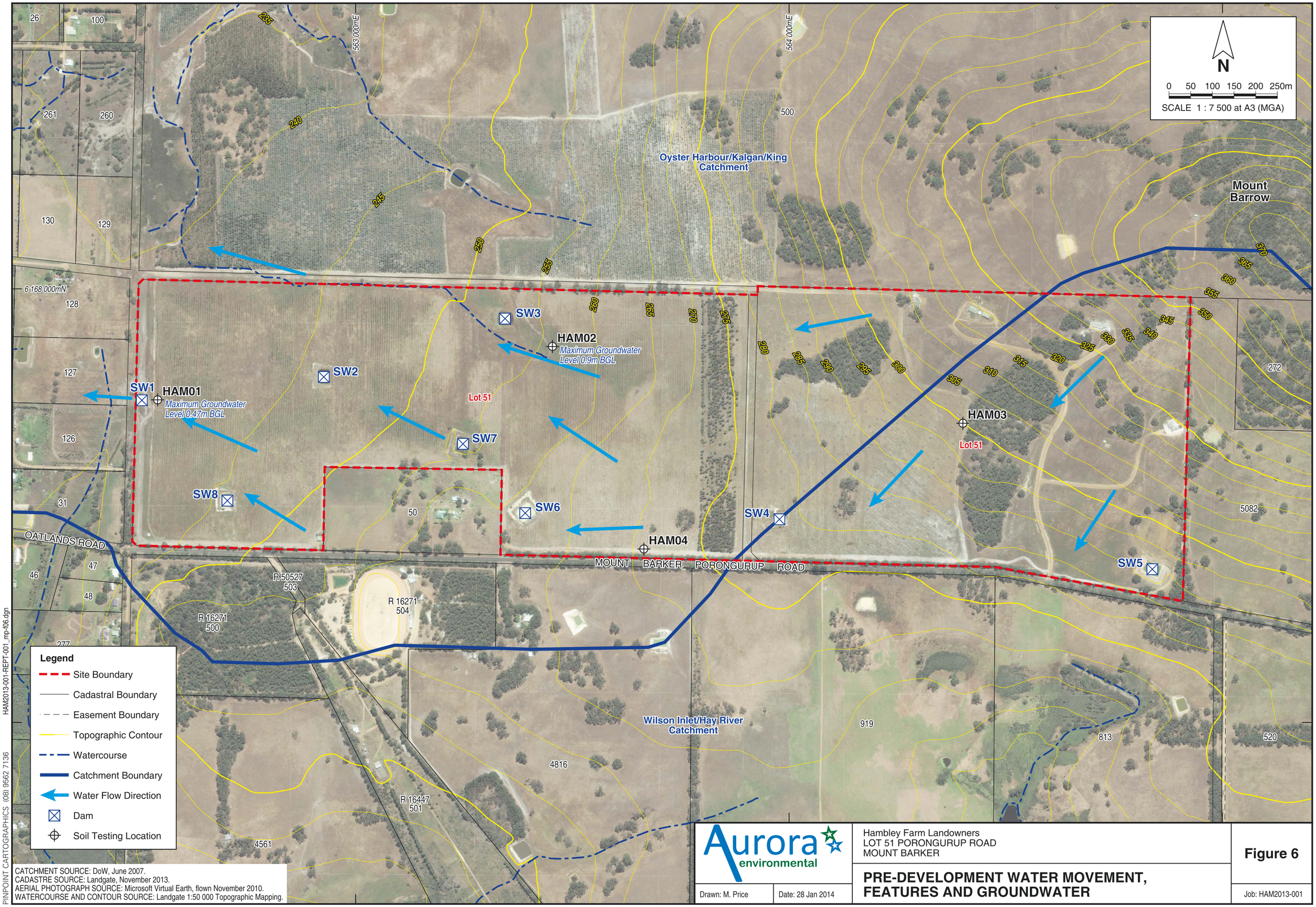

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Hambley Farm Landowners
LOT 51 PORONGURUP ROAD
MOUNT BARKER

Figure 6

PRE-DEVELOPMENT WATER MOVEMENT, FEATURES AND GROUNDWATER

Drawn: M. Price | Date: 28 Jan 2014 | Job: HAM2013-001