# ATTACHMENTS

## Development and Infrastructure Services Committee Meeting

**1 December2021**

6.00pm

City of Albany Council Chambers

# TABLE OF CONTENTS

# CITY OF ALBANY

# LOCAL PLANNING SCHEME NO. 1

# AMENDMENT NO. 12

AYTON BAESJOU
PLANNING

ABN: 15 061 140 172
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

**MINISTER FOR PLANNING**

**PROPOSAL TO AMEND A LOCAL PLANNING SCHEME**

| | |
|---|---|
| LOCAL AUTHORITY: | **CITY OF ALBANY** |
| DESCRIPTION OF LOCAL PLANNING SCHEME: | **LOCAL PLANNING SCHEME No. 1** |
| TYPE OF SCHEME: | **DISTRICT SCHEME** |
| SERIAL No. OF AMENDMENT: | **AMENDMENT No. 12** |

PROPOSAL:

*Rezoning Location 1879 Davies Road, Lower Kalgan from the 'General Agriculture' zone to the 'Rural Residential' zone and 'Parks & Recreation' reserve.*

# LOCAL PLANNING SCHEME No. 1

**AMENDMENT No.12**

## CONTENTS



*October 2014*

**PLANNING AND DEVELOPMENT ACT 2005**

**RESOLUTION DECIDING TO AMEND A LOCAL PLANNING SCHEME**

**CITY OF ALBANY**

**LOCAL PLANNING SCHEME No. 1**

**DISTRICT SCHEME**

**AMENDMENT No. 12**

RESOLVED that the Council, in pursuance of Section 75 of the Planning and Development Act 2005, amend the above town planning scheme by:

*Rezoning Location 1879 Davies Road, Lower Kalgan from the 'General Agriculture' zone to the 'Rural Residential' zone and 'Parks & Recreation' reserve.*

Dated this _____day of _____ _____

_____

**CHIEF EXECUTIVE OFFICER**

# CITY OF ALBANY

## LOCAL PLANNING SCHEME NO. 1

## AMENDMENT NO. 12

## PLANNING REPORT

## LOT 1879 DAVIES ROAD, LOWER KALGAN

# Contents

## 1. INTRODUCTION

Lot 1879 is located within a Rural Residential Development Precinct as set out in the City of Albany's Local Planning Strategy.

The policy for the area indicates that Council will generally support proposals for rural residential development subject to compliance with relevant general policies and management of identified issues.

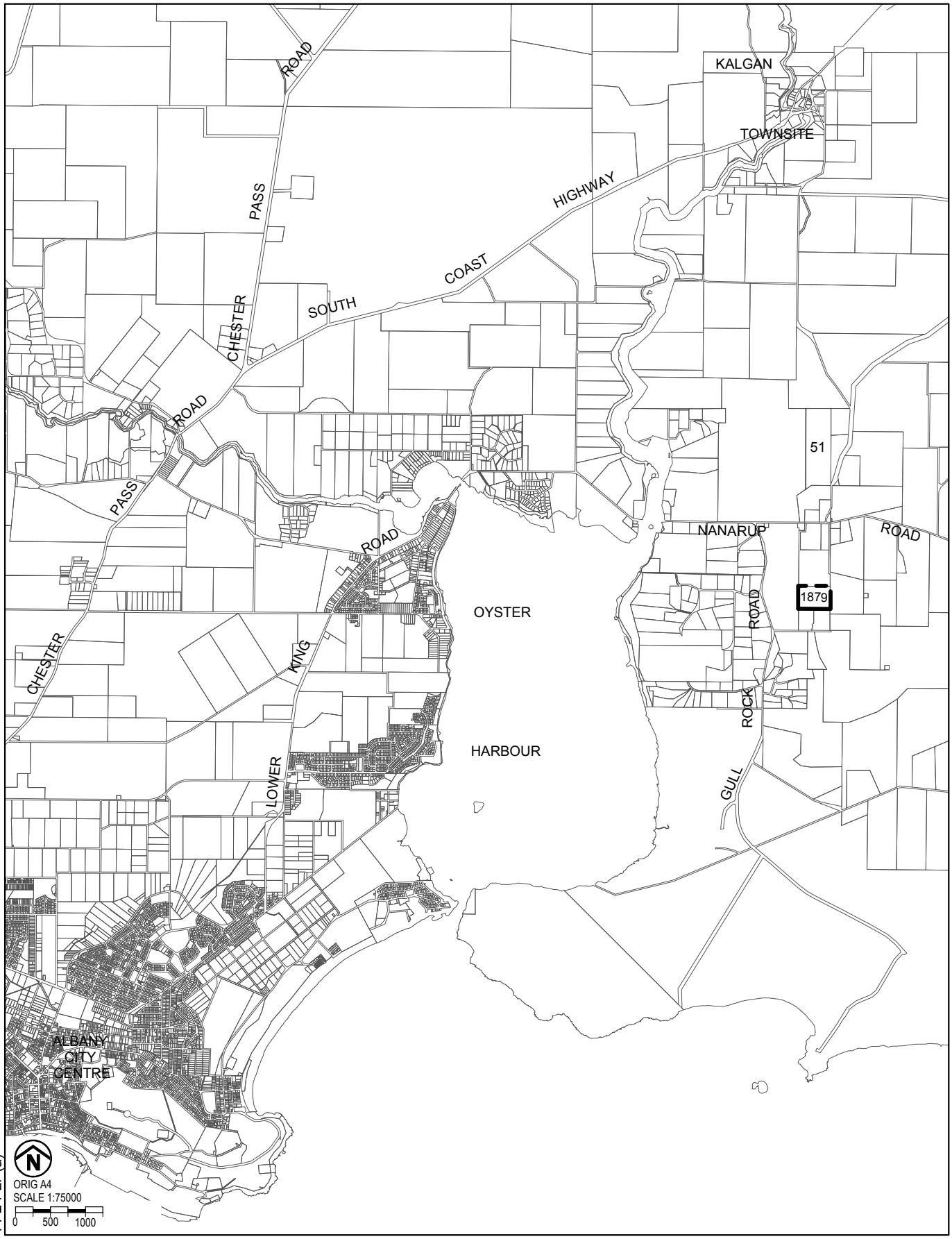
As the adjoining properties to the north and west have already been zoned for rural residential purposes and are currently subject to detailed subdivision application, the owners of Lot 1879 wish to extend that zoning so that infrastructure planning can be co-ordinated with the adjoining developer.

The following report provides background information in support of the rezoning.

## 2. LOCATION, AREA & ZONING

Lot 1879 is located between Nanarup Road and Davies Road, some 16 kilometres northeast from the Albany City Centre. Refer Location Plan. The site is located on elevated land with outstanding views over Oyster Harbour and King George Sound.

The property is 14.1640ha in area and is currently zoned 'General Agriculture' under the provisions of Council's Local Planning Scheme No. 1.




14-24-LP(a)

AYTON BAESJOU
PLANNING
66 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

LOCATION PLAN
Lot 1879 Davies Road
Kalgan, City of Albany

## 3. PLANNING CONTEXT

The key planning document within rural areas of the City of Albany is the Local Planning Strategy. As noted in the introduction, the property is located within a precinct identified for Rural Residential zoning, subdivision and landuse.

This has followed the rationale and arguments for same contained within the previous Rural Strategy as follows:

**Policy Justification**

a) Due to its undulating topography, scenic quality and the spectacular views it affords, the area has the potential for both rural residential development and small scale tourist development;

b) Land in the area generally has a high or moderate capability for housing development;

c) Revegetation of cleared areas and protection of existing remnant vegetation would be achieved as a result of subdivision; and

d) Sealed road access is available.

**Identified Constraints and Land Management Needs**

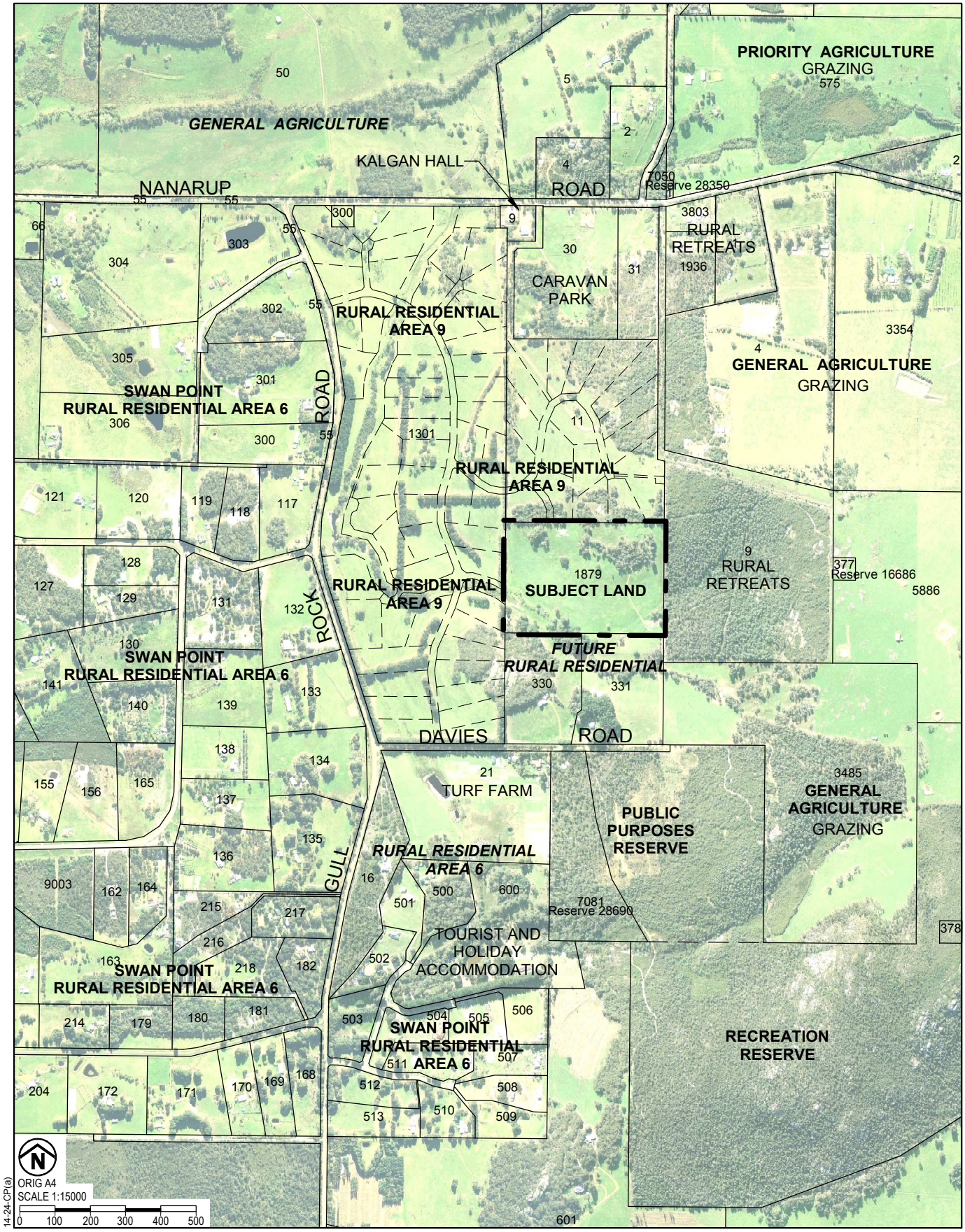
a) The area generally needs revegetation (particularly that part of the area adjacent to Gull Rock Road) and existing remnant vegetation needs protection from stock;

b) Low lying areas and creek lines need to be revegetated to prevent further erosion and minimise nutrient runoff;

c) Land uses need to be established such that nutrient losses to the Kalgan River and Oyster Harbour are prevented;

d) Some steep slopes are unsuitable for development (or where pole or pier construction may be appropriate);

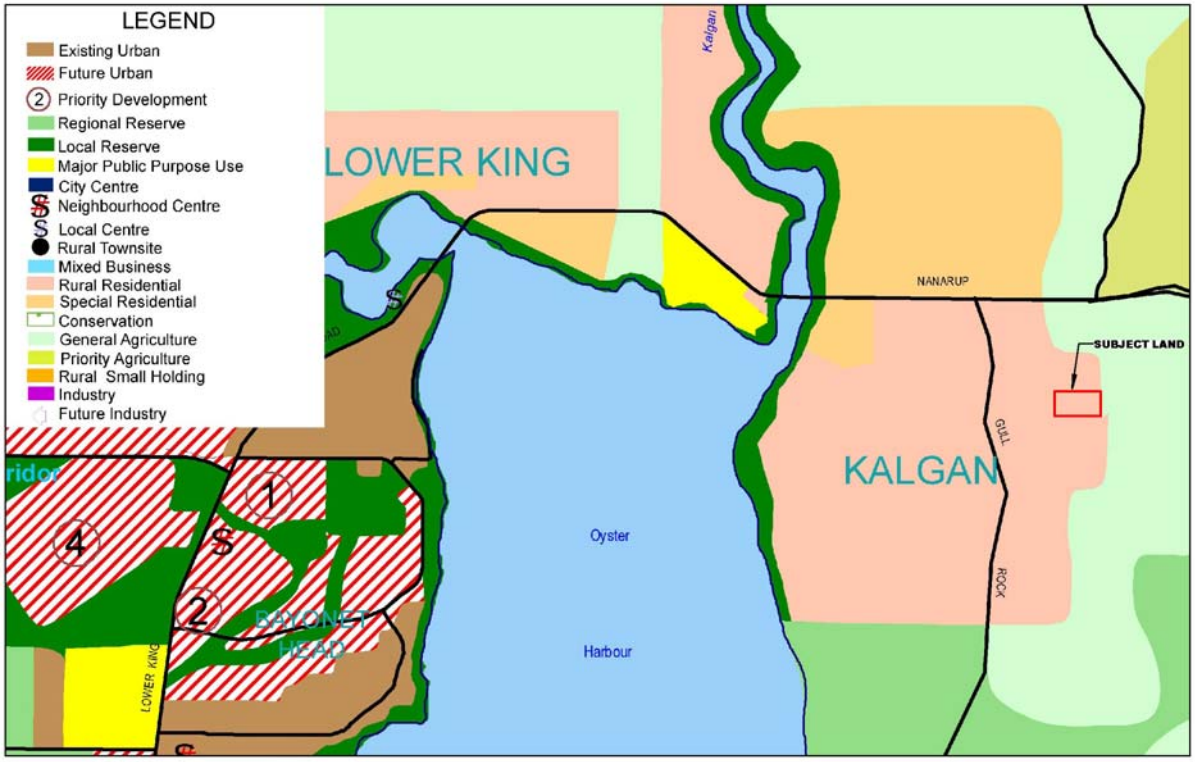
e) Some low lying areas may be unsuitable for development.




AYTON BAESJOU
PLANNING
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494



CONTEXT PLAN
Lot 1879 Davies Road
Kalgan, City of Albany




Excerpt from City of Albany Local Planning Strategy

## 4. SITE DESCRIPTION

*(REFER TO LANDFORM RESEARCH ATTACHMENT I)*

Location 1879 lies on the western flanks of Mount Mason North to the east of Oyster Harbour.

The land accommodates a substantial dwelling and associated outbuildings in the north east. Access is provided by a formal Right of Carriageway through to Davies Road.

The general area has been used for agriculture for many years. The more capable soils are cleared, although portions of the more rocky soils in the north of the site remain as grazed remnant vegetation. Properties in this area were first settled in 1834, when Patrick Taylor established a farm to the north of Nanarup Road.

The Lower Kalgan area has experienced changes in land uses in recent years with significant portions of the area being converted to small rural holdings and lots. The adjoining land to the west and north has been subdivided to rural living lots.

Some land use diversification has been locally occurring on a small scale, to orchards, horticulture, small scale tourist accommodation and hobby farms/rural industries.

## 5. EXISTING ENVIRONMENT

*(SOURCE: LANDFORM RESEARCH ATTACHMENT I)*

### 5.1 Geology and Geomorphology

The site lies on the western flanks of Mount Mason North dropping from ≈148 metres AHD in the north eastern corner down to 110 metres in the south western corner. Mount Mason North is a remnant granite/gneiss hill that has been of a similar form during recent geological time.

The granite and gneiss of Proterozoic age, with included occasional dolerite dykes were once covered by a laterite soil profile across the landscape, although this has been largely removed from Location 1879 apart from some gravel in some upper soil profiles.

Weathering of the granite to the east has released medium grained quartz sand that has been deposited in the small valley in the south.

### 5.2 Soils

Three main soils exist across Location 1879, reflecting the various regolith history of the weathering granite/gneiss basement.

**Brown Gravelly Loams** occur on the lower slopes in the east. These soils have yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils.

These loam soils are developed on the deep weathering profile of the granite/gneiss basement with laterite gravel shed from upslope and degeneration of the laterite soil profile added to the upper horizons.

Slopes are moderate.

**Brown Sand over Loam Duplex**

These occur on the lower slopes with sand to depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. The sands are medium grained quartz sand shed from weathering of granite up slope. Sand is more prominent at lower elevations along the creek line in the southwest.

These loam soils are developed on the deep weathering profile of the granite/gneiss basement with quartz sand shed from upslope being added to the upper soil horizons.

Slopes are moderate to steep.

**Rocky Loam**

Where the basement granite has been exposed in the north and northeast, brown loam and yellow brown loam with sandy surface horizons are present.

Basement granite/gneiss rock outcrop is frequent and slopes tend to be steeper.

The key soil types are listed below.

| KEY | SOIL TYPE | DESCRIPTION |
|---|---|---|
| S/L | Brown Sand over Loam Duplex | Medium grained quartz sand depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. Sand is more prominent at lower elevations along the creek line. Slopes are moderate to steep, becoming steeper upslope. |
| R | Rocky Soils | Dark brown loam grading to lighter clays between common and frequently large granite outcrops. Steep slopes. |
| GL | Brown Gravelly Loams | Yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils. Slopes are moderate to steep. |

## 5.3 Climate

Weather data is recorded at Albany, but the local climate may be slightly different due to the orographic effects of the slopes of North Mount Mason.

The overall climate however is warm, dry summers with cool, wet winters.

Rainfall at Albany is about 800 mm per year.

Temperatures have summer maxima of 25$^{O}$C in the hottest months down to just over 15$^{O}$C in the coldest months, July and August. Minimum temperatures range down to 10 $^{O}$ C in the coldest months. The cool winter temperatures can assist potential fruit crops that require a chill factor. Frosts are not common.

Annual evaporation is less than 1000 mm per year, with rainfall exceeding evaporation for almost nine months of the year.

## 5.4 Vegetation

The better soils have been cleared apart from scattered trees which generally remain on the upper slopes in the north which were not suitable for cultivation but have been grazed.

**Rare and Priority Species**

A search was made of the CALM and WA Herbarium databases prior to the site inspection. The perennial species listed on those databases are generally easily recognised and would be observable at this time of year. Whilst it was the wrong time of the year to observe annual species such as the Orchidaceae, they are unlikely to be present based on the lack of species, understorey and amount and continued grazing.

No Declared Rare or Priority species were observed during the site inspection.

The tree species are Jarrah *Eucalyptus marginata* in one patch in the central north with Marri *E. calophylla* in the remainder and on the slopes. One plant of *Kingia australis* was observed associated with the granite outcrop. The vegetation was probably originally Jarrah-Marri Low Forest. *Agonis linearifolia* Thicket occurs along the creek line, with the introduced Black Wattle *Acacia decurrens* occurring on the creekline in the central south.

**Species List**

All species noted during the site inspections are listed below:

| Family | Genus/Species | Remnant Jarrah-Marri Low Forest | Creek line |
|---|---|---|---|
| Dasypogonaceae | *Kingia australis* | X | |
| Mimosaceae | *Acacia decurrens** | | X |
| Myrtaceae | *Agonis linearifolia* | | X |
| | *Eucalyptus calophylla* | X | |
| | *Eucalyptus marginata* | X | |

**Vegetation Condition**

Remnant tree cover only occurs along the creek line and associated with the granite outcrops in the north.

The vegetation condition is classified as "Completely Degraded" with a clump of "Good" condition associated with the creek.

### 5.5 Surface and Groundwater

Water runoff from the area can be significant during storm events down the steeper slopes to the creek.

The quality of the water in the creek at the time of the site inspection was 70 mSm or 385 mg/L salt, which is fresh (potable <180 mSm).

No seepages were observed on the upper or lower slopes.

### 5.6 Fauna

The amount of fauna is directly related to the proportion of remnant indigenous vegetation. Even isolated trees have habitat potential and the clumps of remnant trees are correspondingly important. The scattered trees in the north, and the vegetation associated with the creekline, will provide habitat for birds, with some small reptiles likely to be associated with the granite outcrops. Frogs are likely along the creek line.

The survival of fauna is dependent on the retention of habitat, land uses on already cleared areas and education of landholders.

### 5.7 Heritage

**Aboriginal Sites**

The Department of Indigenous Affairs database has no known aboriginal sites recorded for the property. Clearing was commenced generally in the area in the mid 1830's and thus much of the site has been disturbed for many years. On the other hand aboriginal sites are known from nearby, such as the stone fish traps in Oyster Harbour. There are many developments in closer proximity to the fish traps than this site.

**European Heritage**

Whilst the site has been farmed for many years there are no heritage features on site.

## 6. HYDROLOGICAL ASSESSMENT

*(SOURCE: LANDFORM RESEARCH ATTACHMENT I)*

Surface water runoff can be significant from sloping land such as this during storm events and in winter when the soils are saturated.

Calculations of runoff can be estimated based on Coles and Moore, 1998, *Runoff and Water Erosion*, in Soil Guide, Agriculture WA, Bulletin 4343 which assumes approximately 70 mm runoff for an 800 mm rainfall and a 90% exceedance rate. Runoff from the granite outcrops is likely to be greater.

Small quantities of water could be captured by dams located on the slopes but without seepages these may not hold water through summer. Water is associated with the creek, and a bore or dam may be possible adjacent to the watercourse.
In general therefore there is only likely to be sufficient water for stock, and with small rural lifestyle lots scheme or other water may be required to supply stock.

A calculation of the quantity of water able to be captured can be made.

Using a conservative figure of 70mm runoff from the loamy slopes and say 100mm for steeper slopes this will generate 700 - 1000 kL/ha/year. Water harvesting techniques may have to be used. These would include:

- Forming contour drains feeding to storage dams in lower elevations. The contour drains will need to be cut into the clayey subsoils.
- Directing the collected water to dams.

Water quality is expected to be good and suitable for all uses.

Potable water can be readily provided by 90 000 - 140 000 litre rainwater tanks.

## 7. ALTERNATIVE LANDUSES

*(SOURCE: LANDFORM RESEARCH ATTACHMENT I)*

Whilst the site has some good quality soils, the soils are steep and there is a significant amount of rocky soils with granite outcrop. The site is also restricted by the creek in the south. Land to the and north has been subdivided to rural living. When taking into account all the factors, a change to rural living is possibly a likely and desirable outcome depending on planning issues.

A change of land use could provide reductions in nutrients and help satisfy market demands for lots of this type.

## 8. GEOTECHNICAL FACTORS

*(SOURCE: LANDFORM RESEARCH ATTACHMENT I)*

### 8.1 Foundation Stability

Whilst the site is underlain by granitic rocks, the steeper slopes and subsoil loam and clay require consideration when developed. However the soil conditions are similar to the steeper parts of the Albany townsite.

Restrictions on foundation conditions can be overcome by engineering input and design.

Slopes across the site vary from 10 to 15% with minor localised steeper areas.

Foundation stability is provided in the table below for the soil types present, but is generalised only for those soil types. Depending on the nature of the proposed development, the design and earthworks, Site Class P may apply. For example constructions requiring more than 400 mm natural fill and/or 800mm sand fill should be classified as Site Class P to ensure adequate compaction to prevent differential settling.

Winter rainfall has not been as great over the past few years and the soils are not as wet as they would have been previously. In a sequence of wet years it can be expected that the soils of the lower slopes would have higher moisture levels, based on the duplex nature of the soils.

**Management Actions** that may be used to improve foundation stability could include but not be limited, to the following. See Australian Geomechanics Journal March 2000 (*Landslide Risk Management*). The following are engineering practices for sloping soils that have been used, for example, in the construction of dwellings within the Albany townsite.

- Provide upslope cut off drains
- Do not load soils with water, up slope of developments.
- Minimise the depth of cut and fill.
- Ensure natural soil fill is adequately compacted, especially where dry clay is used as fill in summer.
- Provide retaining walls and structures for fill.
- Retain trees on steeper slopes and plant further trees.
- Consider the use of flexible or split level structures
- Secure or remove any loose boulders
- In some situations sub-surface drainage may be required.
- Place retaining walls on natural basement rock where possible
- Design for lateral creep pressures on slopes.
- Use rows of piers or strip footings orientated up slope on sloping ground.
- Design drains to minimise erosion.
- Minimise water loading of soils.

| **Soil Description** | **Foundation Soil Stability** | **AS 2870 Site Class** | **Ease of Excavation** | **Constraint which may be present. See Table in Appendix 3** |
|---|---|---|---|---|
| Brown Sand over Loam Duplex | Moderate | S - M * | Moderate to high | a c t |
| Rocky Soils | High | S - M * | Can be very low | a k n r v x |
| Brown Gravelly Loams | Moderate | S - M * | Moderate to high | ---- |

* Site Class P may apply. For example constructions requiring more than 400 mm natural fill and/or 800mm sand should be classified as Site Class P to ensure adequate compaction to prevent differential settling.
Individual site assessments are recommended for developments because soil conditions change laterally.

| **Geotechnical issue** | **Management** |
|---|---|
| Foundation Stability | • See the above Management Actions for some methods of reducing potential foundation limitations on steeper slopes and more clayey soils.<br>• Compaction of clay fills can be difficult when dry or may potentially expand when wetted. Clay is therefore not recommended for fill.<br>• Foundation stability for developments on the more gentle slopes is high, AS 2870 Site Class S but M on steeper slopes.<br>• Developments requiring more than 400 mm fill may be AS 2870 Site Class P with engineering input into the design and placement of footings.<br>• Clay based fill should not be loaded with water from above as this will decrease stability.<br>• Individual site assessments are recommended for developments because soil conditions change laterally. |

### 8.2 Drainage & Flood Risk

Flood data is not known, but on geomorphological and field evidence, the only risk areas are storm flows from upslope which will be minor and localised and along the creekline for which setbacks will apply.

| Geotechnical Issue | Management |
|---|---|
| Flood Risk | • Setbacks from the creek will be required. |

### 8.3 Stability of Dams

There is potential for dams to be located on slopes. Construction is recommended to be by an experienced operator because of the risk of slope failure for inadequate structures.

| Geotechnical Issue | Management |
|---|---|
| Stability of Dams | • Any dam should be constructed by or supervised by an experienced operator.<br>• Dwellings should not be located downstream of dams. |

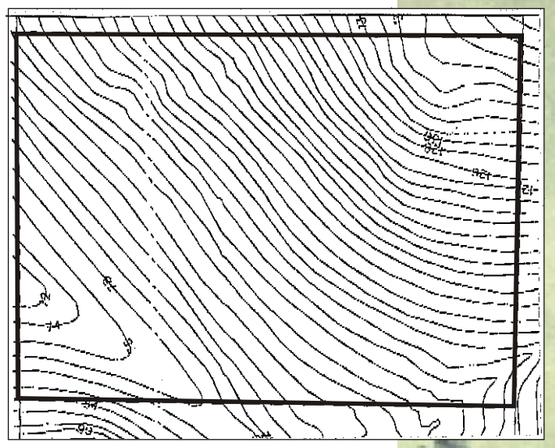
### 8.4 Capability for On Site Effluent Disposal

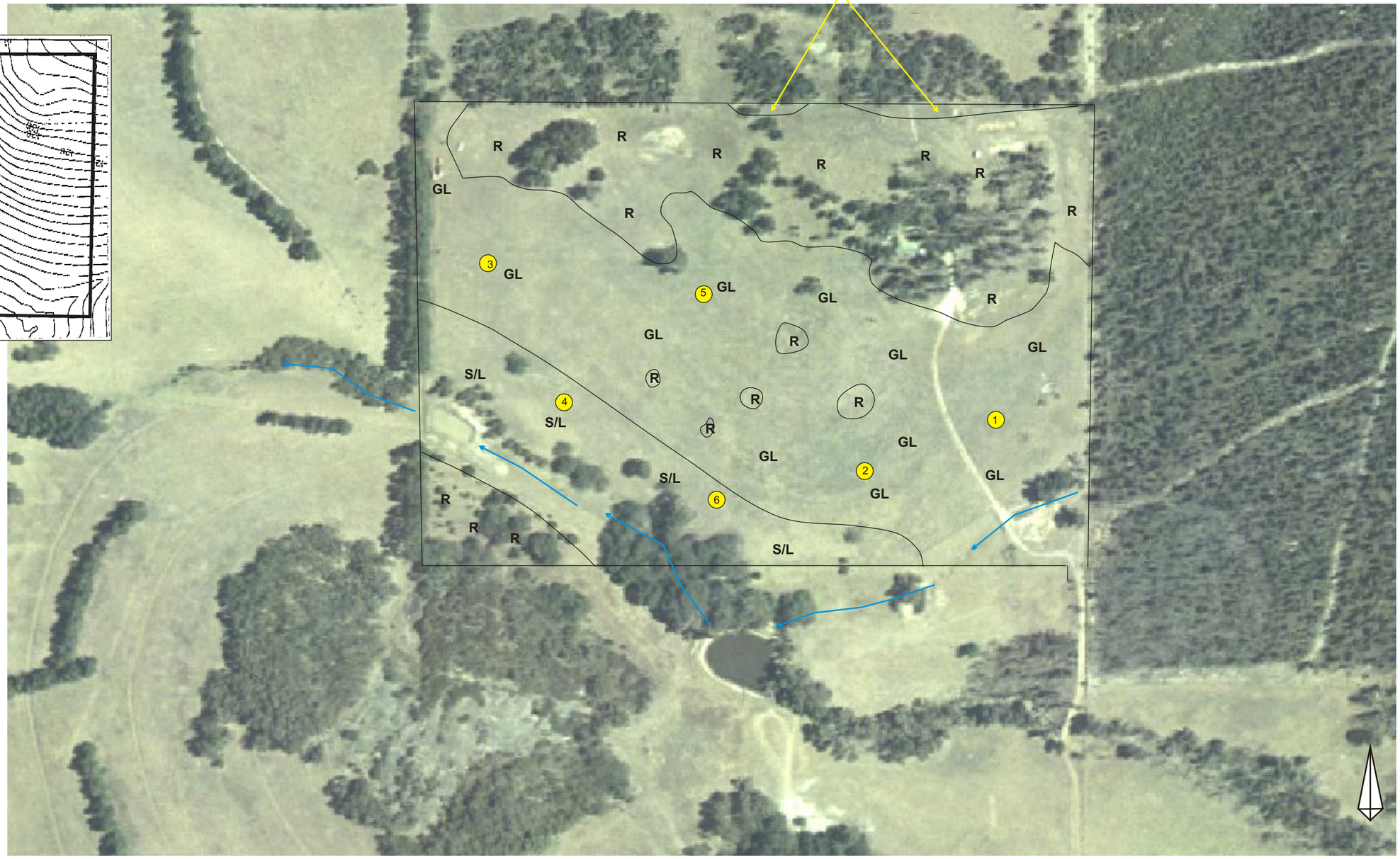
Phosphate Retention Indices (PRI) of all soils on site are high when compared to the database of type soils held by Landform Research for PRI and with Chemistry Centre data. However the sandy upper soil horizons that occur on top of some soil units have reduced water retention and therefore lower phosphate retention. For example wastewater could run laterally through the more sandy surface soils especially near the creek and not be retained for sufficient time within the soil profile.

PRI tests can frequently be misleading because all materials greater than 2 mm are sieved from the sample prior to testing. This means that a gravelly material will have the phosphate retaining gravel removed from the sample prior to testing, most likely resulting in a PRI value much different to the actual situation. On the other hand clay normally has a high PRI, but in the field duplex soils and reduced permeability means that nutrient enriched water will often not or only slowly penetrate the clay layer. This can show lower phosphate retention in the field than indicated by the PRI. In the case of the subject land interpretations of the nutrient management of the soils is felt to be more valid.

Nitrogen loss will occur in moist soil conditions through denitrification if water is retained for sufficient time. See 9.6 Nutrient Management.

| Soil Description | Effluent Disposal | Comment |
|---|---|---|
| Brown Sand over Loam Duplex | Low to High | See following Table |
| Rocky Soils | High where wastewater is contained in loam soils between outcrops, otherwise very low | See following Table |
| Brown Gravelly Loams | Moderate to High | See following Table |






| KEY | SOIL TYPE | DESCRIPTION |
|---|---|---|
| S/L | Brown Sand over Loam Duplex | Medium grained quartz sand depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. Sand is more prominent at lower elevations along the creek line. Slopes are moderate to steep, becoming steeper upslope. |
| R | Rocky Soils | Dark brown loam grading to lighter clays between common and frequently large granite outcrops. Steep slopes. |
| GL | Brown Gravelly Loams | Yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils. Slopes are moderate to steep. |

| KEY | SOIL TYPE | Foundation Stability | Effluent Disposal | Constraint See Table |
|---|---|---|---|---|
| S/L | Brown Sand over Loam Duplex | S-M* | Low to High | a c t |
| R | Rocky Soils | S-M* | Generally low but can be High where waste water is confined to loam soils | a k n r v x |
| GL | Brown Gravelly Loams | S-M* | Moderate to High | ---- |

* Site Class P may apply. For example constructions requiring more than 400 mm natural fill and/or 800 mm sand should be classified as Site Class P to ensure adequate compaction to prevent differential settling.

Individual site assessments are recommended for developments because soil conditions change laterally.

1 Soil Test Hole

0 100 100 150 200 METRES

| SOILS - LAND CAPABILITY | |
|---|---|
| LOCATION 1879, DAVIES ROAD, LOWER KALGAN | |
| Landform Research | November 2004 |
| Basemap DOLA Air Photo | Scale 1 : 3 000 at A3 |

**Permeability and Infiltration Results**

No permeability or infiltration tests were conducted on this site. Samples were conducted on the adjoining lots to the north and west in the same soil types and these can be used to indicate the permeability because they were undertaken in winter conditions.

Those infiltration tests were established according to the Health Regulations. However no aggregate was used and the holes were not scraped out the next morning because it was felt that this gives a more realistic reading, with the settled clays being similar to organic sludge that can accumulate in leach drains. Testing soils in this manner cannot compensate for any microspores in the soil due to invertebrate or other soil fauna activity that may not occur under a leach drain.

Based on those tests and soil observations some subsoils with a significant clay content had slow infiltration of greater than 60 minutes for 25 mm. The upper soil horizons were found to be better. Therefore inverted and semi inverted leach drains or alternative wastewater treatment systems are recommended.

| Geotechnical Issue | Management |
|---|---|
| Site Capability for Effluent Disposal | • Conventional septic systems are recommended to be inverted or semi inverted, and bunded by natural loam or gravel soils on the down slope side or installed with an impermeable membrane setback from the side of the leach drain on the down slope side to assist in waste water penetrating the natural soils.<br>• Alternative effluent systems are with wastewater disposal areas to be sized according to underlying subsoil permeability. 10L/$m^2$ is regarded as acceptable.<br>• Appropriate setbacks will be required from water bodies. A buffer of 50 metres for development and alternative wastewater disposal and 100 metres for a conventional septic system to the creek line is recommended.<br>• Stormwater drainage and retention may be required. |

### 8.5 Landscape Risk

The site is underlain by granitic basement close to the surface, with frequent outcrop in the central and northern parts.

An assessment of the Landslip Risk using Australian Geomechanics Guidelines lists a Low to Moderate Risk of minor structural damage such as separations, cracking and minor movements on the steeper slopes.

Potential slippage on slopes relates to foundation stability and is considered under 8.1 Foundation Stability. Under that section a range of potential management actions are listed, based on the Australian Geomechanics Society Guidelines, together with the site classification based on AS2870. Some sites may require a Site Class P where engineering input is required.

| Geotechnical Issue | Management |
|---|---|
| Landscape Risk | • Covered by the considerations in 5.1 Foundation stability. |

## 9. ENVIRONMENTAL MANAGEMENT

*(SOURCE: LANDFORM RESEARCH ATTACHMENT I)*

The following items are identified as the most likely to impact on the environment. These items can be managed by the implementation of the management recommendations. Other items are unlikely to impact or the impact is regarded as small.

### 9.1 Aesthetics

The site lies to the south of Nanarup Road protected visually from Nanarup Road by being located on a south facing slope.

Portion of the site will be able to be seen from Gull Rock and Davies Road, but only as glimpses.

Developments will be partially protected by existing vegetation on site and on adjoining properties.

The colour and style of developments should be visually compatible with the area.

| Environmental Issue | Management |
|---|---|
| Remnant Vegetation | • Development should include preservation of existing remnant vegetation.<br>• Mature trees should be preserved and protected from grazing pressure. |
| Dwellings, fences and other developments are to be aesthetically compatible with the area. | • Restrictions can be placed on the use of visually non compatible materials. |
| Potential Land Uses | • Scattered dwellings on smaller rural holdings are becoming more common in the Kalgan area, even on sloping sites. For example adjoining subdivisions to the north and west.<br>• The existing trees, landform and roadside vegetation provide screening from most of the surrounding areas. |

### 9.2 Preservation of Agricultural Land

Whilst the site has some good quality soils they are steep (for agricultural purposes) and there is a significant amount of rocky soils with granite outcrop. The site is also restricted by the creek in the south. Adjoining land to the north and west has been subdivided to rural living.

The site forms a disjointed smallholding in an area currently experiencing subdivision pressure and therefore this loss of less productive land will not be significant.

| Environmental Issue | Management |
|---|---|
| Protection of Agricultural Land | • Significant constraints apply to agriculture use on site and the loss of this type of land is not considered significant. |
| Soil Preservation | • Restrictions could be placed on stocking rates to Agriculture WA standards, to ensure soil preservation on the soils. |

### 9.3 Landuse Buffers

The adjoining land to the north and west has been subdivided to rural living and thus the land use on site is compatible with those land uses. Dwellings are present to the south and the land to the east is remnant vegetation.

| Environmental Issue | Management |
|---|---|
| Lot Sizes | • Lot sizes are more related to planning issues than land capability. Most soils are capable of effluent disposal systems on lots as small as 2 000$m^2$, although planning and servicing considerations will determine the actual lot sizes, which will be larger than this minimum size. |
| Buffers | • No special buffers required. |

### 9.4 Rivers & Streams

There is only one watercourse in the south of the site.

A buffer for development from this creekline is recommended. This could be 50 metres for development and alternative wastewater disposal and 100 metres for a conventional septic system. Natural regeneration (*Agonis linearifolia*) of this buffer would occur from the existing vegetation if stock were excluded and the *Acacia decurrens* are removed.

| Environmental Issue | Management |
|---|---|
| Stream Side Vegetation | • It is recommended that there be no clearing of the vegetation along the watercourse. |
| Stream Flows | • Stream flows entering the site are unlikely to be available to future landholders who may not hold riparian rights. Environmental flows should be maintained, and any dam or bore should be set back from the watercourse. |

### 9.5 Flora & Fauna

The only remnant vegetation are scatted Eucalypt trees (see 5.4 Vegetation).

Stream side vegetation should be retained. There is an opportunity to form a corridor along the creek line to link to the remnant vegetation to the east.

The protection of flora, fauna and biodiversity depends on the maintenance and enhancement of habitat. As the vegetation is recommended to be retained and linkages upgraded, the existing fauna is unlikely to be significantly impacted on by any changes in land use on the existing cleared areas.

| Environmental Issue | Management |
|---|---|
| Flora and Fauna Corridors | • Mature trees should be preserved where possible.<br>• Clearing restrictions and the use of building envelopes are recommended to be applied to the remnant trees.<br>• Stream line vegetation and vegetation associated with rock soils and outcrops should be protected.<br>• It may be possible, when considering additional screening belts, to link the vegetation remnants along the creek towards the remnant vegetation to the east. |
| Remnant Vegetation | • See Flora and Fauna corridors above. |

### 9.6 Nutrient Management

Currently potential nutrient export comes from the washing of fertiliser, soil particles and manure down the sloping soils to the creek line during the significant rainfall events. The worst time for nutrient export from grazing is during summer storms and in winter when the soils are saturated.

The presence of dung beetles increases the rate of nutrient recycling and thus reduces the potential for nutrient export.

As the site is proposed for rural smallholdings wastewater disposal will be the main issue.

**Effluent Disposal**

The capability of the soils for wastewater disposal is considered under 8.4 Capability for Onsite Effluent Disposal. This section considers the fate of nutrients and their potential to be exported from the site.

The main issue with effluent disposal is the design and placement of the system to ensure adequate microbial purification and retention of nutrients. The gravelly loam and loam soils have high capability for wastewater disposal. However the duplex nature of the sandy upper horizons and slower permeability of the subsoils mean that consideration must be given to the potential for lateral leakage.

Research by Gerritse et al 1995A, on leach drains servicing septic tanks in the Perth Hills in gravel soils, shows that under wet conditions nitrogen is effectively lost within 10 metres. Other studies, for example Dawes and Goonetilleke, found that all nitrogen can be lost within 1 metre in damp soil conditions. Moist soils in the Albany area would behave in a similar manner and contribute to nitrogen recycling back to the atmosphere.

Gerritse et al, 1995B, found that all phosphate was adsorbed within 2 metres from a 7 year old leach drain in Yarrigal loam soils that are not unlike the loam clay soils on site, and within 5 metres for a 6 year old leach drain in Dwellingup Gravels which have some similarity with the gravelly loam soils. Gerritse and Adeney 1992, in an analysis of urban areas in the hills of Perth on lot sizes as small as 2000m$^2$, found that the export of nutrients in streams was low, in the order of micrograms/litre. Nitrogen losses were only 5% of the input concentrations. These soils are not dissimilar to those on the study site. Thus when properly installed it is not expected that there will be a significant nutrient impact arising from residential and small rural holdings on appropriately sized lots.

Leach drains of conventional septic systems are suitable but should be inverted or semi inverted. Leach drains installed in these soils are recommended to be bunded by natural soil to prevent wastewater short circuiting the soils. On the other hand alternative waste water systems are acceptable. When wastewater penetrates the soils, good nutrient management and microbial purification should result.

**Nutrient Loadings and Stocking Rates**

Stocking rates for soils of the site are estimated to be 10 DSE for dry pasture and where limited supplemental feed is supplied. Stocking rates should be to Department of Agriculture recommendations.

Estimations of the actual nutrient loading at this stage are difficult because the nature of any alternative land uses is not known in addition to the fate of nutrients as a result of denitrification, volatilisation of ammonia, recycling, uptake by vegetation and soil phosphate adsorption.

With a current average stocking rate of 10 DSE, the estimated nutrient loading when fully stocked with sheep or equivalent numbers of stock could be 106 kg/N/ha/year and 14.63 kg/P/ha/year. The likely nutrient loading and its potential export following subdivision and potential changed activities can only be estimated because of the variable nature of the land uses possible.

A typical conventional septic system releases 5.5kg P year and 18 kg N/year. However allowing for six chickens, a dog and cat and a 250m$^2$ area of fertilised horticulture, a further loading of 12.3kg N/year and 5.2 kg P/year can be added for the dwelling area. (Data from Select Committee on Metropolitan Development and Groundwater Supplies, Legislative Assembly 1994 and Nitrate management in the Jandakot UWPCA, Dames and Moore, undated). One horse is estimated at 60 kg/N/year and 11 Kg/P/year, and one sheep 10.06 kg/N/year and 1.47 Kg/P/year. Data for cattle from Select Committee on Metropolitan Development and Groundwater Supplies shows cattle as 57.4 kg/N/year and 17.6 kg/P/year. The value for phosphorous may be too high for cattle not fed introduced feed.

Data for typical land uses listed below, which might be used at some stage in the future, show that overall nutrient loading is unlikely to rise with changes in land use, and with continued grazing there will also be no change.

**Typical nutrient loadings of some land uses**

| Possible lot size and activity | Nitrogen loading per hectare | Phosphorous loading per hectare | Likely nutrient scenario |
|---|---|---|---|
| Estimated average current stocking rate over the whole property 10 DSE per hectare | 106 kg/N/ha/year | 14.63 kg/P/ha/year | Possible nutrient loss through washing of dung down slope during waterlogged conditions and during storms. |
| 2 hectare rural living property, conventional septic system, garden, dog and cat as listed above and 1 horse | 45.2 kg/N/ha/year | 10.9 kg/P/ha/year | Unlikely to be nutrient export when correctly established. |
| 0.5 hectare rural living property, conventional septic system, no stock, but garden and dog and cat as listed above | 60.6 kg/N/ha/year | 21.4 kg/P/ha/year | Unlikely to be nutrient export when correctly established. |

| Environmental Issue | Management |
|---|---|
| Effluent Disposal | • Soil types are suitable for conventional septic systems with some care required in the sand over clay duplex soil types.<br>• See 5.4. |
| Potential Water Pollutants | • Surface run off from hard surfaces should be fed through detention basins and soak wells.<br>• Constructed dams should incorporate sediment traps.<br>• Normal soil management practices such as maintaining adequate pasture filter strips, contour cultivation, contour banks as necessary and sediment traps will reduce potential loss of solid particles.<br>• Dung beetles are active on the site in winter, reducing potential nutrient loss from stock.<br>• A buffer of 50 metres for development and alternative wastewater disposal and 100 metres for a conventional septic system to the creek line is recommended. |

### 9.7 Salinity

There is no evidence of salinity. In granite country such as this where the soils are relative shallow and the rainfall high, the salt is normally already flushed out and there is little risk of significant increases in salinity. Minor salt is added from wastewater but this is not considered significant considering the likely lot sizes.

Surface water tested was less than 70 mSm (potable water < 180 mSm).

The potential impact on salinity is therefore regarded as low and it is unlikely that there will be any changes to salinity as a result of more intensive land uses.

| Environmental Issue | Management |
|---|---|
| Salinity | • Unlikely to be any significant changes to the regime. |

### 9.8 Stormwater, Erosion Potential and Soil Management

The potential for wind erosion of the site is minimal in soils such as this.

Potential water erosion is confined to the steeper slopes, drainage lines and gutters which direct and concentrate water. Currently there is minor evidence of water erosion in the eastern gully.

Some management activities that could be used to prevent soil degradation could include:

- constructing roads, fence lines and firebreaks in locations which are less likely to lead to soil erosion.
- planting deep rooted species.
- agricultural practices suited to the retention of adequate vegetation over summer, use of perennial species etc.
- utilisation of grassed waterways, drains and filter strips.
- minimisation of vehicular traffic to prevent compaction.

With subdivision and development there is potential for further planting of trees to assist soil management.

Stormwater from hard surfaces can either be detained on site or directed over broad areas such as swale drains and the like or shallow detention wetlands prior to release to the water course. On the other hand the storm water could be directed to storage dams for use on site. Road drainage and other surface drainage facilities should have baffles and other restraining devices built into them to minimise erosion.

| Environmental Issue | Management |
|---|---|
| Water Erosion | • EPA Guidance Number 26, Management of Surface Runoff from Industrial and Commercial Sites (draft) 1999.<br>• See Engineers Australia 2003, Australian Runoff Quality, National Committee on Water Engineering.<br>• Stormwater Management Manual for Western Australia, Department of Environment WA, 2004.<br>• Guidelines for Groundwater Protection in Australia, ARMCANZ, ANZECC, September 1995.<br>• Environmental Protection Authority Victoria/ Melbourne Water, undated, Urban Stormwater, Best Practice Environmental Management Guidelines<br>• Water and Rivers Commission, 1998, Manual for Managing Urban Stormwater Quality in Western Australia.<br>• Surface run off from hard surfaces could be fed through shallow vegetated detention basins that can act as wetlands, prior to emptying to drainage lines<br>• Dung beetles are active on the site in winter, reducing potential nutrient loss from stock.<br>• Swale drains and detention basins could be formed as grassed areas, 300 mm deep, with a 1 : 10 year rainfall event retention time of 20 hours. (See Water and Rivers Commission, 1998, *A Manual for Managing Urban Stormwater Quality in Western Australia*, Water and Rivers Commission. See 3.17 Grass Swales (BMP14) page 100 and Extended detention Basins (BMP17) page 108 of that document).<br>• Stormwater from roofs could be used as a potable water source or should be retained on each lot.<br>• Agricultural practices should reflect the sloping nature of some soils<br>• Maintenance of adequate vegetation through summer is normal best practise to reduce the potential for soil erosion. |
| Wind Erosion | • No special recommendations required. |

See the Local Water Management Plan (Attachment II) for management strategies.

### 9.9 Fire Management

A detailed Fire Management Plan has been prepared and is included as Attachment III.

### 9.10 Social Impacts

The social impact of possible changes to rural living will be similar to the impacts arising from the subdivisions to the north and west. This subdivision is much smaller and therefore any changes are likely to be minor. Location 1879 is only 14 hectares.

Diversification of land uses can be of significant benefit to the local community through the provision of additional tourist facilities, and the introduction of more residents to the area.

| Environmental Issue | Management |
|---|---|
| Social Impact | • No action necessary apart from protection measures. |

## 10. PROPOSED DEVELOPMENT

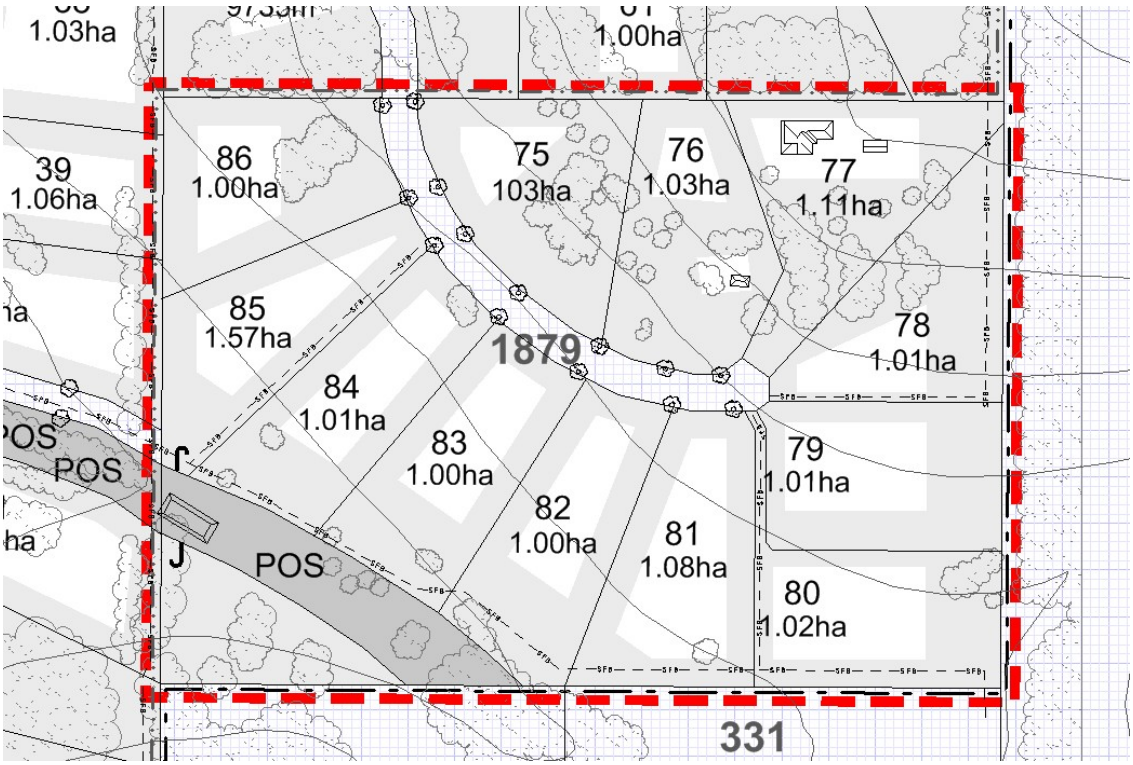
Based on the environmental assessment carried out by Landform Research, the most appropriate use of the land is for rural retreat purposes. This is in contrast to larger hobby farms which would encourage the agistment of stock and possible horticultural activities. Given the steeper slopes, such activities would have the potential for nutrients to be exported to the creekline in the southwest corner of the property and ultimately into Oyster Harbour.

Smaller retreat lots based on the minimum lot size of 1ha are recommended and will conform with applicable strategy and the rural residential development to the north and west.

A following plan has been prepared to indicate how the property may be subdivided for rural retreat/lifestyle purposes.

One of the constraints associated with this property is the lack of a gazetted road frontage. Currently road access is made via a Right of Carriageway (ROCW) across the eastern boundary of the adjoining property to the south through to Davies Road.

Road access for the development will be provided via Lot 11 to the north and for emergency purposes through Lot 1301 to the west. The ROCW to Davies Road can also be retained for emergency access purposes.




Excerpt from Subdivision Guide Plan

Key elements of the subdivision and development proposal are outlined below.

**Public Open Space**

An area of public open space is designated to protect the creekline which runs through the southeast corner of the property. This area will link up with the POS on Lot 1301 to the west thereby providing a vegetated corridor which runs down to Gull Rock Road, Nanarup Road, across into Candyup, with proposed links to Mount Boyle and down to the Kalgan River. The POS can also ultimately link through Lots 330 & 331 to the south and then east into the reserves on Mt Mason. Revegetation associated with this extensive corridor will provide a strategic buffer helping to minimise nutrients washing into the creek as well as a corridor for local fauna.

**Protection of Remnant Vegetation**

Building envelopes are designated for each lot and will ensure building does not occur within areas of existing remnant vegetation. Due to the lack of understorey and open nature of parkland cleared areas (noted as completely degraded), boundary fencing for Lots 77 & 78 can be provided without impact.

The small area of good quality remnant vegetation associated with the drainage line is protected by being located outside of identified building envelopes and being located within the public open space network.

**Access**

Provision of access from Lot 11 to the north will enable the subdivisional road to be constructed along the contour as far as possible. This will help to minimise the impact of drainage flowing downslope to the creekline. The road and associated swales will act as an interceptor drains managing overland flow during heavy rain events, also helping to minimise erosion and reduce the export of nutrients.

While an additional access point has been provided from Lot 1301 to the west, this is not required for subdivisional purposes for lots of 1ha in area. It will however provide an alternate emergency access and egress point and access along the creekline.

**Services**

Scheme water will be provided to each lot with fire hydrants provided as per policy. Underground power and telecommunications will also be provided to each lot. Effluent disposal will be carried out on site taking into account the detailed recommendations outlined in Section 8.4 of the environmental assessment. Drainage management will follow the recommendations in the Local Water Management Plan (Attachment II).

**Management Provisions**

Comprehensive management provisions have been incorporated into Council's Local Planning Scheme for the Rural Residential development on and to the north and west of the subject land and apply in addition to the Policy Plan. A copy of the existing provisions and policy plan are included in Attachment IV.

As the landform and management issues are similar it is proposed that this development be included into the same zone area. This action removes the need for a separate Policy Plan for Lot 1879 by including provisions specific to the requirements of Lot 1879; requirements such as fire safe construction standards, assessment of foundation zone to inform foundation design, hazard separation area requirements and creekline protection.

## 11. CONCLUSION

Lot 1879 is located within an area specifically identified for the proposed form of subdivision and development. Land to the north and west has already been zoned Special Rural and an approval for the initial stage has issued. This proposal has been designed to integrate with the adjoining development, particularly in relation to roads, emergency access and creekline/vegetation corridor protection. Similar lot sizes are proposed which are designed to maximise the enjoyment of the exceptional views over Oyster Harbour and King George Sound.

Due to the comparatively steep slopes for agricultural use, remnant vegetation, granite outcrops and the creekline, Rural uses are not considered viable in the main and would present ongoing concern in terms of nutrient runoff into the waterways.

Rural retreat development, coupled with the proposed comprehensive management provisions is recommended and is in conformity with Albany Local Planning Strategy and associated policies.

# Attachment I

# Landform Research

# Land Capability & Geotechnical Assessment

# Land Capability and Geotechnical Assessment

## Location 1879, Davies Road, Lower Kalgan

November 2004

# Land Capability and Geotechnical Assessment

# Location 1879, Davies Road, Lower Kalgan

**November 2004**

Landform Research
Land Systems - Quarries - Environment
ABN 29 841 445 694

Lindsay Stephens Bsc (Geology), Msc (Botany) MEIANZ
Mem Aust Geomechanics Soc - Mem WA Environ Cons Assoc

25 Heather Road, Roleystone WA 6111
Tel 9397 5145 Fax 9397 5350

## SUMMARY AND LAND CAPABILITY

Land Capability is the recognition of the suitability of a site for a proposed land use. An integral part of this process is the identification of issues and the way they can be managed to ensure that the proposed land use is sustainable and does not lead to significant environmental impacts.

Capability is also very much tied up with the creativity and determination of the planner and future land holders.

### The Site

The site study is based on Location 1879, Davies Road, east of Oyster Harbour and south of Nanarup Road.

### Current Land Use

Location 1879 has been used for broad acre agriculture for many years with the area being first settled in the 1830's. The more capable soils are cleared, although scattered Eucalypts remain on portions of the more rocky soils in the north.

The Lower Kalgan area has experienced changes in land uses in recent years with significant portions of the area being converted to small rural living. The adjoining land to the north and west has been subdivided for this purpose.

Some land use diversification has also been occurring locally on a small scale to orchards, horticulture, small scale tourist accommodation and hobby rural industries.

### Opportunities and Constraints

#### Opportunities

- The sloping nature of the site with views to the south and west across to Oyster Harbour.
- The local area is increasingly being considered to be a tourist and rural living area
- The views and landscapes that can be obtained from parts of the site.
- Proximity to Albany and other tourist locations in the area such as the Porongurup and Stirling Ranges.
- The nearby land is increasingly being used for small scale diversified land uses and small rural residential holdings.
- Good reliable rainfall of about 800 mm with rainfall exceeding evaporation for 8 months of the year.
- The site is well drained.
- Remnant trees that can provide visual screening.
- Good quality water is available from the stream in the south.

#### Constraints

- Most parts of the site have limitations on ground and surface water availability.
- Water from the stream in the south may only be available to southern portions of the site.
- Some steeper slopes and rock outcrops occur in the north.
- Developments located on steeper slopes may require engineering input at the design and construction stages.

**Potential and Likely Landuses**

Whilst the land has some good Gravelly Loam soils other factors such as the steeper slopes combined with an existing small lot size and adjoining land that has been subdivided for rural living, all combine to mean that the best land use will most likely be rural living, depending on planning issues.

**Environmental and other issues that have been identified for the proposed land use.**

There are minimal significant environmental issues for small rural holdings on Location 1879.

| Issue | Comment and Proposed Management | Conclusions and Reference |
|---|---|---|
| Nutrient export | • The soils have generally high nutrient retention capability, with some reduction in capability in sand over loam duplex soils. The soils are capable of accepting waste water from dwellings when waste water systems are correctly installed.<br>• Setbacks from the existing creek will help reduce the potential for nutrient export. | Nutrient management is discussed in 6.6 Nutrient Management. |
| Remnant vegetation | • The existing remnant trees are recommended for protection.<br>• Stream line vegetation and vegetation associated with the rocky granite outcrops are recommended for protection and could form linkages to the remnant vegetation to the east.<br>• Any additional planting of vegetation should provide linkages between the areas of remnant vegetation. | Most of the remnant vegetation on site can be protected. |

**CONCLUSIONS**

The soils have been assessed and the environmental issues considered.

The site is capable of accepting rural living lots. The soils are suitable for waste water disposal and the site joins approved small rural lots.

Environmental issues are not generally significant and can be readily managed.

Lindsay Stephens

## CONTENTS

## 1.0 INTRODUCTION

A site study was carried out on Location 1879, Davies Road, Lower Kalgan on 31 March 2004 to map the soils and hydrology and provide geotechnical and land systems assessment, to determine the suitability of the land systems to support alternative land uses.

During this study auger holes were drilled as necessary to confirm soil type or gain information on the soils, the geology, and hydrology. A backhoe was used to obtain soil logs at six locations. The salinity of all water courses and water bodies was determined. In addition to field observations interpretations were made from aerial photography and research.

### Site Description

Location 1879 lies on the western flanks of Mount Mason North to the east of Oyster Harbour. Whilst high scenic values can be obtained generally faces south.

The site is some 12 km north east from Albany town centre.

The general area has been used for agriculture for many years. The more capable soils are cleared, although portions of the more rocky soils in the north of the site remain as grazed remnant vegetation. Properties in this area were first settled in 1834, when Patrick Taylor established a farm to the north of Nanarup Road.

The Lower Kalgan area has experienced changes in land uses in recent years with significant portions of the area being converted to small rural holdings and lots. The adjoining land to the west and north has been subdivided to rural living lots.

Some land use diversification has been locally occurring on a small scale, to orchards, horticulture, small scale tourist accommodation and hobby rural industries.

## 2.0 EXISTING ENVIRONMENT

### 2.1 Geology and Geomorphology

The site lies on the western flanks of Mount Mason North dropping from 350 metres AHD in the north eastern corner down to 110 metres in the south western corner. Mount Mason North is a remnant granite/gneiss hill that has been of a similar form during recent geological time.

The granite and gneiss of Proterozoic age, with included occasional dolerite dykes were once covered by a laterite soil profile across the landscape, although this has been largely removed from Location 1879 apart from some gravel in some upper soil profiles.

Weathering of the granite to the east has released medium grained quartz sand that has been deposited in the small valley in the south.

### 2.2 Soils

Three main soils exist across Location 1879, reflecting the various regolith history of the weathering granite/gneiss basement.

**Brown Gravelly Loams** occur on the lower slopes in the east. These soils have yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils.

These loam soils are developed on the deep weathering profile of the granite/gneiss basement with laterite gravel shed from upslope and degeneration of the laterite soil profile added to the upper horizons.

Slopes are moderate to steep.

**Brown Sand over Loam Duplex**

These occur on the lower slopes with sand to depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. The sands are medium grained quartz sand shed from weathering of granite up slope. Sand is more prominent at lower elevations along the creek line in the south west.

These loam soils are developed on the deep weathering profile of the granite/gneiss basement with quartz sand shed from upslope being added to the upper soil horizons.

Slopes are moderate to steep, becoming steeper upslope.

**Rocky Loam**

Where the basement granite has been exposed in the north and north east, brown loam and yellow brown loam with sandy surface horizons are present.

Basement granite/gneiss rock outcrop is frequent and slopes tend to be steeper.

The key soil types are listed below.

| KEY | SOIL TYPE | DESCRIPTION |
|---|---|---|
| S/L | Brown Sand over Loam Duplex | Medium grained quartz sand depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. Sand is more prominent at lower elevations along the creek line. Slopes are moderate to steep, becoming steeper upslope. |
| R | Rocky Soils | Dark brown loam grading to lighter clays between common and frequently large granite outcrops. Steep slopes. |
| GL | Brown Gravelly Loams | Yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils. Slopes are moderate to steep. |

## 2.3 Climate

Weather data is recorded at Albany, but the local climate may be slightly different due to the orographic effects of the slopes of North Mount Mason.

The overall climate however is warm, dry summers with cool, wet winters.

Rainfall at Albany is about 800 mm per year.

Temperatures have summer maxima of 25$^{O}$C in the hottest months down to just over 15$^{O}$C in the coldest months, July and August. Minimum temperatures range down to 10 $^{O}$ C in the

coldest months. The cool winter temperatures can assist potential fruit crops that require a chill factor. Frosts are not common.

Annual evaporation is less than 1000 mm per year, with rainfall exceeding evaporation for almost nine months of the year.

## 2.4 Vegetation

The better soils have been cleared apart from scattered trees which generally remain on the upper slopes in the north which were not suitable for cultivation but have been grazed.

### Rare and Priority Species

A search was made of the CALM and WA Herbarium databases prior to the site inspection. The perennial species listed on those data bases are generally easily recognised and would be observable at this time of year. Whilst it was the wrong time of the year to observe annual species such as the Orchidaceae, they are unlikely to be present based on the lack of species, understorey and amount and continued grazing.

The CALM and WA Herbarium databases are shown in Appendix 2. No Declared Rare or Priority species were observed during the site inspection.

The tree species are Jarrah *Eucalyptus marginata* in one patch in the central north with Marri *E. calophylla* in the remainder and on the slopes. One plant of *Kingia australis* was observed associated with the granite outcrop. The vegetation was probably originally Jarrah-Marri Low Forest.

*Agonis linearifolia* Thicket occurs along the creek line, with the introduced Black Wattle *Acacia decurrens* occurring on the creekline in the central south.

A few minor weeds were noticed such as Ink Weed *Phytolacca octan*dra around the granite outcrops.

### Species List

All species noted during the site inspections are listed below:

| Family | Genus/Species | Remnant Jarrah-Marri Low Forest | Creek line |
|---|---|---|---|
| Dasypogonaceae | *Kingia australis* | X | |
| Mimosaceae | *Acacia decurrens** | | X |
| Myrtaceae | *Agonis linearifolia* | | X |
| | *Eucalyptus calophylla* | X | |
| | *Eucalyptus marginata* | X | |

### Vegetation Condition

Remnant vegetation only occurs along the creek line and associated with the granite outcrops in the north.

The vegetation condition is classified as "Completely Degraded" with a clump of "Good" condition associated with the creek.

## 2.5 Surface and Groundwater

Water runoff from the area can be significant during storm events down the steeper slopes to the creek.

The quality of the water in the creek at the time of the site inspection was 70 mSm or 385 mg/L salt, which is fresh (potable < 180 mSm).

No seepages were observed on the upper or lower slopes.

## 2.6 Fauna

The amount of fauna is directly related to the proportion of remnant indigenous vegetation. Even isolated trees have habitat potential and the clumps of remnant trees are correspondingly important. The scattered trees in the north, and the vegetation associated with the creekline, will provide habitat for birds, with some small reptiles likely to be associated with the granite outcrops. Frogs are likely along the creek line.

The survival of fauna is dependant on the retention of habitat, land uses on already cleared areas and education of landholders.

## 2.7 Heritage

### Aboriginal Sites

The Department of Indigenous Affairs database has no known aboriginal sites recorded for the property. Clearing was commenced generally in the area in the mid 1830's and thus much of the site has been disturbed for many years. On the other hand aboriginal sites are known from nearby, such as the stone fish traps in Oyster Harbour.

There are many developments in closer proximity to the fish traps than this site.

### European Heritage

Whilst the site has been farmed for many years there are no heritage features on site.

## 3.0 HYDROLOGICAL ASSESSMENT - WATER AVAILABILITY

Surface water runoff can be significant from sloping land such as this during storm events and in winter when the soils are saturated.

Calculations of runoff can be estimated based on Coles and Moore, 1998, *Runoff and Water Erosion*, in Soil Guide, Agriculture WA, Bulletin 4343 which assumes approximately 70 mm runoff for an 800 mm rainfall and a 90% exceedance rate. Runoff from the granite outcrops is likely to be greater.

Small quantities of water could be captured by dams located on the slopes but without seepages these may not hold water through summer. Water is associated with the creek, and a bore or dam may be possible adjacent to the watercourse.

In general therefore there is only likely to be sufficient water for stock, and with small rural lifestyle lots scheme or other water may be required to supply stock.

A calculation of the quantity of water able to be captured can be made.

Using a conservative figure of 70 mm runoff from the loamy slopes and say 100 mm for steeper slopes this will generate 700 - 1000 kL/ha/year. Water harvesting techniques may have to be used. These would include

- Forming contour drains feeding to storage dams in lower elevations. The contour drains will need to be cut into the clayey subsoils.
- Directing the collected water to dams.

Water quality is expected to be good and suitable for all uses.

Potable water can be provided by 90 000 - 140 000 litre rainwater tanks.

## 4.0 ALTERNATIVE LANDUSES

Whilst the site has some good quality soils, the soils are steep and there is a significant amount of rocky soils with granite outcrop. The site is also restricted by the creek in the south. Land to the and north has been subdivided to rural living. When taking into account all the factors, a change to rural living is possibly a likely and desirable outcome depending on planning issues.

A change of land use could provide reductions in nutrients and help satisfy market demands for lots of this type.

## 5.0 GEOTECHNICAL FACTORS

### 5.1 Foundation Stability

Whilst the site is underlain by granitic rocks, the steeper slopes and subsoil loam and clay require consideration when developed. However the soil conditions are similar to the steeper parts of the Albany townsite.

Restrictions on foundation conditions can be overcome by engineering input and design.

Slopes across the site vary from 10 to 15% with minor localised steeper areas.

Foundation stability is provided in the table below for the soil types present, but is generalised only for those soil types. Depending on the nature of the proposed development, the design and earthworks, Site Class P may apply. For example constructions requiring more than 400 mm natural fill and/or 800 mm sand fill should be classified as Site Class P to ensure adequate compaction to prevent differential settling.

Winter rainfall has not been as great over the past few years and the soils are not as wet as they would have been previously. In a sequence of wet years it can be expected that the soils of the lower slopes would have higher moisture levels, based on the duplex nature of the soils.

**Management Actions** that may be used to improve foundation stability could include but not be limited, to the following. See Australian Geomechanics Journal March 2000 (*Landslide Risk Management*). The following are engineering practices for sloping soils that have been used, for example, in the construction of dwellings within the Albany townsite.

- Provide upslope cut off drains
- Do not load soils with water, up slope of developments.
- Minimise the depth of cut and fill.
- Ensure natural soil fill is adequately compacted, especially where dry clay is used as fill in summer.
- Provide retaining walls and structures for fill.
- Retain trees on steeper slopes and plant further trees.
- Consider the use of flexible or split level structures
- Secure or remove any loose boulders
- In some situations sub-surface drainage may be required.
- Place retaining walls on natural basement rock where possible
- Design for lateral creep pressures on slopes.
- Use rows of piers or strip footings orientated up slope on sloping ground.
- Design drains to minimise erosion.
- Minimise water loading of soils.

| **Soil Description** | **Foundation Soil Stability** | **AS 2870 Site Class** | **Ease of Excavation** | **Constraint which may be present. See Table in Appendix 3** |
|---|---|---|---|---|
| Brown Sand over Loam Duplex | Moderate | S - M * | Moderate to high | a c t |
| Rocky Soils | High | S - M * | Can be very low | a k n r v x |
| Brown Gravelly Loams | Moderate | S - M * | Moderate to high | ---- |

* Site Class P may apply. For example constructions requiring more than 400 mm natural fill and/or 800 mm sand should be classified as Site Class P to ensure adequate compaction to prevent differential settling.

Individual site assessments are recommended for developments because soil conditions change laterally.

| | **GEOTECHNICAL ISSUE** | **MANAGEMENT** |
|---|---|---|
| 5.1.1 | Foundation stability | • See the above Management Actions for some methods of reducing potential foundation limitations on steeper slopes and more clayey soils.<br>• Compaction of clay fills can be difficult when dry or may potentially expand when wetted. Clay is therefore not recommended for fill.<br>• Foundation stability for developments on the more gentle slopes is high, AS 2870 Site Class S but M on steeper slopes.<br>• Developments requiring more than 400 mm fill may be AS 2870 Site Class P with engineering input into the design and placement of footings.<br>• Clay based fill should not be loaded with water from above as this will decrease stability.<br>• Individual site assessments are recommended for developments because soil conditions change laterally. |

## 5.2 Drainage and Flood Risk

Flood data is not known, but on geomorphological and field evidence, the only risk areas are storm flows from upslope which will be minor and localised and along the creekline for which setbacks will apply.

| | GEOTECHNICAL ISSUE | MANAGEMENT |
|---|---|---|
| 5.2.1 | Flood risk | • Setbacks from the creek will be required. |

## 5.3 Stability of Dams

There is potential for dams to be located on slopes. Construction is recommended to be by an experienced operator because of the risk of slope failure for inadequate structures.

| | GEOTECHNICAL ISSUE | MANAGEMENT |
|---|---|---|
| 5.3.1 | Stability of dams | • Any dam should be constructed by or supervised by an experienced operator.<br>• Dwellings should not be located downstream of dams. |

## 5.4 Capability for On Site Effluent Disposal

Phosphate Retention Indices (PRI) of all soils on site are high when compared to the database of type soils held by Landform Research for PRI and with Chemistry Centre data. However the sandy upper soil horizons that occur on top of some soil units have reduced water retention and therefore lower phosphate retention. For example waste water could run laterally through the more sandy surface soils especially near the creek and not be retained for sufficient time within the soil profile.

PRI tests can frequently be misleading because all materials greater than 2 mm are sieved from the sample prior to testing. This means that a gravelly material will have the phosphate retaining gravel removed from the sample prior to testing, most likely resulting in a PRI value much different to the actual situation. On the other hand clay normally has a high PRI, but in the field duplex soils and reduced permeability means that nutrient enriched water will often not or only slowly penetrate the clay layer. This can show lower phosphate retention in the field than indicated by the PRI. In the case of the subject land interpretations of the nutrient management of the soils is felt to be more valid.

Nitrogen loss will occur in moist soil conditions through denitrification if water is retained for sufficient time. See 6.6 Nutrient Management.

| Soil Description | Effluent Disposal | Comment |
|---|---|---|
| Brown Sand over Loam Duplex | Low to High | See 5.4.1 below |
| Rocky Soils | High where waste water is contained in loam soils between outcrops, otherwise very low | See 5.4.1 below |
| Brown Gravelly Loams | Moderate to High | See 5.4.1 below |

### Permeability and Infiltration Results

No permeability or infiltration tests were conducted on this site. Samples were conducted on the adjoining lots to the north and west in the same soil types and these can be used to indicate the permeability because they were undertaken in winter conditions.

Those infiltrations tests were established according to the Health Regulations. However no aggregate was used and the holes were not scraped out the next morning because it was felt that this gives a more realistic reading, with the settled clays being similar to organic sludge that can accumulate in leach drains. Testing soils in this manner cannot compensate for any

micropores in the soil due to invertebrate or other soil fauna activity that may not occur under a leach drain.

Based on those tests and soil observations some subsoils with a significant clay content had slow infiltration of greater than 60 minutes for 25 mm. The upper soil horizons were found to be better. Therefore inverted and semi inverted leach drains or alternative waste water treatment systems are recommended.

| | GEOTECHNICAL ISSUE | MANAGEMENT |
|---|---|---|
| 5.4.1 | Site Capability for Effluent Disposal | • Conventional septic systems are recommended to be inverted or semi inverted, and bunded by natural loam or gravel soils on the down slope side or installed with an impermeable membrane setback from the side of the leach drain on the down slope side to assist in waste water penetrating the natural soils.<br>• Alternative effluent systems are with waste water disposal areas to be sized according to underlying subsoil permeability. 10L/$m^2$ is regarded as acceptable.<br>• Appropriate setbacks will be required from water bodies. A buffer of 50 metres for development and alternative waste water disposal and 100 metres for a conventional septic system to the creek line is recommended.<br>• Stormwater drainage and retention may be required. |

## 5.5 Landslip Risk

The site is underlain by granitic basement close to the surface, with frequent outcrop in the central and northern parts.

An assessment of the Landslip Risk using Australian Geomechanics Guidelines lists a Low to Moderate Risk of minor structural damage such as separations, cracking and minor movements on the steeper slopes.

Potential slippage on slopes relates to foundation stability and is considered under 5.1 Foundation Stability. Under that section a range of potential management actions are listed, based on the Australian Geomechanics Society Guidelines, together with the site classification based on AS2870. Some sites may require a Site Class P where engineering input is required.

| | GEOTECHNICAL ISSUE | MANAGEMENT |
|---|---|---|
| 5.5.1 | Landslip Risk | • Covered by the considerations in 5.1 Foundation stability. |

## 6.0 ENVIRONMENTAL MANAGEMENT

The following items are identified as the most likely to impact on the environment. These items can be managed by the implementation of the management recommendations. Other items are unlikely to impact or the impact is regarded as small.

### 6.1 Aesthetics

The site lies to the south of Nanarup Road protected visually from Nanarup Road by being located on a south facing slope.

Portion of the site will be able to be seen from Gull Rock and Davies Road, but probably only as glimpses.

Developments will be partially protected by existing vegetation on site and on adjoining properties.

The colour and style of developments should be visually compatible with the area.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.1.1 | Remnant vegetation | • Development should include preservation of existing remnant vegetation.<br>• Mature trees should be preserved and protected from grazing pressure. |
| 6.1.2 | Dwellings, fences and other developments are to be aesthetically compatible with the area. | • Restrictions can be placed on the use of visually non compatible materials. |
| 6.1.3 | Potential land uses | • Scattered dwellings on smaller rural holdings are becoming more common in the Kalgan area, even on sloping sites. For example adjoining subdivisions to the north and west.<br>• The existing trees, landform and roadside vegetation provide screening from most of the surrounding areas. |

### 6.2 Preservation of Agricultural Land

Whilst the site has some good quality soils the soils are steep and there is a significant amount of rocky soils with granite outcrop. The site is also restricted by the creek in the south. Adjoining land to the north and west has been subdivided to rural living.

The site forms a disjointed small holding in an area currently experiencing subdivision pressure and therefore this loss of less productive land will not be significant.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.2.1 | Protection of agricultural land | • Significant constraints apply to agriculture use on site and the loss of this type of land is not considered significant. |
| 6.2.2 | Soil Preservation | • Restrictions could be placed on stocking rates to Agriculture WA standards, to ensure soil preservation on the soils. |

### 6.3 Land Use Buffers

The adjoining land to the north and west has been subdivided to rural living and thus the land use on site is compatible with those land uses. Dwellings are present to the south and the land to the east is remnant vegetation.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.3.1 | Lot sizes | • Lot sizes are more related to planning issues than land capability. Most soils are capable of effluent disposal systems on lots as small as 2 000 $m^2$, although planning and servicing considerations will determine the actual lot sizes, which will be larger than this minimum size. |
| 6.3.2 | Buffers | • No special buffers required. |

### 6.4 Rivers and Streams

There is only one watercourse in the south of the site.

A buffer for development from this creekline is recommended. This could be 50 metres for development and alternative waste water disposal and 100 metres for a conventional septic system. Natural regeneration (*Agonis linearifolia*) of this buffer would occur from the existing vegetation if stock were excluded and the *Acacia decurrens* are removed.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.4.1 | Stream side vegetation | • It is recommended that there be no clearing of the vegetation along the watercourse. |
| 6.4.2 | Stream flows | • Stream flows entering the site are unlikely to be available to future land holders who may not hold riparian rights. Environmental flows should be maintained, and any dam or bore should be set back from the watercourse. |

### 6.5 Flora and Fauna

The only remnant vegetation are scatted Eucalypt trees (see 2.4 Vegetation).

Stream side vegetation should be retained. There is an opportunity to form corridors along the north and along the creek line to link to the remnant vegetation to the east.

The remnant vegetation to the east outside the site is in good or better condition and the subdivision should not impact on that vegetation. A 10 metre buffer of planted local vegetation can be used to provide a buffer to the remnant vegetation. The buffer can provide a means of trapping and controlling weeds before they enter the adjoining remnant vegetation. This needs to be balanced against the need to provide for low fuel buffers.

The protection of flora, fauna and biodiversity depends on the maintenance and enhancement of habitat. As the vegetation is recommended to be retained and linkages upgraded, the existing fauna is unlikely to be significantly impacted on by any changes in land use on the existing cleared areas.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.5.1 | Flora and fauna corridors | • Mature trees should be preserved where possible.<br>• Clearing restrictions and the use of building envelopes are recommended to be applied to the remnant trees.<br>• Stream line vegetation and vegetation associated with rock soils and outcrops should be protected.<br>• It may be possible, when considering additional screening belts, to link the vegetation remnants along the creek and across the north of the site, towards the remnant vegetation to the east.<br>• A 10 metre vegetated buffer to the remnant vegetation to the east could be considered. This needs to be balanced against the need to provide for low fuel buffers. |
| 6.5.2 | Remnant vegetation | • See Flora and Fauna corridors above. |

## 6.6 Nutrient Management

Currently potential nutrient export comes from the washing of fertiliser, soil particles and manure down the sloping soils to the creek line during the significant rainfall events. The worst time for nutrient export from grazing is during summer storms and in winter when the soils are saturated.

The presence of dung beetles increases the rate of nutrient recycling and thus reduces the potential for nutrient export.

As the site is proposed for rural small holdings waste water disposal will be the main issue.

**Effluent Disposal**

The capability of the soils for waste water disposal is considered under 5.4 Capability for Onsite Effluent Disposal. This section considers the fate of nutrients and their potential to be exported from the site.

The main issue with effluent disposal is the design and placement of the system to ensure adequate microbial purification and retention of nutrients. The gravelly loam and loam soils have high capability for waste water disposal. However the duplex nature of the sandy upper horizons and slower permeability of the subsoils mean that consideration must be given to the potential for lateral leakage.

Research by Gerritse et al 1995A, on leach drains servicing septic tanks in the Perth Hills in gravel soils, shows that under wet conditions nitrogen is effectively lost within 10 metres. Other studies, for example Dawes and Goonetilleke, found that all nitrogen can be lost within 1 metre in damp soil conditions. Moist soils in the Albany area would behave in a similar manner and contribute to nitrogen recycling back to the atmosphere.

Gerritse et al, 1995B, found that all phosphate was adsorbed within 2 metres from a 7 year old leach drain in Yarrigal loam soils that are not unlike the loam clay soils on site, and within 5 metres for a 6 year old leach drain in Dwellingup Gravels which have some similarity with the gravelly loam soils. Gerritse and Adeney 1992, in an analysis of urban areas in the hills of Perth on lot sizes as small as 2 000$m^2$, found that the export of nutrients in streams was low, in the order of micrograms/litre. Nitrogen losses were only 5% of the input concentrations. These soils are not dissimilar to those on the study site. Thus when properly installed it is not expected that there will be a significant nutrient impact arising from residential and small rural holdings on appropriately sized lots.

Leach drains of conventional septic systems are suitable but should be inverted or semi inverted. Leach drains installed in these soils are recommended to be bunded by natural soil to prevent waste water short circuiting the soils. On the other hand alternative waste water systems are acceptable. When waste water penetrates the soils, good nutrient management and microbial purification should result.

**Nutrient Loadings and Stocking Rates**

Stocking rates for soils of the site are estimated to be 10 DSE for dry pasture and where limited supplemental feed is supplied. Stocking rates should be to Department of Agriculture recommendations.

Estimations of the actual nutrient loading at this stage are difficult because the nature of any alternative land uses is not known in addition to the fate of nutrients as a result of denitrification, volatilisation of ammonia, recycling, uptake by vegetation and soil phosphate adsorption.

With a current average stocking rate of 10 DSE, the estimated nutrient loading when fully stocked with sheep or equivalent numbers of stock could be 106 kg/N/ha/year and 14.63 kg/P/ha/year. The likely nutrient loading, and its potential export following subdivision and potential changed activities can only be estimated because of the variable nature of the land uses possible.

A typical conventional septic system releases 5.5 kg P year and 18 kg N/year. However allowing for six chickens, a dog and cat and a 250 $m^2$ area of fertilised horticulture, a further loading of 12.3 kg N/year and 5.2 kg P/year can be added for the dwelling area. (Data from Select Committee on Metropolitan Development and Groundwater Supplies, Legislative Assembly 1994 and Nitrate management in the Jandakot UWPCA, Dames and Moore, undated). One horse is estimated at 60 kg/N/year and 11 Kg/P/year, and one sheep 10.06 kg/N/year and 1.47 Kg/P/year. Data for cattle from Select Committee on Metropolitan Development and Groundwater Supplies shows cattle as 57.4 kg/N/year and 17.6 kg/P/year. The value for phosphorous may be too high for cattle not fed introduced feed.

Data for typical land uses listed below, which might be used at some stage in the future, show that overall nutrient loading is unlikely to rise with changes in land use, and with continued grazing there will also be no change.

**Typical nutrient loadings of some land uses**

| Possible lot size and activity | Nitrogen loading per hectare | Phosphorous loading per hectare | Likely nutrient scenario |
|---|---|---|---|
| Estimated average current stocking rate over the whole property 10 DSE per hectare | 106 kg/N/ha/year | 14.63 kg/P/ha/year | Possible nutrient loss through washing of dung down slope during waterlogged conditions and during storms. |
| 2 hectare rural living property, conventional septic system, garden, dog and cat as listed above and 1 horse | 45.2 kg/N/ha/year | 10.9 kg/P/ha/year | Unlikely to be nutrient export when correctly established. |
| 0.5 hectare rural living property, conventional septic system, no stock, but garden and dog and cat as listed above | 60.6 kg/N/ha/year | 21.4 kg/P/ha/year | Unlikely to be nutrient export when correctly established. |

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.6.1 | Effluent disposal | • Soil types are suitable for conventional septic systems with some care required in the sand over clay duplex soil types.<br>• See 5.4. |
| 6.6.2 | Potential water pollutants. | • Surface run off from hard surfaces should be fed through detention basins and soak wells.<br>• Constructed dams should incorporate sediment traps.<br>• Normal soil management practices such as maintaining adequate pasture filter strips, contour cultivation, contour banks as necessary and sediment traps will reduce potential loss of solid particles.<br>• Dung beetles are active on the site in winter, reducing potential nutrient loss from stock.<br>• A buffer of 50 metres for development and alternative waste water disposal and 100 metres for a conventional septic system to the creek line is recommended. |

## 6.7 Salinity

There is no evidence of salinity. In granite country such as this where the soils are relative shallow and the rainfall high, the salt is normally already flushed out and there is little risk of significant increases in salinity. Minor salt is added from waste water but this is not considered significant considering the likely lot sizes.

Surface water tested was less than 70 mSm (potable water < 180 mSm).

The potential impact on salinity is therefore regarded as low and it is unlikely that there will be any changes to salinity as a result of more intensive land uses.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.7.1 | Salinity | • Unlikely to be any significant changes to the regime. |

## 6.8 Stormwater, Erosion Potential and Soil Management

The potential for wind erosion of the site is minimal in soils such as this.

Potential water erosion is confined to the steeper slopes, drainage lines and gutters which direct and concentrate water. Currently there is minor evidence of water erosion in the eastern gully.

Some management activities that could be used to prevent soil degradation could include;

- constructing roads, fencelines and firebreaks in locations which are less likely to lead to soil erosion.
- planting deep rooted species.
- agricultural practices suited to the retention of adequate vegetation over summer, use of perennial species etc.
- utilisation of grassed waterways, drains and filter strips.
- minimisation of vehicular traffic to prevent compaction.

With subdivision and development there is potential for further planting of trees to assist soil management.

Stormwater from hard surfaces can either be detained on site or directed over broad areas such as swale drains and the like or shallow detention wetlands prior to release to the water course. On the other hand the storm water could be directed to storage dams for use on site. Road drainage and other surface drainage facilities should have baffles and other restraining devices built into them to minimise erosion.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.8.1 | Water erosion | • *EPA Guidance Number 26, Management of Surface Runoff from Industrial and Commercial Sites (draft) 1999.*<br>• *See Engineers Australia 2003, Australian Runoff Quality, National Committee on Water Engineering.*<br>• *Stormwater Management Manual for Western Australia, Department of Environment WA, 2004.*<br>• *Guidelines for Groundwater Protection in Australia, ARMCANZ, ANZECC, September 1995.*<br>• *Environmental Protection Authority Victoria/ Melbourne Water, undated, Urban Stormwater, Best Practice Environmental Management Guidelines*<br>• *Water and Rivers Commission, 1998, Manual for Managing Urban Stormwater Quality in Western Australia.*<br><br>• Surface run off from hard surfaces could be fed through shallow vegetated detention basins that can act as wetlands, prior to emptying to drainage lines<br>• Dung beetles are active on the site in winter, reducing potential nutrient loss from stock.<br>• Swale drains and detention basins could be formed as grassed areas, 300 mm deep, with a 1 : 10 year rainfall event retention time of 20 hours. (See Water and Rivers Commission, 1998, *A Manual for Managing Urban Stormwater Quality in Western Australia*, Water and Rivers Commission. See 3.17 Grass Swales (BMP14) page 100 and Extended detention Basins (BMP17) page 108 of that document).<br>• Stormwater from roofs could be used as a potable water source or should be retained on each lot.<br>• Agricultural practices should reflect the sloping nature of some soils<br>• Maintenance of adequate vegetation through summer is normal best practise to reduce the potential for soil erosion. |
| 6.8.2 | Wind erosion | • No special recommendations required. |

## 6.9 Fire Control

Fire Control falls under the Bush Fires Control Act (as amended) and the City of Albany.

Any constructed dams and water tanks on properties can be used as a water source for fire fighting.

Planning For Fire, 2001 (WAPC and FESA) provides guidance on the management of the subdivision-bushland interface in Part 3. Guidelines on the acceptable road designs are incorporated into Part 3 of the document. In general the conditions require a 100 metre fuel

reduction zone and good vehicular access and escape for adjoining vegetation such as that to the east. The 100 metres could, for example, consist of the fuel reduction zone of say 60 metres, a 20 metre road reserve and road, and 20 metres setback on individual lots or 40 metres setbacks. Discussions with the local fire officer are recommended.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.9.1 | Fire Risk | • See Planning For Fire, 2001 (WAPC and FESA) Part 3.<br>• Access and fire management should be discussed with the relevant fire control officer. A Fire Management Plan may be required to sufficiently address all issues. |

## 6.10 Social Impacts

The social impact of possible changes to rural living will be similar to the impacts arising from the subdivisions to the north and west. This subdivision is much smaller and therefore any changes are likely to be minor. Location 1879 is only 14 hectares.

Diversification of land uses can be of significant benefit to the local community through the provision of additional tourist facilities, and the introduction of more residents to the area.

Heritage areas of the site can be better protected and linked to future developments.

| | ENVIRONMENTAL ISSUE | MANAGEMENT |
|---|---|---|
| 6.10.1 | Social impact | • No action necessary apart from protection measures and incorporation of heritage into planning for the site. |

**REFERENCES**

ARMCANZ, ANZECC, September 1995, *Guidelines for Groundwater Protection in Australia*,

Coles and Moore, 1998, *Runoff and Water Erosion*, in Soil Guide, WA Department of Agriculture, Bulletin 4343.

Dames and Moore, undated, *Nitrate management in the Jandakot UWPCA*.

Data from *Select Committee on Metropolitan Development and Groundwater Supplies*, Legislative Assembly 1994.

Dawes L and A Goonetilleke, 2001, *The importance of site assessment in designing effluent disposal areas*, Proceedings of the 2nd Australia and New Zealand Conference on Environmental Geotechnics - Geoenvironment, University of Newcastle, New South Wales.

Department of Environment WA, 2004, *Stormwater Management Manual for Western Australia*.

Department of Mineral and Petroleum Resources, 1995, *Mount Barker - Albany 1 : 250 000 Hydrological Series*.

EPA Guidance Number 26, *Management of Surface Runoff from Industrial and Commercial Sites* (draft) 1999.

Environmental Protection Authority Victoria/ Melbourne Water, undated, *Urban Stormwater, Best Practice Environmental Management Guidelines.*

FESA, 2000, *Planning for Fire*, Fire and Emergency Services Authority of Western Australia.

Gerritse et al, 1995A, *Nitrogen Losses from a Domestic Septic Tank System on the Darling Plateau in Western Australia*, Wat. Res. Vol 29, No 9.

Gerritse et al, 1995B, *Retention of Nitrate and Phosphate in Soils of the Darling Plateau in Western Australia: Implications for Domestic Septic Tank Systems*, Aust. J. Soil Res. 33, 353-67.).

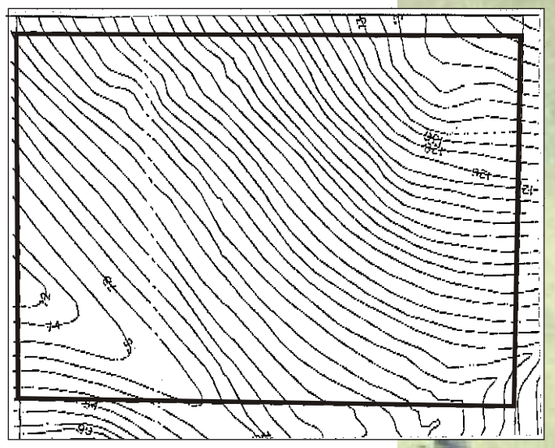
Gerritse R, 1993, *The influence of landuse and soil type on nutrient losses*, IN Swan River - The Future, Swan River Trust Report No 8.

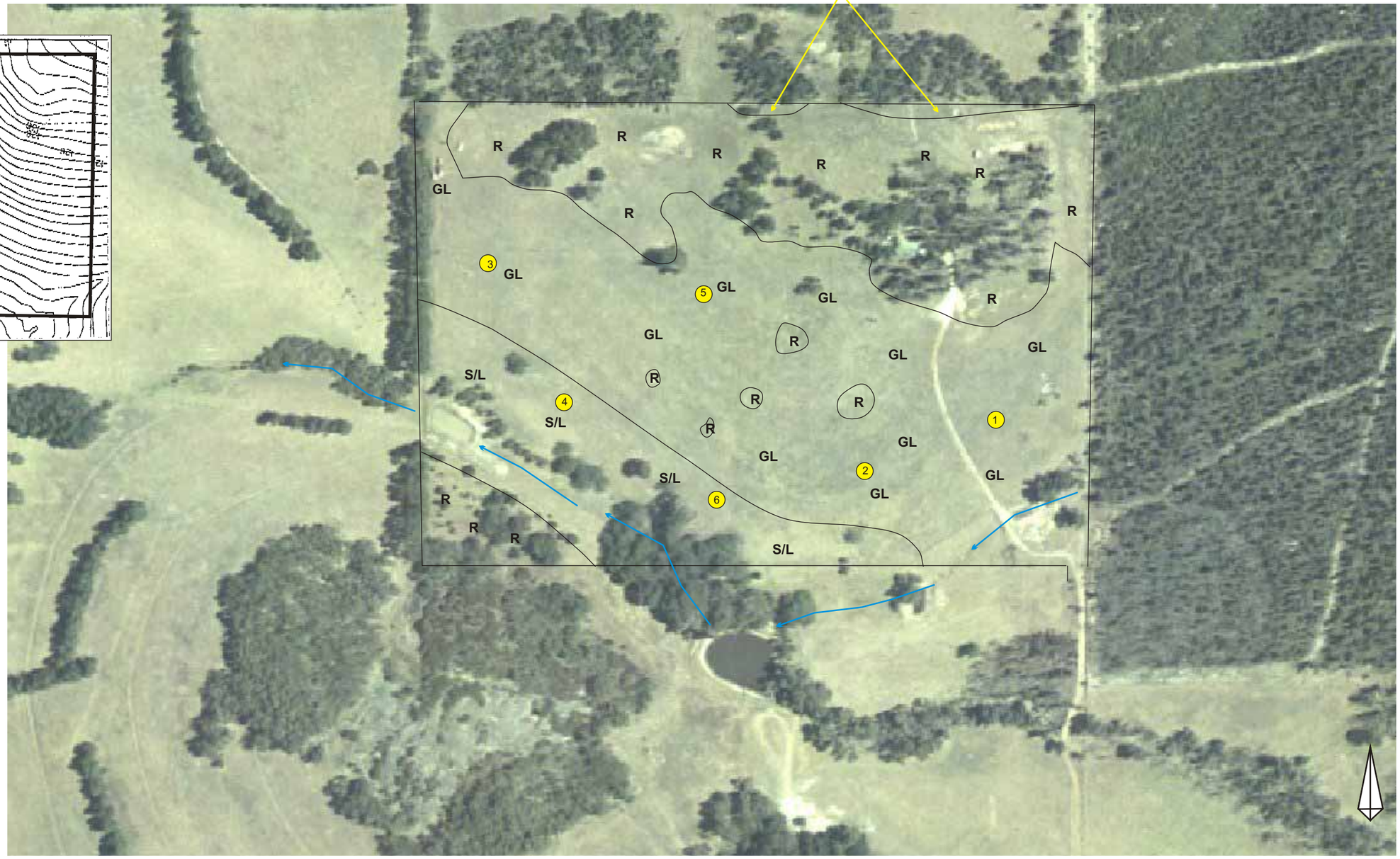
Gerritse R G and J A Adeney, *Nutrient export from various land uses on the Darling Plateau in Western Australia CSIRO Report 92/41.*

Muhling P C and A T Brakel, 1985, *Albany - Mount Barker 1 : 250 000 Geological series*, WA Geol Surv. WA.

Water and Rivers Commission, 1999, *Draft Rights In Water and Irrigation Act*.

Water and Rivers Commission, 1997, *Survey of River Foreshores in the Oyster Harbour Catchment.*






| KEY | SOIL TYPE | DESCRIPTION |
|---|---|---|
| S/L | Brown Sand over Loam Duplex | Medium grained quartz sand depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. Sand is more prominent at lower elevations along the creek line. Slopes are moderate to steep, becoming steeper upslope. |
| R | Rocky Soils | Dark brown loam grading to lighter clays between common and frequently large granite outcrops. Steep slopes. |
| GL | Brown Gravelly Loams | Yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils. Slopes are moderate to steep. |

| KEY | SOIL TYPE | Foundation Stability | Effluent Disposal | Constraint See Table |
|---|---|---|---|---|
| S/L | Brown Sand over Loam Duplex | S-M* | Low to High | a c t |
| R | Rocky Soils | S-M* | Generally low but can be High where waste water is confined to loam soils | a k n r v x |
| GL | Brown Gravelly Loams | S-M* | Moderate to High | ---- |

* Site Class P may apply. For example constructions requiring more than 400 mm natural fill and/or 800 mm sand should be classified as Site Class P to ensure adequate compaction to prevent differential settling.

Individual site assessments are recommended for developments because soil conditions change laterally.

(1) Soil Test Hole

0 100 100 150 200 METRES

| SOILS - LAND CAPABILITY | |
|---|---|
| LOCATION 1879, DAVIES ROAD, LOWER KALGAN | |
| Landform Research | November 2004 |
| Basemap DOLA Air Photo | Scale 1 : 3 000 at A3 |

View from north western corner to the south east

View from the central borth to the south west

Soil test hole 3

View from the central west up slope towards the north eastern corner

Rocky soils in the central north with *Eucalyptus calophylla*

Soil test hole 5, looking towards the rocky soils

| PHOTOGRAPHS | |
|---|---|
| LOCATION 1879, DAVIES ROAD, LOWER KALGAN | |
| Landform Research | March 2004 |

Your Ref:
Our Ref: 2001F001173VO7
Enquires: John Riley
Phone: (08) 9334 0123
Fax: (08) 9334 0278
Email:

DEPARTMENT OF
Conservation
AND LAND MANAGEMENT
*Conserving the nature of WA*

Landform Research
25 Heather Road
ROLESTONE WA 6111

Dear Mr Stephens

**REQUEST FOR RARE FLORA INFORMATION**

I refer to your request of 19 March 2003 for information on rare flora in the Kalgan area. The search co-ordinates used were $34^0$ 54' - $34^0$ 59' S and $117^0$ 52' - $118^0$ 3' E.

A search was undertaken for this area of (1) the Department's *Threatened (Declared Rare) Flora* database (for results, if any, see "Summary of Threatened Flora Data" – coordinates are GDA94), (2) the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, if any, see "WAHERB Specimen Database General Enquiry"- coordinates are AGD84) and (3), the Department's *Declared Rare and Priority Flora List* [this list, which may also be used a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) – for results, if any, see "Declared Rare and Priority Flora List"].

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point which refers to the requirement to undertake field investigations for the accurate determination of rare flora occurrence at a site. *The information supplied should be regarded as an indication only of the rare flora that may be present and may be used as a target list in any surveys undertaken.*

An invoice for $200 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of rare flora encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss rare flora management, please contact my Principal Botanist, Dr Ken Atkins, on (08) 9334 0425.

Yours faithfully

.....
for Keiran McNamara
ACTING EXECUTIVE DIRECTOR

19 March, 2003

Attached

ATTACHMENT

# DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

## RARE FLORA INFORMATION

## CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data to be made in writing to the Executive Director, Department of Conservation and Land Management, Attention: Administrative Officer Flora, Wildlife Branch.

2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the Executive Director, Department of Conservation and Land Management.

3. Specific locality information for Declared Rare Flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for DRF may not be used in public reports without the written permission of the Executive Director, Department of Conservation and Land Management. Publicly available reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Department is to be contacted for guidance on the presentation of rare flora information.

4. Note that the Department of Conservation and Land Management respects the privacy of private landowners who may have rare flora on their property. Rare flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Conservation and Land Management.

5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Conservation and Land Management accepts no responsibility for this.

6. Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.

7. It should be noted that the supplied data do not necessarily represent a comprehensive listing of the rare flora of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. The receiving organisation should employ a botanist, if required, to undertake a survey of the area under consideration.

8. Acknowledgment of the Department of Conservation and Land Management as source of the data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Conservation and Land Management, Attention: Principal Botanist, Wildlife Branch.

# THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

## DECLARED RARE AND PRIORITY FLORA LIST

for Western Australia

CONSERVATION CODES

R: Declared Rare Flora - Extant Taxa

**Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection,** and have been gazetted as such.

X: Declared Rare Flora - Presumed Extinct Taxa

**Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently,** and have been gazetted as such.

1: Priority One - Poorly known Taxa

**Taxa which are known from one or a few (generally <5) populations which are under threat**, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

**Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat** (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

**Taxa which are known from several populations, and the taxa are not believed to be under immediate threat** (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four - Rare Taxa

**Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors**. These taxa require monitoring every 5-10 years.

ABBREVIATIONS USED IN THREATENED FLORA DATABASE PRINTOUTS

**VESTING**

| | |
|---|---|
| AGR | Chief Exec Dept of Agriculture |
| ALT | Aboriginal Land Trust |
| BAP | Baptist Union of WA Inc |
| BSA | Boy Scouts Association |
| CC | Conservation Comission –NPNCA |
| CGT | Crown Grant in Trust |
| COM | Commonwealth of Australia |
| CRO | Crown Freehold-Govt Ownership |
| DOL | Dept of Land Administration |
| DPU | Ministry for Planning |
| EXD | Exec Direc CALM |
| FRE | Freehold |
| HOW | Homeswest |
| ILD | Industrial Lands Develop. Auth |
| JOI | Joint Vesting-NPNCA & Shire |
| LAC | LandCorp |
| LFC | Lands and Forests Commission |
| MAG | Minister for Agriculture |
| MED | Ministry of Education |
| MHE | Minister for Health |
| MIN | Minister for Mines |
| MPL | Ministry for Planning |
| MPR | Minister for Prisons |
| MRD | Main Roads WA |
| MTR | Minister for Transport |
| MWA | Minister for Water Resources |
| MWO | Minister for Works |
| NAT | Natural Trust of Australia WA |
| NON | Not Vested |
| NPN | NPNCA |
| OTH | Other |
| PRI | Private |
| RAI | Westrail |
| SEC | Western Power |
| SHI | Shire |
| SPC | State Planning Commission |
| TEL | Telstra |
| TGR | Timber Govt Requirement |
| TOW | TOWN |
| UNK | Unknown |
| WAT | Water Corporation |
| WEL | Minister Community Welfare |
| WRC | Water & Rivers Commission |
| XPL | Ex-Pastoral Lease |

**PURPOSES**

| | |
|---|---|
| ABR | Aboriginal Reserve |
| AER | Aerodrome |
| CAM | Camping |
| CAR | Caravan park |
| CEM | Cemetery |
| CFA | Conservation of Fauna |
| CFF | Conservation Of Flora & Fauna |
| CFL | Conservation of Flora |
| CHU | Church |
| CPK | Car Park |
| COM | Common |
| CON | Conservation Park |
| DEF | Defence |
| DRA | Drain |
| EDE | Educational Endowment |
| EDU | Educational purposes UWA |
| ENE | Enjoyment of Natural Environ. |
| EXC | Excepted from sale |
| EXL | Exploration Lease |
| EXP | Experimental Farm |
| FIR | Firing Range |
| FOR | State Forest |
| GHA | Grain Handling |
| GOL | Golf |
| GRA | Gravel Pit |
| GRE | Green Belt |
| GVT | Government Requirements |
| HAR | Harbour Purposes |
| HEP | Heritage Purposes |
| HER | Heritage trail |
| HOS | Hospital |
| KEN | Kennels |
| MIN | Mining lease |
| MUN | Municipal Purposes |
| NPK | National Park |
| NRE | Nature Reserve |
| OTH | Other |
| PAC | Public access |
| PAR | Parkland (& Recreation) |
| PAS | Pastoral lease |
| PFL | Protection of Flora |
| PIC | Picnic ground |
| PLA | Plantation |
| POS | Public Open Space |
| PPA | Public parkland |
| PRS | Prison site |
| PUT | Public Utility |
| QUA | Quarry |
| RAD | Radio Station |
| RAC | Racecourse |
| REC | Recreation |
| REH | Rehabilitation |
| RNP | Re-establish Native Plants |
| RRE | Railway Reserve |
| RUB | Rubbish |
| SAN | Sand |
| SCH | School-site |
| SET | Settlers requirements |
| SHI | Shire Requirements |
| SHO | Showgrounds |
| SNN | Sanitary |
| STO | Stopping place |
| TIM | Timber |
| TOU | Tourism |
| TOW | Town-site |
| TRA | Training Ground |
| TRI | Trig station |
| TVT | Television transmitting |
| UNK | Unknown |
| UTI | Utilities |
| VCL | Vacant Crown Land |
| VER | Road Verge |
| VPF | Vermin Proof Fence |
| WAT | Water |
| WCO | Water & Conservation of F & F |
| WOO | Firewood |

| Taxon Name | Cons. | Pop ID | Latitude | Longitude | Purpose | Vest |
|---|---|---|---|---|---|---|
| Banksia brownii | R | 4B | 34^54'00.6" | 117^54'05.5" | REC | SHI |
| Banksia brownii | R | 6 | 34^55'01.6" | 117^52'14.5" | VER | SHI |
| Banksia goodii | R | 27 | 34^55'55.6" | 117^56'35.5" | SHI | SHI |
| Bossiaea divaricata | 3 | 3 | 34^55'13.6" | 117^58'41.5" | | SHI |
| Caladenia plicata | 4 | 18 | 34^54'11.6" | 117^58'02.5" | CFF | CC |
| Chorizema reticulatum | 3 | 9 | 34^54'55.6" | 117^54'05.5" | GRA | SHI |
| Chorizema reticulatum | 3 | 13 | 34^54'32.6" | 117^55'10.5" | RUB | SHI |
| Chorizema reticulatum | 3 | 15 | 34^56'03.6" | 117^56'02.5" | VER | SHI |
| Drakaea micrantha ms | R | 2 | 34^54'47.6" | 117^56'40.5" | CFF | CC |
| Hakea tuberculata | 3 | 6A | 34^56'16.6" | 118^00'32.5" | VER | SHI |
| Hakea tuberculata | 3 | 6B | 34^56'16.6" | 118^00'30.5" | | PRI |
| Laxmannia jamesii | R | 1 | 34^57'04.6" | 118^01'59.5" | VER | SHI |
| Laxmannia jamesii | R | 5A | 34^58'20.6" | 117^55'24.5" | VER | SHI |
| Laxmannia jamesii | R | 5B | 34^58'20.6" | 117^55'24.5" | REC | SHI |
| Laxmannia jamesii | R | 5C | 34^58'20.6" | 117^55'24.5" | | PRI |
| Laxmannia jamesii | R | 15 | 34^58'56.6" | 117^54'43.5" | OTH | MAG |
| Lysinema lasianthum | 4 | 4 | 34^55'37.6" | 117^54'46.5" | NRE | CC |
| Melaleuca diosmifolia | 3 | 3 | 34^58'55.6" | 117^56'05.5" | UNK | UNK |
| Microtis globula | R | 4A | 34^54'17.6" | 117^58'07.5" | CFF | CC |
| Microtis globula | R | 4B | 34^54'17.6" | 117^58'07.5" | | PRI |
| Microtis globula | R | 6A | 34^54'41.6" | 117^57'08.5" | CFF | CC |
| Microtis globula | R | 6B | 34^54'49.6" | 117^56'49.5" | CFF | CC |
| Microtis globula | R | 7 | 34^55'15.6" | 117^56'10.5" | CFF | CC |
| Stylidium plantagineum | 4 | 2 | 34^57'46.6" | 118^02'19.5" | GRA | SHI |
| Stylidium plantagineum | 4 | 8 | 34^58'59.6" | 117^54'51.5" | EDU | MED |

A total of 25 records were printed.

REPORT ITEM DIS 289 REFERS



**DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT**
**DECLARED RARE AND PRIORITY FLORA LIST**
**23 August 2001**

| SPECIES / TAXON | CONS CODE | CALM REGION | DISTRIBUTION | FLOWER PERIOD |
|---|---|---|---|---|
| Acacia declinata | 3 | SC | Borden, Boxwood Hill, Kalgan | Aug-Oct |
| Cymbonotus preissianus | 2 | SC,(?SW ),* | Mt Barker, Borden, ?Fremantle, Kalgan, Eastern States | - |
| Hakea lasiocarpha | 3 | SC,WB | Kalgan River, Kamballup, Kojaneerup, Stirling Range, Lake Bryde | |
| Hakea tuberculata | 3 | CF,SC | Scott River, Gingilup Swamp, Stirling Range NP, Moodiarup, Kalgan River | Apr |
| Rumex drummondii | 4 | MW,SC, SW | Regan's Ford, (Gingin), Kalgan River, Manypeaks,Pinjarra | |
| Spyridium oligocephalum | 3 | SC | Pingrup, Jerramungup, Kalgan River, Fitzgerald River NP | Mar,Jul-Oct |
| Verticordia harveyi | 4 | SC | Cape Riche, Manypeaks, Lower Kalgan, Stirling Range NP | Mar |

WAHERB SPECIMEN DATABASE
GENERAL ENQUIRY

Andersonia auriculata
L.Watson (Epacridaceae)
CONSERVATION STATUS:P2
Coll.: E.M. Sandiford s.n. Date: 22 07 1988 ( PERTH 1178385 )
LOCALITY Old Quarrum Townsite, c. 2.5 km E of Bow Bridge on South Coast Highway WA
LAT 34 Deg 58 Min 20.000 Sec S LONG 117 Deg 53 Min 50.000 Sec E
Dwarf shrub-spreading. Flowers pale blue and white. Sandy soil, very gentle slope periodically swampy.
Allocasuarina fraseriana open woodland over scrub <1.5m : Kunzea
recurva, Melaleuca thymoides, Jacksonia horrida, Adenanthos
oboratus, Anarthria scapra, Dasypogon bromliifolius, Leucopogon distans.

Banksia brownii
R.Br. (Proteaceae)
CONSERVATION STATUS:R
Coll.: A. Cochrane JAC 421 Date: 21 08 1993 ( PERTH 03199894 )
LOCALITY S verge of Hazzard Road, 100 m from Dougle Road turnoff, Albany shire WA
LAT 34 Deg 55 Min 6.000 Sec S LONG 117 Deg 52 Min 9.000 Sec E
Large spreading to 7 m tall with clear trunk, branching at 2 m.
Undulating low hills. Grey sand clay loam, pH: 6.0. Remnant road verge vegetation with Eucalyptus marginata, E.
calophylla, Acacia sp., Conospermum sp., Dryandra serra.
Abundance: 11 plants/10 sq. m. in area 2-5 m.

Banksia goodii
R.Br. (Proteaceae)
CONSERVATION STATUS:R
Coll.: A. Gray s.n. Date: 26 06 1963 ( PERTH 0997935 )
LOCALITY Millbrook Road and near King River Bridge. [Ca 0.5 km S of King River]. WA
LAT 34 Deg 56 Min 30.000 Sec S LONG 117 Deg 54 Min 0.000 Sec E
Prostrate species with leaves and spikes larger than other prostrate banksias.
Almost extinct.
Previous det.: Banksia Goodii

Banksia goodii
R.Br. (Proteaceae)
CONSERVATION STATUS:R
Coll.: A. Gray s.n. Date: 26 06 1963 ( PERTH 0997900 )
LOCALITY Mill Brook Road & Baker's Property, King River Bridge. [Ca 0.5 km S of King River]. WA
LAT 34 Deg 56 Min 30.000 Sec S LONG 117 Deg 54 Min 0.000 Sec E
A prostrate species with leaves and spikes larger than other prostrate banksias.
Appears now almost extinct. Confined to this locality.
Previous det.: Banksia goodii

Boronia crassipes
Bartl. (Rutaceae)
CONSERVATION STATUS:P3
Coll.: E. Hickman EJH 431 Date: 17 01 2001 ( PERTH 05846064 )
LOCALITY Creekline S of Warrangoo Road, E of Lound Street, Bayonet Head, Albany, WA
LAT 34 Deg 58 Min 59.999 Sec S LONG 117 Deg 57 Min 0.000 Sec E
Erect shrub 1.5 m high, 40 cm wide; few, pink flowers.
Creekline. Surface not visible due to mass of Empodisma. Grey/brown sand/loam over peat.
Sedgeland with Leptospermum firmum and Empodisma sp.
Frequency:50+ plants.

Boronia crassipes
Bartl. (Rutaceae)
CONSERVATION STATUS:P3
Coll.: B.E. Hall 158 Date: 15 09 1982 ( PERTH 04369386 )
LOCALITY Link Road, off South Coast Highway, Albany, WA
LAT 34 Deg 56 Min 30.000 Sec S LONG 117 Deg 52 Min 47.000 Sec E
1.5 m high, with pink flowers. Peaty swamp.
In association with Callistemon sp.

Chorizema reticulatum
Meisn. (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: E.J. Croxford 2042 Date: 13 09 1982 ( PERTH 04462920 )
LOCALITY Rubbish Dump, Chester Pass Road, WA
LAT 34 Deg 54 Min 37.000 Sec S LONG 117 Deg 54 Min 41.000 Sec E
40 cm high, with yellow and pink flowers.
Sand over laterite.
In association with Casuarina sp. and Eucalyptus sp.

Chorizema reticulatum
Meisn. (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: K.R. Newbey 1848 Date: 16 09 1965 ( PERTH 03550370 )
LOCALITY 8 miles N of Albany WA
LAT 34 Deg 54 Min 57.000 Sec S LONG 117 Deg 52 Min 47.000 Sec E
2 ft high. Sand.
Previous det.: Chorizema reticulatum Meissner

Chorizema reticulatum
Meisn. (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: J.M. Taylor & P. Ollerenshaw JMT 1803
Date: 14 09 1983 ( PERTH 02933837 )
LOCALITY 3 km along Mulbrook road from Chester Pass road, Napier, c. 12 km by road from Albany, Darling District WA
LAT 34 Deg 55 Min 0.000 Sec S LONG 117 Deg 54 Min 0.000 Sec E

Flat, clay. Open Eucalyptus forest with E. calophylla, Melaleuca and small shrubs.
Abundance: single clump.

Dampiera sericantha
Benth. (Goodeniaceae)
CONSERVATION STATUS:P1
Coll.: E.J. Croxford 2134 Date: 25 10 1982 ( PERTH 04334620 )
LOCALITY Elizabeth Street, Lower King River, E of Albany, WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
40 cm high, with light blue flowers. Sandy gravel soil. In association with Eucalyptus sp. and Persoonia sp.
This specimen is housed at Albany.

Drakaea elastica
Lindl. (Orchidaceae)
CONSERVATION STATUS:R
Coll.: M. Sherwood 61 Date: 15 09 1978 ( PERTH 04528395 )
LOCALITY Lower King Road, opposite cemetery, E of Albany, WA
LAT 34 Deg 59 Min 0.000 Sec S LONG 117 Deg 54 Min 9.000 Sec E
20-30 cm plant with red brown flowers. Soil, sand, coastal.
In association with Eucalyptus sp. and Casuarina sp.
This specimen is housed at Albany.

Drakaea elastica
Lindl. (Orchidaceae)
CONSERVATION STATUS:R
Coll.: M. Sherwood 534 Date: 09 10 1981 ( PERTH 04528328 )
LOCALITY Private property, off Lower King Road, E of Albany, WA
LAT 34 Deg 59 Min 0.000 Sec S LONG 117 Deg 54 Min 9.000 Sec E
40 cm plant with burgundy green flowers.
Soil, sand. In association with Eucalyptus sp. and Casuarina sp.
This specimen is housed at Albany.

Drakaea micrantha
Hopper & A.P.Br. ms (Orchidaceae)
CONSERVATION STATUS:R
Coll.: S.D. Hopper 2694 Date: 21 10 1982 ( PERTH 232181 )
LOCALITY 2 km E of King River settlement, 10 km NNE of Albany, Bakers Junction Nature Reserve WA
LAT 34 Deg 56 Min 0.000 Sec S LONG 117 Deg 55 Min 0.000 Sec E
No odours, leaves withered but predominantly veined, glabrous. In deep white sand on hill slope with SW aspect.
Growing in Eucalyptus marginata, Casuarina fraseriana open low woodland over dwarf scrub-tall sedges.
Abundance: three plants, two in full flower, one withered. Two leaves present also.
Frequency:three plants, two in full flower, one withered. Two

Drosera fimbriata
DeBuhr (Droseraceae)
CONSERVATION STATUS:P4
Coll.: E.J. Croxford 1635 Date: 09 10 1981 ( PERTH 04408853 )
LOCALITY King Road, off Gibb Reserve, WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
5 cm high, with white flowers. Grey sandy soil. In association with Kingia sp. and Melaleuca sp.
This specimen is housed at Albany.
Previous det.: Drosera fimbriata DeBuhr

Drosera fimbriata
DeBuhr (Droseraceae)
CONSERVATION STATUS:P4
Coll.: S. Barrett 822 Date: 08 12 1999 ( PERTH 05569559 )
LOCALITY Lower King Road, W side, N of Bayonet Road, WA
LAT 34 Deg 58 Min 25.000 Sec S LONG 117 Deg 55 Min 19.000 Sec E
Herb to 15 cm. Slope to S. White sand.
Heath/sedgeland with Evandra aristata, Laxmannia jamesii and Agonis parviceps.
Frequency:occasional.

Dryandra preissii
Meisn. (Proteaceae)
CONSERVATION STATUS:P4
Coll.: D. Davidson s.n. Date: 17 06 1982 ( PERTH 04150570 )
LOCALITY Lower Mount Mason, off Nanarup Road, Albany E, WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 118 Deg 0 Min 0.000 Sec E
30 cm high, with pale yellow flowers. Sandy soil. In association with Eucalyptus sp. and Allocasuarina sp.
This specimen is housed at Albany.

Dryandra serra
R.Br. (Proteaceae)
CONSERVATION STATUS:P4
Coll.: A.S. George 9486 Date: 03 08 1969 ( PERTH 05040205 )
LOCALITY Mount Willyung, N of Albany WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
Shrub with few erect branches to 5 m tall; flowers pale yellow. In lateritic clay loam.

Hakea lasiocarpha
R.Br. (Proteaceae)
CONSERVATION STATUS:P3
Coll.: K. Newbey 1292 Date: 02 08 1964 ( PERTH 06150969 )
LOCALITY 20 miles E of Mount Barker WA
LAT 34 Deg 58 Min 0.000 Sec S LONG 118 Deg 0 Min 0.000 Sec E
7 ft high. In sand.
Previous det.: Hakea dolichostyla Diels

Hakea tuberculata
R.Br. (Proteaceae)
CONSERVATION STATUS:P3

Coll.: N. Gibson 2502 Date: 28 03 1997 ( PERTH 04679741 )
LOCALITY Creekline beside Hunton Road, ca 500 m N of Nanarup Road, ca 15 km WNW of Albany WA
LAT 34 Deg 56 Min 15.000 Sec S LONG 118 Deg 0 Min 27.000 Sec E
Shrub 2.5 m high. With typical columnar branching habit. Winter wet flat. Red loam over massive ironstone.
Marri - Bullich Open Woodland over Agonis parviceps Dense Heath A with
Hakea varia, Sphenotoma sp., Pericalymma ellipticum, Boronia sp. over Tall Open Sedgeland.
Abundance: common.
Previous det.: Hakea tuberculata R.Br.

Laxmannia jamesii
Keighery (Anthericaceae)
CONSERVATION STATUS:R
Coll.: C.J. Robinson 912 Date: 03 09 1992 ( PERTH 03134067 )
LOCALITY Two Peoples Bay road, S verge at intersection with Nanarup road WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 118 Deg 2 Min 0.000 Sec E
Herb 50 mm high, flowers white. Flat, sand.
Agonis parviceps heath.
Abundance: 22 plants (this one dislodged and out of soil).

Laxmannia jamesii
Keighery (Anthericaceae)
CONSERVATION STATUS:R
Coll.: C.J. Robinson 1011 Date: 13 11 1992 ( PERTH 03134024 )
LOCALITY Lower King road, 800 m E of unfenced Bayonet Head road, N side uncleared WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
Stilted rambling perennial herb up to 100 mm. Old flowers only - fruits. Gentle slope, sandy grey peaty.
Low heath over sedges, scattered trees.
Abundance: common under sedges.

Laxmannia jamesii
Keighery (Anthericaceae)
CONSERVATION STATUS:R
Coll.: L. Anderson s.n. Date: 25 04 1990 ( PERTH 04475186 )
LOCALITY Corner of Two Peoples Bay and Nanarup Roads, E of Albany, WA
LAT 34 Deg 55 Min 36.000 Sec S LONG 118 Deg 2 Min 13.000 Sec E
10-20 cm plant with white flowers. Soil, grey sand.
In association with Eucalyptus marginata, Agonis parviceps and Beaufortia decussata.

Laxmannia jamesii
Keighery (Anthericaceae)
CONSERVATION STATUS:R
Coll.: C.J. Robinson 957 Date: 13 10 1992 ( PERTH 03134059 )
LOCALITY Lower King road, 800 m N of Bayonet Head road on uncleared, unfenced land, W side WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
Rambling stilted herb 100 mm high, flowers white. Sloped, grey sand. Sedge - heath.
Abundance: common

Laxmannia jamesii
Keighery (Anthericaceae)
CONSERVATION STATUS:R
Coll.: G.J. Keighery 2824 Date: 20 05 1972 ( PERTH 1041231 )
LOCALITY 6 miles E of Albany on Borden Road (Chester Pass Road) at turnoff to Two Peoples Bay. WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 117 Deg 54 Min 0.000 Sec E
Rambling perennial herb, flowers under tepals white, outer striped red. Grey sand swamp. Melaleuca/Nuytsia/Banksia.
Common.
Previous det.: Laxmannia sp. nov.

Laxmannia jamesii
Keighery (Anthericaceae)
CONSERVATION STATUS:R TYPE STATUS: HOL
Coll.: G.J. Keighery 196 Date: 20 05 1975 ( PERTH 1041258 )
LOCALITY Turnoff to Two Peoples Bay from Albany to Nanarup Road. [Ca 17 km ENE of Albany] WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 118 Deg 2 Min 0.000 Sec E
Small erect perennial herb, flowers red/white outer perianth, white inside, self compatible. Black swampy sand.
Banksia overstorey.
Previous det.: Laxmannia sessiliflora Decne.

Laxmannia jamesii
Keighery (Anthericaceae)
CONSERVATION STATUS:R TYPE STATUS: ISO
Coll.: G.J. Keighery 196 Date: 20 05 1975 ( PERTH 1152262 )
LOCALITY Turnoff to Two Peoples Bay from Albany to Nanarup Road. [Ca 17 km ENE of Albany] WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 118 Deg 2 Min 0.000 Sec E
Small erect perennial herb, flowers red/white outer perianth, white inside, self compatible. Black swampy sand.
Banksia overstorey.

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: E.J. Croxford 3206 Date: 19 07 1984 ( PERTH 04307690 )
LOCALITY Baker's Junction, E off Hassell Highway, WA
LAT 34 Deg 55 Min 42.000 Sec S LONG 117 Deg 54 Min 41.000 Sec E

30 cm high, with white flowers. Sandy peat soil. In association with Cosmelia sp. and Hakea sp.

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: G.J. Keighery 11692 Date: 13 10 1986 ( PERTH 05121922 )
LOCALITY Bakers Junction Reserve, 12 km NE of Albany, WA
LAT 34 Deg 57 Min 19.000 Sec S LONG 117 Deg 58 Min 0.000 Sec E
Slender erect shrub 20-40 cm. Flowers white, calyx pale brown. Drainage line, black sand over clay.
Banksia quercifolia heath.
Abundance: common.

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: R.D. Royce 4265 Date: 30 07 1953 ( PERTH 1017799 )
LOCALITY 2 miles E of King River WA
LAT 34 Deg 55 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
Swampy sand. Heath.

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: R.J. Cranfield 4957 Date: 30 09 1984 ( PERTH 1017780 )
LOCALITY 1 km SE of Ledge Beach turnoff along Gull Rock Road, Albany WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 117 Deg 58 Min 0.000 Sec E
Erect open spindly shrub 45 cm high. Flowers cream-white. Swamp. Black sandy peat.
Closed sedgeland.
Abundant.

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: R.D. Royce 4265 Date: 30 07 1953 ( PERTH 1018256 )
LOCALITY 2 miles E of King River WA
LAT 34 Deg 55 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
Swamp sand. Heath.

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: C.J. Robinson 952 Date: 12 10 1992 ( PERTH 03134903 )
LOCALITY Bakers Junction Nature Reserve, 150 m N of Hassell Highway, 1st creekline E of junction WA
LAT 34 Deg 55 Min 42.000 Sec S LONG 117 Deg 54 Min 41.000 Sec E
Spindly shrub 4-500 mm, flowers yellowish - white.
Flat, wey grey sands.
Wet heath, Homalospermum firmum and sedges.
Abundance: + 50 plants

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: R. Melville & R.D. Royce 4410 Date: 30 07 1953 ( PERTH 1018221 )
LOCALITY 2 miles E of King River on Albany - Mount Many Peaks Road. WA
LAT 34 Deg 55 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
Shrub 12-18 inches high, corolla tube white, lobes cream, bracts brown. Sandy margin of swamp.
Scattered Jarrah merging into Jarrah forest; Cyperaceae, Restionaceae and Cephalotus.

Lysinema lasianthum
R.Br. (Epacridaceae)
CONSERVATION STATUS:P4
Coll.: R.D. Royce 4265 Date: 30 07 1953 ( PERTH 1018205 )
LOCALITY 2 miles E of King River WA
LAT 34 Deg 55 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
Swampy sand. Heath.

Melaleuca diosmifolia
Andrews (Myrtaceae)
CONSERVATION STATUS:P3
Coll.: E.J. Croxford 6522 Date: 21 05 1991 ( PERTH 04314239 )
LOCALITY Bayonet Head, Oyster Harbour, E of Albany, WA
LAT 34 Deg 59 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
1.5 m plant with greenish yellow flowers. Soil, sandy.
In association with Eucalyptus sp. and Allocasuarina sp. This specimen is housed at Albany.

Microtis globula
R.J.Bates (Orchidaceae)
CONSERVATION STATUS:R
Coll.: A.P. Brown 2303 Date: 06 12 1997 ( PERTH 04912268 )
LOCALITY Hassell Highway, 1.9 km E of Chester Pass Road on N side, ca 30 m in from road on edge of winter wet swamp WA
LAT 34 Deg 55 Min 20.000 Sec S LONG 117 Deg 56 Min 5.000 Sec E
Flat. Swamp. Permanently wet grey peaty soil.
Regenerating thicket (from fire last summer) with Homalospermum firmum,
Callistemon speciosa, Acacia spp., Thelymitra tigrina and Dampiera sp.
Abundance: 50+ plants in area 10 x 10 m, plants healthy.

Microtis pulchella
R.Br. (Orchidaceae)
CONSERVATION STATUS:P4
Coll.: R. Heberle DLJ 5416 Date: 17 11 1989 ( PERTH 05861160 )
LOCALITY Bakers Junction, Eyre District, WA
LAT 34 Deg 55 Min 0.000 Sec S LONG 117 Deg 54 Min 0.000 Sec E

Flowers greenish-white, fragrant. Plants very slender. Black peaty soil. Burnt swamp. Fluid.
Previous det.: Microtis alba
Frequency:common.

Olax scalariformis
A.S.George (Olacaceae)
CONSERVATION STATUS:P3
Coll.: K.H. Rechinger 60303 Date: 11 12 1982 ( PERTH 03191281 )
LOCALITY Along Hassell Highway, 15 km NE Albany WA
LAT 34 Deg 56 Min 10.000 Sec S LONG 117 Deg 59 Min 19.000 Sec E
Previous det.: Olax sp.

Spyridium spadiceum
(Fenzl)Benth. (Rhamnaceae)
CONSERVATION STATUS:P2
Coll.: E.J. Croxford 360 Date: 10 06 1979 ( PERTH 04118766 )
LOCALITY Top of a hill above Gull Rock Beach Road, Albany, WA
LAT 34 Deg 59 Min 0.000 Sec S LONG 118 Deg 1 Min 0.000 Sec E
Sandy soil. In association with coastal heath and Agonis.
Previous det.: Spyridium rotundifolia F.Muell.

Stylidium plantagineum
Sond. (Stylidiaceae)
CONSERVATION STATUS:P4
Coll.: S. James 71.12/6 Date: 12 1971 ( PERTH 1031686 )
LOCALITY 4 km W of Nanarup. Where the dirt road to Two People Bay branches off the bitumen road to Nanarup WA
LAT 34 Deg 57 Min 0.000 Sec S LONG 118 Deg 2 Min 0.000 Sec E

Stylidium plantagineum
Sond. (Stylidiaceae)
CONSERVATION STATUS:P4
Coll.: E.J. Croxford 5757 Date: 04 12 1987 ( PERTH 04548264 )
LOCALITY Below lookout, Bayonet Head, off Lower King Road, Albany, WA
LAT 34 Deg 59 Min 0.000 Sec S LONG 117 Deg 56 Min 0.000 Sec E
40 cm plant with pale mauve flowers. Soil, red loam. In association with Allocasuarina sp. and Banksia sp.
This specimen is housed at Albany.
ALB. 10275

Stylidium pseudohirsutum
Mildbr. (Stylidiaceae)
CONSERVATION STATUS:P3
Coll.: R.J. Chinnock 3240 Date: 05 10 1976 ( PERTH 03173054 )
LOCALITY 16 km NNE of Albany off the Chester Pass Road WA
LAT 34 Deg 54 Min 0.000 Sec S LONG 117 Deg 55 Min 0.000 Sec E
Grasslike tufted herb, with large cream flowers. Orange-brown on margins and back. White sandy loam.
Casuarina woodland.
Previous det.: Stylidium sp.
Frequency:rare.

Thysanotus gageoides
Diels (Anthericaceae)
CONSERVATION STATUS:P3
Coll.: N.H. Brittan 74/52 Date: 15 10 1974 ( PERTH 1122436 )
LOCALITY Chester Pass Road, 0.2 miles S of 54 mile peg opposite truck bay on W side road WA
LAT 34 Deg 54 Min 0.000 Sec S LONG 117 Deg 55 Min 0.000 Sec E
In gravel.
Previous det.: Thysanotus gageoides Diels

# APPENDIX 2

## SOIL SUMMARY

| Soil Characteristics | Brown Gravelly Loams | Brown Sand over Loam Duplex | Rocky Loam |
|---|---|---|---|
| Location | Central south facing slopes | Drainage line | Granite dome |
| Origin | Developed on granite/gneiss | Outwash of sediments soil from the granite dome | Weathered granite/gneiss |
| Top soil Texture | Gravelly sandy loam | Medium to coarse grey to brown sand | Yellow brown and brown sandy loam between basement outcrop |
| Sub soil Texture | Yellow brown loam sandy and clay | Light coloured sands over clay subsoils at 400 - 1000 mm | Basement granite with loam patches grading to light yellow to brown loam with saprolite. |
| Stone in profile | Uncommon | Uncommon | Common basement outcrop |
| Bedrock | Generally more than 2 metres | Generally more than 3 metres | 0 - 2 metres |
| Gravel | Common | Minor | Nil |
| Hardpan | Traffic hardpan can develop | Minor traffic hardpan can develop | Granite basement |
| PH | Weakly acidic | Weakly acidic | Neutral to acidic |
| Salinity | Nil | Nil | Nil |
| Soil Permeability | Moderate to high in upper horizons reducing in subsoils | High in upper horizons | Generally low, moderate in loam areas |
| Soil Shrinkage | Some minor potential for soil shrinkage | Little soil shrinkage | Some minor potential for soil shrinkage in patches of loam |

## LAND QUALITIES

| Land Qualities | Brown Gravelly Loams | Brown Sand over Loam Duplex | Rocky Loam |
|---|---|---|---|
| Slope | Moderate to steep | Gentle | Steep |
| Slope Stability | Moderate | Moderate | High |
| Wind Erosion Risk | Low | Low | Very low |
| Water Erosion Risk | Moderate to high | Moderate to high | Low |
| Drainage | Good | Good | Good |
| Moisture Availability | Moderate | Moderate | Low |
| Water Logging | Nil | Nil | Nil |
| Flood Risk | Nil | Restricted to drainage lines | Nil |
| Surface Water Availability/ Quality | Unlikely | Adjacent to watercourse | Dam sites not available |
| Ground Water Availability/ Quality | Low | Some water will be available for dams and bores | Nil |
| Salinity Risk | Very low | Very low | Very low |
| Microbial Purification | Moderate to high if waste water is contained within the soil | Moderate to high if waste water is contained within the soil | Very low |
| Water Pollution Risk | Low | Moderate | High |
| Phosphate Retention - profile | Moderate to high if waste water is contained within the soil | Low to high if waste water is contained within the soil | Low |
| Nitrogen loss - Profile | High, based on the interpreted degree of anoxic conditions and estimated microbial activity | Moderate if waste water is contained within the soil | Low |

## AGRICULTURE CAPABILITY

| Agriculture Capability | Brown Gravelly Loams | Brown Sand over Loam Duplex | Rocky Loam |
|---|---|---|---|
| Soil Workability/ Trafficability | Low to moderate because of slopes | Moderate to high | Not suitable |
| Rooting Conditions | Moderate<br>Restricted by clay subsoils for perennial crops | Moderate<br>Restricted by clay subsoils for perennial crops | Very low |
| Grazing | Moderate | Moderate, too small and adjacent to watercourse | Low |
| Grain/hay Crops | Not suitable | Low, too small and adjacent to watercourse | Not suitable |
| Annual Horticulture | Not suitable | Low, too small and adjacent to watercourse | Not suitable |
| Perennial Horticulture | Moderate<br>Restricted by clay subsoils for perennial crops | Low, too small and adjacent to watercourse | Not suitable |
| Intensive Livestock | Not suitable | Not suitable | Not suitable |

Landform Research

Lindsay Stephens BSc (Geology) MSc (Botany) MEIANZ
25 Heather Road Roleystone 6111
Phone 9397 5145 Fax 9397 5350

# Regolith and Hydrological Logs

| | | | |
|---|---|---|---|
| Project | Davies Road, Lower Kalgan | Site Assessed by | L Stephens |
| Location | Location 1879, Davies Road, Lower Kalgan | Date of Inspections | 31 March 2004 |

| | | | | |
|---|---|---|---|---|
| Test Hole Number | 1 | Natural Surface | | |
| Location | south east corner | Base of Hole | | |
| Test Hole Type | backhoe | Depth | | |
| Diameter | | Depth of static water level | | |

| Depth | Description | Comments |
|---|---|---|
| 0 - 60 mm | grey loam slightly gravelly | |
| 60 - 350 mm | yellow brown sandy gravel | |
| 350 - 630 mm | yellow brown loamy clay withe yellow brown and brown mottles | |
| 630 - 830 mm | yellow brown clay with reddish and brown mottles | |
| | | |
| Groundwater | Not intersected | |
| Comment | | |

| | | | | |
|---|---|---|---|---|
| Test Hole Number | 2 | Natural Surface | | |
| Location | central west | Base of Hole | | |
| Test Hole Type | backhoe | Depth | | |
| Diameter | | Depth of static water level | | |

| Depth | Description | Comments |
|---|---|---|
| 0 - 70 mm | dark grey sandy loam | |
| 70 - 420 mm | yellow brown sandy gravel | |
| 420 - 800 mm | yellow brown loamy clay, slightly gravelly | |
| 800 - 1150 mm | yellow brown clay with minor red brown and brown mottles | |
| | | |
| Groundwater | Not intersected | |
| Comment | | |

| | | | | |
|---|---|---|---|---|
| Test Hole Number | 3 | Natural Surface | | |
| Location | central west | Base of Hole | | |
| Test Hole Type | backhoe | Depth | | |
| Diameter | | Depth of static water level | | |

| Depth | Description | Comments |
|---|---|---|
| 0 - 90 mm | gravelly sandy loam | |
| 90 - 360 mm | yellow brown coarse loam | |
| 360 - 1180 mm | reddish yellow to dark yellow clay, with red brown and dark yellow mottles | |
| | | |
| Groundwater | not intersected | |
| Comment | | |

| | | | | |
|---|---|---|---|---|
| Test Hole Number | 4 | Natural Surface | | |
| Location | south west | Base of Hole | | |
| Test Hole Type | backhoe | Depth | | |
| Diameter | | Depth of static water level | | |

| Depth | Description | Comments |
|---|---|---|
| 10 -70 mm | dark grey sand | |
| 70 - 230 mm | light grey sand, medium grained | subangular - weathered granite origin |
| 230 - 300 mm | light brown medium grained sand | subangular - weathered granite origin |
| 300 - 480 mm | light brown sand | subangular - weathered granite origin |
| 480 1050 mm | yellow sandy clay with weathered feldspar relicts. Sandy with minor red and yellow stringers and mottles | |
| | | |
| Groundwater | not intersected | |
| Comment | | |

Landform Research

Lindsay Stephens BSc (Geology) MSc (Botany) MEIANZ
25 Heather Road Roleystone 6111
Phone 9397 5145 Fax 9397 5350

# Regolith and Hydrological Logs

| | | | |
|---|---|---|---|
| Project | Davies Road, Lower Kalgan | Site Assessed by | L Stephens |
| Location | Location 1879, Davies Road, Lower Kalgan | Date of Inspections | 31 March 2004 |

| | | | | |
|---|---|---|---|---|
| Test Hole Number | 5 | Natural Surface | | |
| Location | central | Base of Hole | | |
| Test Hole Type | backhoe | Depth | | |
| Diameter | | Depth of static water level | | |

| Depth | Description | Comments |
|---|---|---|
| 0 - 300 mm | dark grey sandy loam | |
| 300 - 340 mm | gritty light brown sand | |
| 340 - 1200 mm | yellowish brown clay with red and lighter yellow brown mottles | |
| 1200 mm | light greyish brown saprock of granite | |
| | | |
| Groundwater | not intersected | |
| Comment | | |

| | | | | |
|---|---|---|---|---|
| Test Hole Number | 6 | Natural Surface | | |
| Location | central south | Base of Hole | | |
| Test Hole Type | backhoe | Depth | | |
| Diameter | | Depth of static water level | | |

| Depth | Description | Comments |
|---|---|---|
| 0 - 70 mm | dark grey sandy loam | could not penetrate |
| 70 - 330 mm | Brownish yellow loam sand, medium grained | |
| 330 - 850 mm | yellow mottled clay with red, darker and lighter mottles composed of material from a granite base. | |
| | | |
| Groundwater | not intersected | |
| Comment | | |

## LIMITATIONS TABLE LAND CAPABILITY FOR RURAL LOTS AND DWELLINGS

| KEY | Capability for Selected Land use |
|---|---|
| I | Very high capability with few physical limitations. |
| II | High capability with some physical limitations that can be overcome by planning and minor site modifications. |
| III | Fair capability with moderate physical limitations which may affect development. Careful planning and site modification may be required. |
| IV | Low capability with many physical limitations. |
| V | Very low physical capability or with significant limitations. |
| X | Development not acceptable because of significant or Government Policy. (Includes Conservation Category or EPP Wetlands and remnant vegetation). |

| | Constraints Identified | Possible Environmental Management Strategies |
|---|---|---|
| a | Soil permeability limitations | • Provide appropriate waste water disposal systems. |
| b | Foundation soundness | • Requires house pads of sufficient depth to counteract potential clay or expanding sub-soils.<br>• Organic subsoils may need to be removed if present. |
| c | Potential slope instability | • AS 2870 Site Class P generally applies to cut and fill.<br>• Provide appropriate foundation design.<br>• Upslope cutoff drains recommended.<br>• Upslope water loading to be avoided<br>• Trees to be retained/planted |
| e | Water erosion risk | • Maintain soil cover.<br>• Use contour drains and agricultural practices.<br>• Stormwater to be controlled. |
| f | Potential flooding | • Requires sand pad to be set sufficiently (0.5m) above highest known water level to minimise capillary effects.<br>• Locate developments outside areas of flooding. |
| i | Subject to water logging risk | • Alternative waste water treatment systems likely to be required.<br>• Raise waste water disposal areas.<br>• Drainage may reduce potential for inundation.<br>• Floor elevations to have clearance above water risk levels. |
| k | Soil workability | • Avoid rock, clay subsoils or other restrictions. |
| m | Low moisture availability of soil | • Reduce stock.<br>• Restrict clearing to building envelopes. |
| n | Low nutrient retention ability | • Alternative waste water treatment systems may be required.<br>• Leach drains may need to be inverted or semi-inverted, bunded by natural soil or impermeable membrane on downslope side.<br>• Setback developments appropriate distances from water bodies/wetlands.<br>• Feed stormwater through detention basins and swale drains.<br>• Reduce nutrient loading by land use change or reduced stock.<br>• Restrict clearing to building envelopes.<br>• Restrict the density of development. |
| o | Water pollution risk by overland flow | • Retain surface water in basins, use swale and grass filters.<br>• Reduce stock and potentially polluting land uses. |
| p | Potentially low microbial purification | • Alternative waste water treatment systems may be required.<br>• Correctly install waste water systems.<br>• Bund waste water disposal areas sufficiently. |
| r | Restricted rooting conditions | • Avoid rock, hardpan or other restrictions. |
| s | Water pollution risk by subsurface flow | • See (n) above. |
| t | Low topsoil nutrient retention | • See (n) above. |
| v | Remnant vegetation | • Restrict clearing to building envelopes. Maintain linkages. |
| w | Wind erosion risk | • Reduce stock, irrigate and improve pasture<br>• Restrict clearing to building envelopes. |
| x | Reduced ease of excavation | • Remove rock or avoid constrained areas. |
| y | Salinity risk | • Provide drainage and reduce ponding.<br>• Plant deep rooted species. |
| z | Wetland conservation | • Exclude building envelopes and developments.<br>• Provide appropriate buffer distances.<br>• Place conservation covenants on wetlands and/or vegetation. |
| & | Potential for acid sulfate conditions | • Minimise deep excavations or bulk earthworks.<br>• Neutralise removed affected soils.<br>• Minimise or exclude dewatering and lowering of groundwater. |
| $ | Restricted water | • Water will be restricted for some horticulture land uses |
| # | Semi-inverted leach drains | • Leach drains should be semi-inverted, bunded by natural soil or impermeable membrane on the downslope side. |
| @ | Alternative waste water treatment system required | • Unsuitable for conventional septic systems. All lots will be required to use alternative waste water treatment systems to comply with Health Act and Department Guidelines. |
| ? | Restricted water availability | • Horticulture land uses may have insufficient water for all activities. |

# Attachment II

# Landform Research

# Local Water Management Plan

# Local Water Management Plan

## Lot 1879,
## Davies Road,
## Lower Kalgan

February 2012

Landform Research
Land Systems - Quarries - Environment
ABN 29 841 445 694

Lindsay Stephens Bsc (Geology), Msc (Botany) MEIANZ

25 Heather Road, Roleystone WA 6111

## BACKGROUND

### Subdivision

It is proposed to subdivide Lot 1879 Davies Road, Lower Kalgan into lots with areas of 1 hectare.

Lot 1879 lies on the western flanks of Mount Mason North, to the east of Oyster Harbour, dropping from 146 metres AHD in the north eastern corner down to 110 metres in the south western corner. A creek line runs across the south western corner.

The site has been used for rural living and grazing. It is cleared, with one dwelling in the north east.

It is a rectangular lot, with a proposed subdivision to 12 lots arranged around a ridge in the north eastern corner, with an access road along contour from the north.

Of the 14 plus hectares of Lot 1879, the total hard surface for the subdivision represents 4.6% of the surface area, which is a very small addition to the site.

All lots are to be connected to scheme water.

### Stormwater from Dwellings

It is proposed that stormwater from the one hour 1 in 1 year return event will be retained within rainwater tanks and soakwells on site. Excess water from rainfall events greater than this will flow onto the ground for broad area infiltration. The large lot sizes with a minimum of 1 hectare provide sufficient area for excess infiltration.

Soak wells are recommended to be installed on sand with a sand buffer of 600 mm placed around the soakwells. Geofabric is recommended to minimise sand inflow.

### Road Drainage

There are 310 metres of internal roads that will be installed with a single swale drain. The road is located along contour and will collect flows from the road in addition to driveways and from the sloping ground above the road.

The runoff from the existing land surface would normally flow downslope during a storm event and enter the creek. The drainage is designed to allow this volume of water to continue to flow to the creek to maintain the pre-subdivision hydrology of the creek.

The design of the road drainage is to include;

- A swale drain on the upslope side of the road,
- Riprap or slowing detention features,
- A small concrete covered sump with a volume in the order of $1m^3$ to collect water and sediment.
- A pipe to direct water to an open drain along an easement on the boundary of Lots 9 or 10.

- A shallow two stage detention basin with each stage having a volume of 12.5 m3 plus freeboard. The basins will be vegetated with reeds and a hard surface spillway to the creek.

**Drainage and Flood Risk**

The only watercourse is the creek which is retained in public open space. The channel is deeply incised and any flood will be retained within the current bed or adjacent to it.

Dwellings will be located 5 plus metres elevation above the public open space.

Some replanting of the public open space with strategically planted native shrubs and trees is recommended provided they do not compromise flood flows and raise the elevation of the flood peaks.

**Groundwater**

There is no evidence of winter wet soils in the areas selected for development.

Winter wet areas near the creek have been excluded from development.

Calculations show that the recharge will not change significantly as a result of subdivision and therefore there is not likely to be any change to groundwater elevations.

**Water Quality**

There is no evidence of salinity of soils on site. No change to salinity is anticipated as a result of subdivision.

There is no evidence of acid sulfate conditions, and unlikely to be, other than a minimal risk based on geological and regolith considerations. No deep excavations are expected to be required that are likely to introduce at risk conditions.

See the Land Capability and Geotechnical Assessment dated November 2004.

**Nutrient Impacts**

The site complies with the Draft Country Sewerage Policy (22 September 2002, SOCWM meeting) which permits waste water disposal on any soil type on lots in excess of 1 hectare, with some site modification.

The soils are capable of accepting and retaining all waste water, however either Alternative/Nutrient adsorbing waste water systems are recommended or leach drains be installed to the City of Albany guidelines for soils such as these. The clay soils horizon between 600 – 1000 should be breached or removed and the underlying soil horizons deep ripped. See City of Albany Guidelines.

See the Land Capability and Geotechnical Assessment dated November 2004.

Lindsay Stephens
Landform Research

**LOCAL WATER MANAGEMENT PLAN SUMMARY**

| SECTION | ITEM | REFERENCE | COMMENTS |
|---|---|---|---|
| Executive Summary | | | |
| Introduction | Context | 1.0 page 1 | |
| Proposed Development | Site Context | 2.0 page 2 | |
| | Proposal Plan | Figure 2<br>2.0 page 2 | |
| | Landscape Plan | Figures 1 and 2 | |
| Design Criteria | Design Criteria | 3.0 page 3<br>Figures 1 and 2 | |
| Pre-Development Environment | Site Assessments | 4.0 page 3 | See the Land Capability and Geotechnical Assessment dated November 2004. |
| | Site Condition | 4.0 page 3 -7<br>Figures 1 - 2 | See the Land Capability and Geotechnical Assessment dated November 2004. |
| | Geotechnical Conditions | 4.0 pages 4 – 7<br>Figures 1 - 3 | See the Land Capability and Geotechnical Assessment dated November 2004. |
| | Environmental Issues | Pages 4 – 7<br>Figure 1 | No wetlands, one watercourse. |
| | Existing Surface Water Flows | 4.5 pages 6 - 7 | |
| | Groundwater | 4.6.6 page 7 | |
| Water Use Sustainability Initiatives | Water efficiency | 5.0 page 7 | |
| | Water Supply | 2.0 page 3 | Scheme |
| | Wastewater Management | 4.3.4 page 12 | See the Land Capability and Geotechnical Assessment dated November 2004. |
| Stormwater Management Strategy | Flood Parameters | 4.5.3 page 7 | No watercourses on development area. Located in POS. |
| | 100 Year Event | Pages 9 - 17 | |
| | 10 Year Event | above | |
| | 1 Year Event | above | |
| | Groundwater Management | 7.0 page 16 | No groundwater impact |
| | Acid Sulfate | 4.3.5 page 5 | No acid sulfate |
| Future Water Management | | | Detailed designs will be required after approvals are gained |
| Implementation | Developer | | This document is to support application for subdivision. |
| | Roles - Funding | | |
| | Review | | |

**CONTENTS**

ATTACHMENTS

| | |
|---|---|
| Figure 1 | Stormwater Management |
| Figure 2 | Aerial Photograph |
| Figure 2 | Contour Plan |

## LOCAL WATER MANAGEMENT PLAN

### 1.0 Introduction

#### 1.1 Background to a Water Management Plan

In recent years Urban Water Management has received greater attention during the design phase to ensure that water resources are maximised and that environmental flows are maintained. The considerations and design are also directed towards minimising impact during storm events.

The Department of Water, 2008, *Better Urban Water Management* documents the issues.

This is also considered in Department of Planning, *Planning Bulletin 92, Urban Water Management.*

The focus of this local urban water planning is to provide for surface and groundwater management at all stages of the Planning and Development process to ensure that the management of water works at a Regional and Local level and that as land is progressively developed, a situation does not arise where a satisfactory solution or management cannot be found in the later stages of development.

In other words drainage and water management is to be considered up front in the broad scale and from there considered in progressively more detail until the final design at the local level is achieved.

With consideration of water issues up front and through the process there is much more potential to design better management of water. The main trends of the *Better Urban Water Management* are summarised below.

- to increase the potential for sustainability,
- maintain environmental flows,
- maintain and enhance water quality
- minimise the potential impact on the surface and groundwater hydrology both onsite and offsite,
- maintain biodiversity
- provide nutrient retention and management,
- minimise flood risk
- encourage water conservation

The key design objectives are to

- maintain the one year one hour average recurrence interval (ARI) event so that the peak post development flow rates are similar to the pre-development conditions.
- manage the catchment runoff from post development for up to the 1 in 100 year ARI event with runoff similar to the pre-development conditions.

- Try to minimise water use within the proposed subdivision to 100 kL per person/year including not more than 40 – 60 kL per person per year of scheme water.

The water planning outlined in *Better Urban Water Management, 2008* is;

1. ***Regional or subregional land and water planning***

   Water planning at a whole of catchment level.

2. ***District water planning document***

   Water planning at the local catchment level or within a planning precinct

3. ***Local water planning***

   Water planning within part of a catchment or at a subdivision level. This is normally conducted using a ***Local Water Management Strategy***. For large subdivisions, or in catchments, more detailed water management is considered in an ***Urban Water Management Plan*** which is completed once the development catchments are known and the flow rates calculated.

4. ***Detailed engineering design with technical calculations***

   This is to accompany the site specific design for the subdivision and follows subdivision approval.

At each stage of the water planning, the water balance, design and considerations would integrate both upwards and downwards. In other words the regional or district planning should not preclude development at a local level and in turn development at a local level should not place unacceptable impacts on district or regional water attributes.

In *Better Urban Water Management* the Local Water Management Strategy is submitted as part of the subdivision application process. It is not a detailed design document with complex calculations and pipe widths and the like, but rather a consideration that sufficient land and management is available to manage the water post development.

**Local Water Management Strategy**

In the case of the proposed subdivision, a Local Water Management Strategy is required by the City of Albany and Department of Water, even though the subdivision is not urban and the lots are over 1.0 hectare.

An ***Urban Water Management Plan*** will be prepared once the development catchments are known and the flow rates calculated.

## 2.0 Proposed Development - Subdivision

It is proposed to subdivide Lot 1879 Davies Road, Lower Kalgan into lots with areas of 1 hectare.

Location 1879 lies on the western flanks of Mount Mason North, to the east of Oyster Harbour.

The site is some 12 km north east from Albany town centre.

The proposed subdivision consists of 12 lots arranged around a ridge in the north eastern corner, with an access road along contour from the north.

All lots are to be connected to scheme water.

A site plan of the proposed subdivision is attached. Figure 2.

## 3.0 Design Criteria

A Local Water Management Strategy, through a stormwater drainage system, is used to provide information on the potential impact of road and other drainage on the local creek network.

The water management will consider potential changes to recharge on individual lots and overall.

It will also consider the management of stormwater from roads in 1, 5, 10 and 100 one hour events, disposal of stormwater, and recommendations on the size and form of on site stormwater drainage and detention basins,

Department of Water seek to retain on site rainfall from a 1 in 1 year ARI 1 hour event with the excess directed to stormwater. Also directed to stormwater is the runoff from hard surfaces such as roads.

## 4.0 Pre-development Environment

### 4.1 Existing Information

A site study was carried out on Lot 1879, Davies Road, Lower Kalgan on 31 March 2004 to map the soils and hydrology and provide geotechnical and land systems assessment, to determine the suitability of the land systems to support alternative land uses.

During this study auger holes were drilled as necessary to confirm soil type or gain information on the soils, the geology, and hydrology. A backhoe was used to obtain soil logs at six locations. The salinity of all water courses and water bodies was determined. In addition to field observations interpretations were made from aerial photography and research.

The site work was listed in the Land Capability and Geotechnical Assessment dated November 2004 prepared by Landform Research.

The layout, landform and site features are readily obvious from viewpoints across the site.

### 4.2 Site Description

The general area has been used for agriculture for many years. The more capable soils are cleared, although portions of the more rocky soils in the north of the site remain as grazed remnant vegetation. Properties in this area were first settled in 1834, when Patrick Taylor established a farm to the north of Nanarup Road.

The Lower Kalgan area has experienced changes in land uses in recent years with significant portions of the area being converted to small rural holdings and lots. The adjoining land to the west and north has been subdivided to rural living lots.

Lot 1879 has been used for rural living and grazing. It is cleared, with one dwelling in the north east.

A creek line runs across the south western corner.

## 4.3 Geotechnical Attributes

### 4.3.1 Geology and Regolith

Lot 1879 lies on the western flanks of Mount Mason North, dropping from 146 metres AHD in the north eastern corner down to 75 metres in the south western corner. Mount Mason North is a remnant granite/gneiss hill that has been of a similar form during recent geological time.

The slopes are therefore moderate, dropping from the north eastern corner.

The granite and gneiss of Proterozoic age, with included occasional dolerite dykes, were once covered by a laterite soil profile across the landscape, although this has been largely removed from Location 1879 apart from some gravel in some upper soil profiles.

Weathering of the granite to the east has released medium grained quartz sand that has been deposited in the small valley in the south.

### 4.3.2 Soils

Three main soils exist across Lot 1879, reflecting the various regolith history of the weathering granite/gneiss basement. The loam soils are developed on the deep weathering profile of the granite/gneiss basement with laterite gravel shed from upslope and degeneration of the laterite soil profile added to the upper horizons.

**Brown Gravelly Loams** occur on the lower slopes in the east. These soils have yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils.

Slopes are moderate to steep.

**Brown Sand over Loam Duplex**

These occur on the lower slopes with sand to depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. The sands are medium grained quartz sand shed from weathering of granite up slope. Sand is more prominent at lower elevations along the creek line in the south west.

Slopes are moderate to steep, becoming steeper upslope.

**Rocky Loam**

Where the basement granite has been exposed in the north and north east, brown loam and yellow brown loam, with sandy surface horizons are present.

Basement granite/gneiss rock outcrop is frequent and slopes tend to be steeper.

### 4.3.3 Soil Permeability

No permeability or infiltration tests were conducted on this site. Samples were conducted on the adjoining lots to the north and west in the same soil types and these can be used to indicate the permeability because they were undertaken in winter conditions.

Those infiltration tests were established according to the Health Regulations.

Based on those tests and soil observations some subsoils with a significant clay content had slow infiltration of greater than 60 minutes for 25 mm. The upper soil horizons were found to be better.

Soils on the lower slopes and valley floor have a layer of overlying quartz sand.

### 4.3.4 Nutrient Retention Capability

The soils on Lot 1879 are capable of accepting and retaining all waste water in areas nominated for dwellings.

Site investigations were conducted by Landform Research and described in the Land Capability and Geotechnical Assessment dated November 2004.

The gravelly and loam soils have high phosphate retention capability and are highly capable of retaining nutrients. On this site, with lot sizes of over 1 hectare, the loading from waste water systems is light compared to small lot urban subdivisions and more than complies with the Government Country Sewerage Policy which permits on site waste water disposal on lots as small as 0.2 hectares.

The critical issues are that the waste water should be disposed of into dry conditions and the waste water should infiltrate into the natural soils and not be able to move laterally and short circuit the disposal area. When this is undertaken good nutrient retention can be achieved.

### 4.3.5 Acid Sulfate Soils

Acid sulfate conditions normally only develop where saturated soil conditions occur in estuarine or peaty environments, in the presence of organic matter, sources of sulfur and under reducing conditions.

All soils observed on site are high in the landscape, well drained and oxidised with the iron minerals being oxides. No reducing conditions were observed at the surface or at depth in the test holes. Any reducing conditions will be temporary due to waterlogging.

No organic pyritic, peat, gley or highly saline conditions were evident in any test hole. The site lies well above estuarine or saline conditions.

No soils, from the descriptions or the geomorphology, that have physical or compositional characteristics of acid sulfate conditions, were recorded in the soil test holes.

## 4.4 Climate

Weather data is recorded at Albany, but the local climate may be slightly different due to the orographic effects of the slopes of Mount Mason North.

The climate of Albany consists of cool winters followed by warm summers.

Weather data is recorded at Albany and Albany Airport.

The overall climate however is warm, dry summers with cool, wet winters. Drizzle from onshore winds is common during summer nights and mornings.

Rainfall at Albany Airport is 798 mm per year and 932 mm in the town, and 794 per year at Kalgan River. Rainfall on site will therefore be likely to be equivalent to the town at say 932 mm. Mean monthly rainfall varies from near 20 mm in summer months to 130 mm in the winter months.

For the Albany area the rainfall storm event is taken as 14 mm per one hour event with a one year return (Department of Water) and Engineers Australia 2007, Australian Rainfall and Runoff. The City of Albany uses 13.48 mm for the 1 year return, 22.05 mm for the 5 year return, 24.94 mm for the 10 year return and 40.21 mm for the 100 year return event.

For a 5 year one hour ARI event the amount of rainfall is 22.5 mm, for a 10 year event 24.0 mm and for a 100 year one hour event the figure is 34.5 mm.

Temperatures could be expected to have a summer average maxima of 25$^{o}$C in the hottest months down to just over 15$^{o}$C in the coldest months, July and August. Minimum temperatures range down to 10 $^{o}$ C in the coldest months.

Annual evaporation is less than 1000 mm per year, with rainfall exceeding evaporation for almost nine months of the year.

## 4.5 Hydrology

### 4.5.1 Soil Moisture

Soils are generally moist throughout the year, with loam soils and a location on the south coast where rainfall is received in all months. The winter months are wetter and therefore the levels of soil moisture increase at that time.

Being elevated, the soils drain well and there is no evidence of saturated soils or seepages.

### 4.5.2 Surface Water

The site drops from the north eastern corner to the creekline in the south east. Slopes are generally moderate and approach steep in some areas particularly associated with the granite outcrops in the north eastern corner.

Surface water runoff drains downslope to the creekline in the south western corner.

Water runoff from the area can be significant during storm events, down the steeper slopes to the creek.

No seepages were observed on the upper or lower slopes.

A summary of the surface water is;

- The slopes are moderate with some steeper areas.
- The site drops from Mount Mason North in the north east at 146 metres AHD down to 110 metres in the south western corner
- All water currently drains to the south west to the creekline across cleared pasture land.

- There is one dam on site in the creekine in the area potentially allocated to Public Open Space.
- The soils appear sufficiently permeable for on site stormwater retention.
- The addition of scheme water will increase water loading but will be offset by trees that will be planted by landowners. See 6.2 Changes to Soil Moisture as a Result of Subdivision.

#### 4.5.3 Flood Risk

The dwellings are elevated well above the existing ceekline which is some 10 metres above the locations where dwellings will be constructed.

There is no flood risk for dwellings, and the creek is small with a small catchment and an incised channel. Storm flows will be contained within the current creek channel.

#### 4.5.4 Wetlands

Apart from the creek there are no wetlands on site. The creek is proposed to be included in Public Open Space.

#### 4.5.5 Salinity

There is no evidence of salinity. The quality of the water in the creek at the time of the site inspection, 31 March 2004, was 70 mSm or 385 mg/L salt, which is fresh (potable <180 mSm). Winter flows are likely to be fresher.

### 4.3 Groundwater

The regional groundwater is deeper than the base of the creekline.

There are no surface seeps of water leaking out from the top of the granite basement.

## 5.0 Water Use and Sustainability Initiatives

The main water use initiatives rely on the individual landholders. The best way is not to mandate the water saving devices but rather to encourage the public on the best water saving management.

*Department of Health Draft, 2002, Guidelines for the Reuse of Greywater in Western Australia* provides the following water use. The figures for an average dwelling in Albany using 220 kL scheme water per year are included.

| | | |
|---|---|---|
| Garden watering | 47% | 103.4 kL |
| Swimming Pool | 2% | 4.4 kL |
| Leaks | 2% | 4.4 kL |
| Taps | 8% | 17.6 kL |
| Shower | 16% | 35.2 kL |
| Washing machine | 13% | 28.6 kL |
| Toilet | 10% | 22.0 kL |

The education of the purchasers is achieved in literature attached to Water Corporation accounts, Department of Water and City of Albany awareness information.

The main water use initiatives for each lot are potentially;

- Potential use of rainwater tanks with a minimum of 5000 kL capacity.
  Saving 15.6 kL per year.

- Recovery and reuse of water from nutrient adsorbing waste water systems.
  Saving 103.4 kL – (Note only one of nutrient adsorbing or grey water systems is possible).

- The recommended use of grey water recovery and use on gardens.
  Savings 81.4 kL – (Note only one of nutrient adsorbing or grey water systems is possible).

- The use of native or low water requiring street trees.
  Savings relate to soil moisture and in this South Coast area the savings are likely to be minimal.

- The encouragement for the use of low water requirement gardens.
  Savings estimated to be 10 – 20 kL per year.

- Encouragement for use of water saving four star and dual flush toilets. These are assumed to be used in the estimated average of 220 kL per year and therefore no additional savings are likely.

- Encouragement for the use of water saving shower heads and appliances. These are assumed to be used in the estimated average of 220 kL per year. Therefore no additional savings are likely apart from education of the public to take shorter showers and use water saving habits in the home.

If the average dwelling holds 2.5 persons and yearly water use is 220 kL per year the average use per person is 88 kL per year, without any savings. To achieve an 80 kL per person use per year, a reduction of 20 kL per year per dwelling is required, and to drop to 60 kL per year a drop of 70 kL per dwelling per year is required.

To achieve the target of 80 kL per person per year, then the use of water wise gardening and plants, combined with rainwater tanks, will achieve the outcome.

To achieve the ideal target of 60 kL per person per year, the use of water recovery and recycling through either a nutrient adsorbing waste water system or a dedicated greywater system will be required and/or changed or aware water use habits will be required.

With the level of public information now available it is likely that some initiatives will be taken up by new landholders. The Water Corporation has ongoing water savings advertising, education and community awareness initiatives.

If half the dwellings installed the water saving initiatives then the Department of Water and Water Corporation recommended target of between 60 – 80 kL per person per year will be met.

For water savings to be made, when compared to an older subdivision, such as the mandating of rainwater tanks, such conditions will need to be placed on the subdivision approval.

## 6.0 Stormwater Management Strategy

### 6.1 Post Subdivision Water Input

The proposed subdivision of Lot 1879 will be connected to scheme water. The amount of scheme water used per dwelling will depend on the number of persons, the amount of water added to gardens and whether there is a swimming pool. The volume is normally in the range 250 – 350 kL per year for a family, with Albany trending towards the lower figures because of rainfall throughout the year.

For a 1 hectare lot with a scheme water use of say 220 kL per year this additional loading represents approximately 220 kL per hectare after allowing for roads, and a slightly larger average lot size, which is equivalent to an additional 22 mm rainfall.

The other loading is from rainfall, at near 850 mm per year (see 3.0 Climate above), of which most falls from April to October inclusive.

For 12 lots at 220 kL per lot, the total scheme water added to the location is 2 640 kL per year. The scheme water will be spread generally over the whole subdivision.

There is potential for rainwater tanks on all lots. On lots connected to scheme water, a small tank for gardens will effectively attenuate rainfall for summer but not in winter when the tank will be full. On the other hand a small tank used for potable water will help attenuate rainfall throughout the year, but will still depend on the amount of water used daily.

The mandating of a 5 000 L rainwater tank and the use of water from that tank could account for a use of 20 plus kL per year per house depending on use patterns, that would reduce the input from scheme water. As the data is generalised, relatively small, and it is uncertain whether rainwater tanks will be used, this use of rainwater is ignored in the calculations.

Greywater disposal on site will potentially offset some scheme water use by replacing the need for scheme water for gardens.

For these calculations and considerations, the potential for some rainwater use by lots connected to scheme water and greywater reuse cannot be guaranteed, so the volumes of such use are not considered in the calculations. (See treatment of Stormwater below).

### 6.2 Changes to Soil Moisture as a Result of Subdivision

In order to determine the effects of development, and what should be designed for and considered, an assessment of the likely recharge now and after development is considered.

This provides an indication of what effect the construction of hard surfaces on the proposed lots and road drainage will have in drying or draining the soils. The changes can be summarised by the following.

> *Scheme water + increased recharge from roofs to soakwells + increased loading from roads and driveways – drainage from roads removed offsite (this includes the recharge from the roads and driveways plus the water running off the sloping land that is collected by the roads) – any water substituted for scheme water use from greywater recovery or rainwater tanks – increased evapotranspiration due to additional trees and landscaping.*

For a dwelling a hard surface area of 350 $m^2$ is assumed, including the dwelling, driveways, sheds and garages.

Engineers Australia 2007 rainfall design criteria is normally used to provide the ARI hourly one year design flow volume. At that criteria 93% of all water will be retained on site. (Department of Water Information). This is the design volume that Department of Water seeks to retain on site, with the excess being directed to stormwater runoff.

With development the amount of hard surface will increase, with dwellings, driveways and roads on the site.

Currently rainfall which falls on the subject land either soaks into the soils or runs from the site.

Apart from scheme water, loading from rainwater that is collected from roofs and not used in rainwater tanks, will be directed to soakwells. For individual lots this is assumed to represent an area of 300 $m^2$ hard surface. The recharge from soils rises because the runoff from the roofs increases and there is no pasture or other vegetation on that footprint to lead to evapotranspiration of the water. Normal recharge for pasture is assumed to be 40% and recharge from roofs and roads is rated at 90%. That is there will be an additional recharge of 50% for the area of hard surfaces on lots connected to scheme water, as a result of subdivision, because the evapotranspiration of pasture and vegetation is replaced by hard surface.

For a 12 lot subdivision a hard surface area of 350 $m^2$ is assumed including dwellings, driveways, sheds and garages.

Surface area as a result of dwellings is 350 x 12 = 4 200 $m^2$.

To this is added 310 metres of internal road at say 6 $m^2$ hard surface per linear metre.

The total area of road hard surface is 310 x 6 = 1 860 $m^2$

Of the 13 plus hectares of Lot 1879, the total hard surface for the subdivision is therefore estimated to be;

4 200 $m^2$ + 1 860 $m^2$ = 6 060 $m^2$.

This represents 4.6 % of the surface area which is a very small addition to the site.

For the 12 (approx) lots connected to scheme water the additional recharge as a result of hard surfaces for buildings that will not use rainwater is as shown below. Local rainfall is assumed to be 932 mm per year.

12 lots x 350 $m^2$ roofs x 0.932m rainfall x 50% increase in recharge = 1 957 $m^3$ or kL per year (increase).

To this must be added the runoff from driveways and sheds etc that cannot be directed to soakwells at say 50 $m^2$ per lot; that is 25 $m^2$ of the hardstand and 25$m^2$ of the driveway. This hardstand is rated as having a reduced runoff on average as not all driveways will be sealed. An average of 70% runoff is assumed.

12 lots x 50 $m^2$ x 0.932 m rainfall x 30% = 168 $m^3$ or kL per year (increase)

There is 310 metres of internal road at 8 metres wide, allowing for pavements, gutters and the like. This forms 2 480 $m^2$ hardstand.

The additional recharge associated with the roads, at 90% runoff from hard surfaces less the probable 40% originally from pasture is;

2 480 $m^2$ x 0.932 m rainfall x 50% = 1 202 $m^3$ or kL per year (increase)

The total recharge is 1 957 $m^3$ + 168 $m^3$ + 1 202 $m^3$ = 256 kL per hectare per year spread over an area of 13 ha. This equates to an increase in rainfall of 25.6 mm.

On the other hand increased evapotranspiration as a result of additional tree planting is likely. On this site, with the proposed lot sizes, gardens, additional landscaping and tree planting, the recharge of the whole subdivision may potentially fall by say 5% from pasture before subdivision to parkland pasture after subdivision.

Without counting the public open space, the change as a result of landscaping, tree planting and gardens at 5% on 13 hectares, is shown by;

14 ha x 10 000 $m^2$ x 0.932 m rainfall x 5% change in recharge = 6 524 kL per year for the subdivision (decrease) or 466 kL per hectare.

- *The overall soil moisture as a result of subdivision will therefore remain similar or reduce slightly when compared to the pre-subdivision condition.*

In the calculations the use of rainwater tanks is ignored because the potential savings are 7% when compared to individual water use by landholders. The mandating of rainwater tanks, if the water is substituted for scheme water, is considered in 6.3.3 Rainwater Tanks.

## 6.3 Stormwater Design

### 6.3.1 Design Criteria - Volumes

Department of Water seek to retain on site rainfall from a 1 in 1 year ARI 1 hour event with the excess directed to stormwater, which represents 93% of the rainfall events.

The one hour one year return storm event that is to be retained is 13.48 mm. The 5 year event is 22.05 mm, the 10 year return event is 24.94 mm and for a 100 year event the figure is 40.5 mm.

### 6.3.2 Roof Drainage and the Size of Soakwells

For a dwelling on a subdivision a hard surface area of 350 $m^2$ is assumed, including dwelling, driveways, sheds and garages.

As the lots will be connected to scheme water, the surface area directed to soakwells is assumed to be 300 $m^2$, because of sheds and driveway runoff not being collected, and the rainfall criteria is 13.48 mm with a 0.9 runoff coefficient from hard surfaces, which result in a volume of up to

300 $m^2$ x 0.9 x 13.48/1000 mm = 3.64 $m^3$ or 1.21 $m^3$ per 100 $m^2$ roof area

Typical soakwells of 1300 mm diameter x 1200 mm depth hold a volume of 1.59 $m^3$ and are capable of holding the runoff from each 100 $m^2$ with an excess capacity of 26%. This does not take into account any seepage of water into the soils that will occur during the one hour.

With two such soakwells a total storage volume will be 3.18 $m^3$ or 73% of the 300 $m^2$ roof area used. Therefore, to round the figure off, a roof area of 300 $m^2$ will require three 1300 x 1200 mm soakwells with a larger roof area requiring correspondingly more soakwells to achieve a 1 in 1 hour ARI rainfall event.

Excess water from rainfall events greater than this will flow onto the ground for broad area infiltration. The large lot sizes with a minimum of 1 hectare provide sufficient area for excess infiltration.

On house sites where silt or reduced permeability subsoils are encountered it is preferable that the infiltration surface area of the soak wells be increased. This can be achieved by removing the clay enriched horizon from under the soakwell to a depth of say 1.5 to 2 metres and backfilling with sand. The soakwells should then be placed on the sand base and surrounded with 600 mm sand. More soakwells could be used. Geofabric may be required to prevent sand from flowing into the soakwell when full.

On a sloping site such as this there is little likelihood of the soakwells not draining well.

The volume of water directed to soak wells can be reduced correspondingly for dwellings with rainwater tanks in excess of say 5 000 litres.

### 6.3.3 Rainwater Tanks

If a minimum 5 000 litre rainwater tank is recommended for lots with scheme water, provided it is plumbed into a system that is used all year round, such as potable water, washing, toilet use or a combination, for toilet use alone, at say a volume of 2.5 L per average flush with 6 flushes per person, the daily use will be 2.5 x 7 = 17.5 L per person per day.

For an average 2.5 person family over a month this amounts to 1 300 L per month or 1.3 $m^3$ kL per month. Even piping rainwater for toilet use represents a water saving, but is not sufficient alone in any month to effectively attenuate a storm event. The use of the rainwater tank to attenuate stormwater flows is therefore not included in the calculations because at this stage the actions of individual owners cannot be anticipated.

The total savings are in the order of 15.6 kL per year for a 2.5 person average family. With an estimated average use of water of 220 kL per year per dwelling in Albany this represents a saving of 7% if the water is substituted for scheme water.

### 6.3.4 Waste Water Management

Nutrient retention is high on this site. This is discussed in the Land Capability and Geotechnical Assessment dated November 2004 prepared by Landform Research.

The site complies with the Draft Country Sewerage Policy (22 September 2002, SOCWM meeting) which permits waste water disposal on any soil type on lots in excess of 2 000 $m^2$ and allows for some site modification. See also 4.3.4 Nutrient Retention Capability.

The soils on Lot 1879 are capable of accepting and retaining all waste water.

Any fertiliser applied to gardens will similarly be strongly adsorbed onto the soil particles.

The critical issues are that the waste water should be disposed of into dry conditions and the waste water should infiltrate into the natural soils and not be able to move laterally and short circuit the disposal area.

The majority of the site will require nutrient adsorbing waste water treatment systems.

The City of Albany normally requires either a conventional septic system, installed with semi inverted leach drains to their specifications, or an alternative waste water system.

On sloping sites such as this a terraced waste water disposal area is likely to be required, with an upslope cutoff drain. This is capable of achieving a dry suitable waste water disposal area. Volume can be reduced by using greywater reuse systems.

When this is undertaken good nutrient retention can be achieved

To increase infiltration and comply with the Health Act Regulations, the City of Albany requires that a 3 metre wide area around the leach drain of a conventional septic system be deep ripped and then the leach drain covered with calcareous sand.

The proposed waste water disposal complies with the Government Country Sewerage Policy and City of Albany Requirements.

### 6.3.5 Size of Road Drainage

Prior to subdivision any storm event will lead to some intermittent and discontinuous surface sheet wash, the location of which is unclear. However post subdivision this flow will be intersected by the proposed road.

The road will pick up all of the flow and it will be directed along the swale drains as per DOW and City of Albany requirements.

It is recommended that the drain be located on the upslope side only because of the steep slopes.

It is assumed that all stormwater on each lot is retained on site. For the lower lots, and those in the east not above the road surface, water runoff will not change and will continue to flow unimpeded as it currently does.

Surface water runoff from above the road will be captured by the road and will have to be treated as road stormwater.

The designed road will require a sump to collect the stormwater from the swale drain on the upslope edge. The sump is proposed to be installed at the low point of the road and then piped under the road to a pipe/ open drain located in an easement on Lots 9/10 as shown on the Plan in Figure 1.

- **Runoff from land surface catchments**

This flow occurs now and cutting it off will reduce the natural environmental flows to the creek. Therefore, whilst this flow will be captured by the road, retaining it all on site, is not desirable based on maintaining environmental flows. What is desirable is to capture the additional flow from the hard surfaces whilst providing filtration for the surface water runoff.

The coefficient of runoff for pasture on steeper rocky slopes such as this is 0.75, from Engineers Australia. For medium slopes a coefficient of runoff is 0.2. Based on the contours an average coefficient of runoff of 0.35 is assumed.

For the mm 1 year 1 hour rainfall event, the volume of the potential surface water from the pasture above the road is calculated as below.

The area of catchment is 2.6 hectares (26 000 $m^2$) above the road. Therefore the runoff from the catchment above the road that will be collected by the road in a 1 in 1 year event will be;

26 000 $m^2$ (area) x 0.01348 m (rainfall) x 0.35 (coefficient of runoff) = 122.7 $m^3$

Although this volume of water will be intersected by the road, its collection reduces the environmental flows and therefore it is not proposed to capture this volume of water.

The volume increases for the other storm events are summarised below.

Upslope catchment - Upslope of roads, runoff from driveways

| Storm Event | Volume of stormwater generated in one hour from above the road by the natural land surface. |
|---|---|
| One hour one year return event | 122.7 $m^3$ |
| One hour 5 year return event | 200.7 $m^3$ |
| One hour 10 year return event | 227.0 $m^3$ |
| One hour 100 year return event | 366.0 $m^3$ |

Downslope of the road there will be no changes to surface water flows as a result of subdivision.

The runoff from the existing land surface would normally flow downslope during a storm event and enter the creek.

To retain this on site would be to change the pre-subdivision hydrology of the creek. In order to maintain the same environmental flows this volume of water should be permitted to flow through the detention basins.

In addition to the surface water runoff there will also be potential for capture of water from hard surfaces such as driveways upslope of the road.

It is likely that on any particular lot only 300 $m^2$ of water from hard surfaces will be able to be retained because of the slopes and driveways to roads. This is the likely maximum volume that will be able to be captured on sloping land such as this and directed to rainwater tanks or soakwells. The remaining 50 $m^2$ will either drain onto the lots or end up running down the driveways to the road. To allow for a small amount of runoff from the driveways an additional volume is required for the 3 affected driveways on Lots 1 – 3. Other driveways will drain to the creek.

150 $m^2$ x 0.01348 mm x 0.9 = 1.82 $m^3$. For a one hour 1 year return event

The data for other return events is shown.

| Storm Event | Volume of stormwater generated in one hour from above the road by driveways. |
|---|---|
| One hour one year return event | 1.82 $m^3$ |
| One hour 5 year return event | 2.98 $m^3$ |
| One hour 10 year return event | 3.37 $m^3$ |
| One hour 100 year return event | 5.43 $m^3$ |

It is noted that that whilst these two tables represent the amount of runoff generated during a one hour storm event, the runoff from the driveways will arrive first and that from the land surface will be attenuated and take longer to reach the drain.

The degree of attenuation will direct the calculations of the pipework required and these calculations will be made during the engineering phase of the design during the road design. Any changes to the catchments will be taken into account at that time.

At the time of the preparation of the Urban Water Management Plan, when detailed engineering calculations will be made, the runoff data will be adjusted as necessary, taking into account any changes to catchments in the post developed environment.

- **Runoff from road pavements**

The Department of Water has guidelines on stormwater management for roads and drains which can be incorporated into the detailed design of the stormwater management (*Guidelines for Development and Subdivision of Land*) for the detention of stormwater.

As noted previously the volume of water coming from roads is given by;

There are 310 metres of internal road at say 6 $m^2$ hard surface per linear metre.

The total area of road hard surface is 310 x 6 = 1 860 $m^2$

For a one hour one year return event the calculation is;

1 860 $m^2$ (area) x 0.01348 m (rainfall) x 0.90 (coefficient of runoff) = 22.57 $m^3$

CATCHMENT ROADS – Generated from road surface

| Storm Event | Volume handled by road drainage |
|---|---|
| One hour one year return event | 22.57 $m^3$ |
| One hour 5 year return event | 36.9 $m^3$ |
| One hour 10 year return event | 41 76 $m^3$ |
| One hour 100 year return event | 67.32 $m^3$ |

DOW require that the 1 in 1 year one hour event is retained in a detention basin, but that other flows are directed through an overflow to the creek.

The road drainage will have to deal with the natural surface water from lots 1 2 and 3, the driveways and the road surface.

To maintain environmental flows to the creek it is recommended that only the increased water as a result of the introduction of hard surfaces is detained on site and the natural surface water be directed to the creek.

The total 1 in 1 year storm event that the road drainage and detention basin will need to deal with is;

122.7 $m^3$ (natural surface) + 1.82 $m^3$ (driveways) + 22.57 $m^3$ (road) = 145.94 $m^3$ or kL

However as noted above retaining the volume of water from up slope will change the pre-subdivision flows in the creek and therefore only the 1 hour one year return storm event from hard surfaces should be retained with the natural surface runoff volume being permitted to flow through.

The drainage system will however need to be designed to cope with the 1 in 100 year storm events.

The volume to be retained in the detention basin is therefore;

1.82 $m^3$ (driveways) + 22.57 $m^3$ (road) = 24.39 $m^3$ or kL

- A series of small riffles is recommended to be installed along the flow path to accept some of the volume and to slow the flow. There will be space for 13 riffles adsorbing perhaps 2 $m^3$ each. The use of a series of small riffles will negate the need for a detention basin and is therefore recommended. The use of riffles on the upslope side of the road, as opposed to a detention basin, will assist visual management, remove the need for a basin in that location and its inherent potential construction and safety issues.

- A small concrete covered sump with a volume in the order of 1$m^3$ is recommended to be installed at the low point in the road to collect any excess water from road drainage.

  See Figure 1.

- From the sump a pipe is recommended to direct water along an easement on the boundary of Lot 9 or 10 to the POS.

The water flow could then be an open drain installed with riprap or riffles, which will make maintenance easier. The volume of the drain will be calculated during the detailed engineering design, based on the capability to handle the 1 in 100 year storm event.

- From the drain the slowed water flow is recommended to feed to a shallow two stage detention basin in public open space.

  The maximum volume required to be retained within the detention basin is 24.39 $m^3$ or kL.

  In the interests of safety and environmental management it is recommended that this be a two stage small shallow basin with a volume of 12.5 $m^3$ plus freeboard. Water will enter from one end, be slowed and then feed to the second stage from which water will leave to travel to the creek.

  Rather it is recommended that the basin be shallow and installed with reeds to slow and attenuate the flows and allow them to overflow trough a hard surface spillway to the creek. This will maintain natural water flows in the creek.

  In the detailed engineering stage the volume may be adjusted for flow rates and catchment attenuation. If any small alteration to the alignment of the road is required to ensure a suitable location for the low point, it will be made at that time.

  See Figure 1.

## 7.0 Groundwater Management Strategy

The water recharge is not anticipated to change, therefore no changes are anticipated to groundwater regimes.

## 8.0 Future Design Considerations

An additional stage of detailed engineering design, to accompany the site specific design for the subdivision, follows subdivision approval. In this case, with a relatively small

number of large lots, the detailed design will be related to road design, swale drainage design and the design of the stormwater detention basins.

An Urban Water Management Plan will be required as part of the next stage of the progress of the subdivision, after approval of the subdivision and prior to construction. The Urban Water Management Plan will be prepared by the engineers who will incorporate any conditions and changed circumstances into the subdivision design and provide the detailed design drawings of the road network and drainage. At that time detailed calculations will be made to confirm and refine the drainage system.

The engineers will provide revised catchment calculations based on any changes to the catchments as a result of development. Flow rates and attenuation will also be considered, including even the 6 minute duration when designing pipework as recommended by the City of Albany.

At that time any adjustments to the alignment of the road will be made to ensure free flow of stormwater from the road as shown on Figure 1.

## 9.0 Monitoring

Monitoring of water quality is not seen as not necessary unless actions following from the monitoring are conditioned on the subdivision.

However the DOW normally requires monitoring.

If monitoring is required, it is recommended that water flowing to the creek be monitored quarterly when flowing.

A total of 2 - 3 years monitoring on a quarterly basis is suggested for the following parameters, TSS, TP, TN, EC DO and pH.

## 10.0 Implementation

Implementation will only occur at the construction stage following the full engineering calculations for the roads and stormwater management.

At this stage, the Local Water Management Strategy is enough to provide sufficient assessment to ensure that there is provision within the subdivision guide plan to enable the required detention basins and drainage systems to be provided for.

**REFERENCES - READING**

Allen D G and R C Jeffery, 1990, *Methods for Analysis of Phosphorous in Western Australian Soils,* Chemistry Centre Report on Investigation No 37.

ANZECC, 1992, *Australian Water Quality Guidelines for Fresh and Marine Waters.*
Australian Health and Medical Research Council, 1996, *Australian Drinking Water Guidelines.*

Berkman D A, 1995, *Field Geologists Manual*, The Australian Institute of Mining and Metallurgy.

Coles and Moore, 1998, *Runoff and Water Erosion*, IN Soil Guide, WA Department of Agriculture, Bulletin 4343.

Commonwealth of Australia, 2005, *Natural Hazard Risk in Perth Western Australia*.

Dames and Moore, undated, *Nitrate Management* in the Jandakot UWPCA.

Data from Select Committee on Metropolitan Development and Groundwater Supplies, Legislative Assembly 1994.

Dawes L and A Goonetilleke, 2001, *The importance of site assessment in designing effluent disposal areas*, Proceedings of the 2nd Australia and New Zealand Conference on Environmental Geotechnics - Geoenvironment, University of Newcastle New South Wales.

Department of Health, 2001, *Code of Practice for the Design, Manufacture, and Operation of Aeorobic Treatment Units Servicing Single Dwellings*

Department of Water, September 2006, *Wastewater treatment – on site domestic systems*, Water Quality protection Note.

Department of Water. 2008, *Better Urban Water Management*.

Environment Australia, 2002, *Introduction to Urban Stormwater Management in Australia.*

Environmental Protection Authority Victoria/ Melbourne Water, undated, *Urban Stormwater, Best Practice Environmental Management Guidelines*

Gerritse et al, 1995, *Retention of Nitrate and Phosphate in Soils of the Darling Plateau in Western Australia*: Implications for Domestic Septic Tank Systems, Aust. J. Soil Res. 33, 36367.).

Gerritse R G and J A Adeney, *Nutrient export from various land uses on the Darling Plateau in Western Australia*, CSIRO Report 92141.

Gerritse R G, C Barber and J A Adeney, 1990, *The Impact of Residential Urban Areas on Groundwater Quality: Swan Coastal Plain, Western Australia*, CSIRO Water Resources Series No 3.

Gerritse R, 1993, *The influence of landuse and soil type on nutrient losses*, IN Swan River - The Future, Swan River Trust Report No 8.

Government of Western Australia, 2003, *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974, Health Act 1911.*

*Guidelines for Groundwater Protection in Australia*, ARMCANZ, ANZECC, September 1995.

Jones T, M Middletone and N Corby, 2005, *Natural hazard risk in Perth, Western Australia*, Australian Government, Geoscience Australia.

King P D and M R Wells, 1990, *Darling Range Rural Land Capability Study*, Department of Agriculture and Food Land Resources Series No 3

Poinke H B, M L Sharma and J K Hosking, *Effect of Irrigated Horticultural Cropping on Groundwater Quality: Swan Coastal Plain, Western Australia*, CSIRO Water Research Series No 2.

Engineers Australia 2003, *Australian Runoff Quality*, National Committee on Water Engineering.

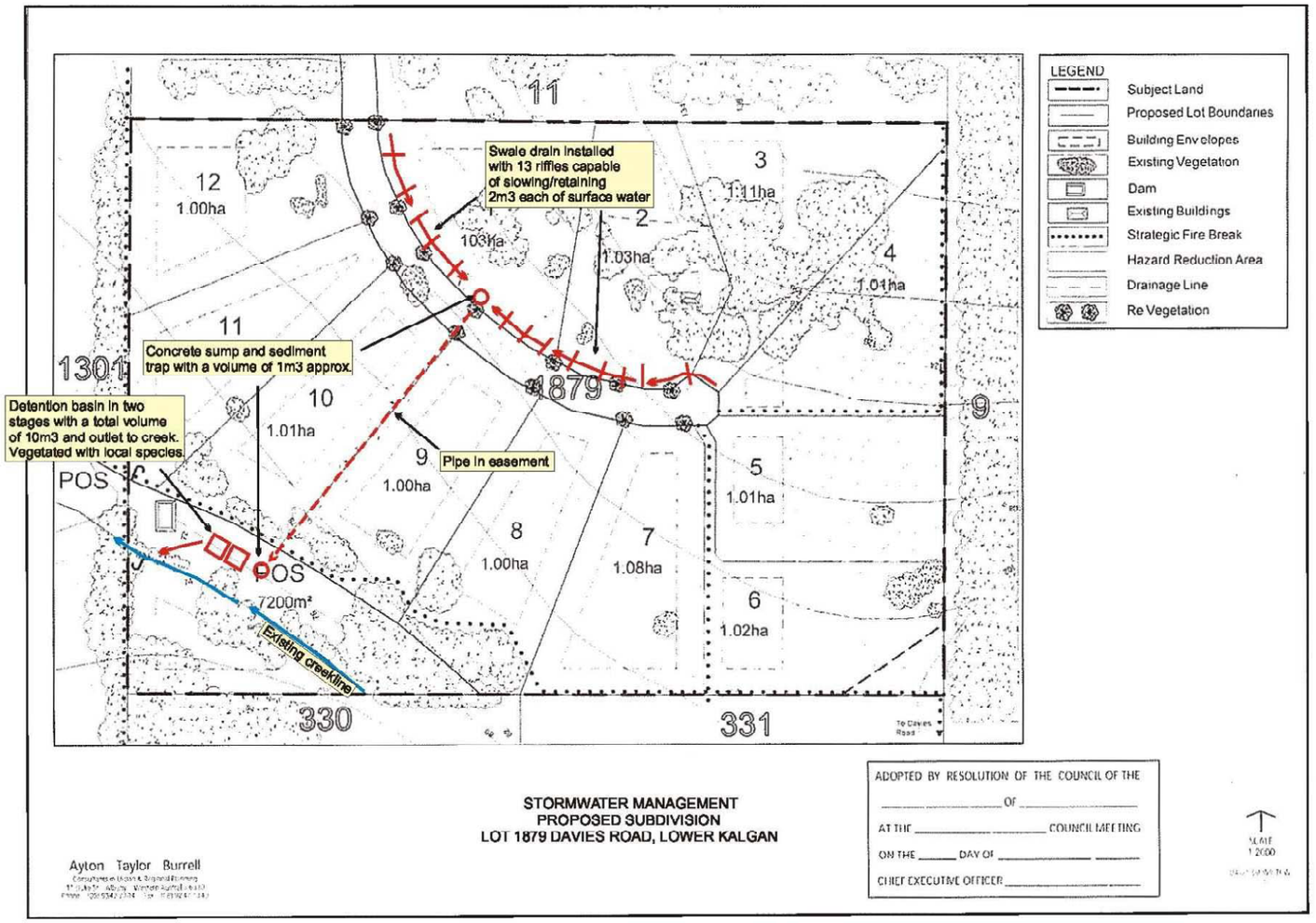
Department of Environment WA, 2004, *Stormwater Management Manual for Western Australia*.

Van Gool D, K Angell and Lindsay Stephens, 2000, *Stocking Rate Guidelines for Rural Small Holdings, Swan Coastal Plain and Darling Scarp, Western Australia*, Department of Agriculture, Miscellaneous Publication 02/2000.

Water and Rivers Commission, 1998*, Manual for Managing Urban Stormwater Quality in Western Australia.*

EPA Bulletin 711, 1*99, Western Australian Water Quality Guidelines for Fresh and Marine Waters.*

Whitehead J H and P M Geary, 2005, *Geotechnical Challenges for Onsite Wastewater Management in the Hunter Region,* Australian Geomechanics Vol 40, No 2, June 2005.




STORMWATER MANAGEMENT
PROPOSED SUBDIVISION
LOT 1879 DAVIES ROAD, LOWER KALGAN

Ayton Taylor Burrell

ADOPTED BY RESOLUTION OF THE COUNCIL OF THE
_____ OF _____
AT THE _____ COUNCIL MEETING
ON THE _____ DAY OF _____
CHIEF EXECUTIVE OFFICER _____

SCALE 1:2000

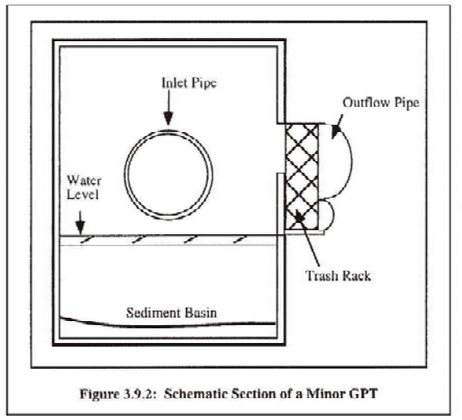



Figure 3.9.2: Schematic Section of a Minor GPT

**CONCEPT SEDIMENT TRAP**

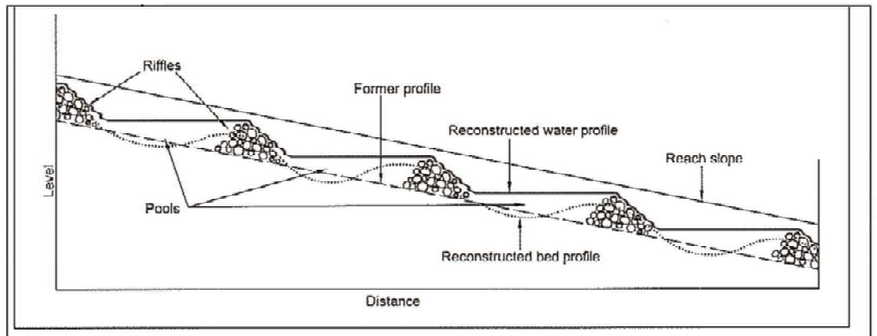



*Figure 6. Ideal reconstructed channel alignment and pool-riffle sequence. (Water and Rivers Commission/ Department of Environment 1999–2003.)*

**CONCEPT RIFFLE SYSTEM IN OPEN DRAIN**

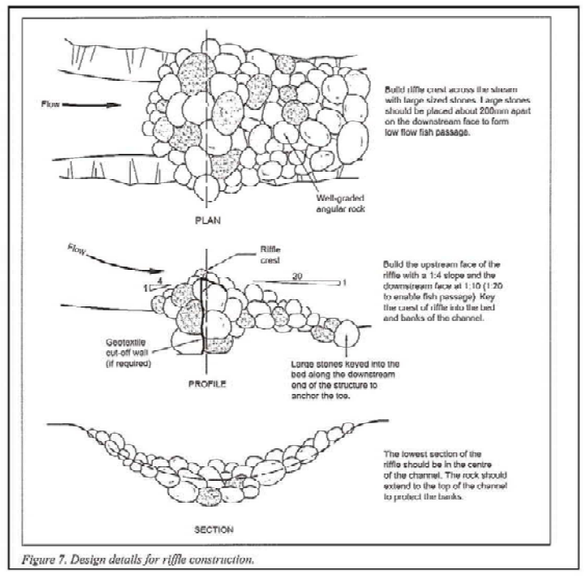



*Figure 7. Design details for riffle construction.*

## 5.2 Constructed Wetlands

*Figure 1. Liege Street Wetland, Cannington, intercepts and treats stormwater prior to it reaching the Canning River. (Photograph: City of Canning 2006.)*

### 3.19 Extended Detention Basins (BMP I7)

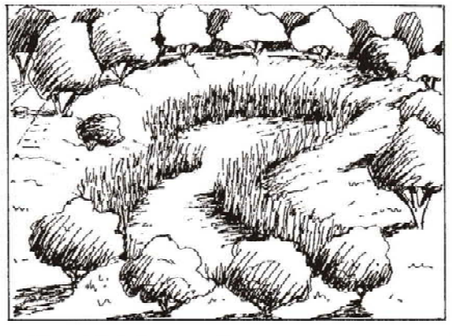


Figure 3.19.1: Schematic of Extended Detention Basins

**CONCEPT VEGETATED DETENTION BASINS**

Diagrams from Department of Water Documentation

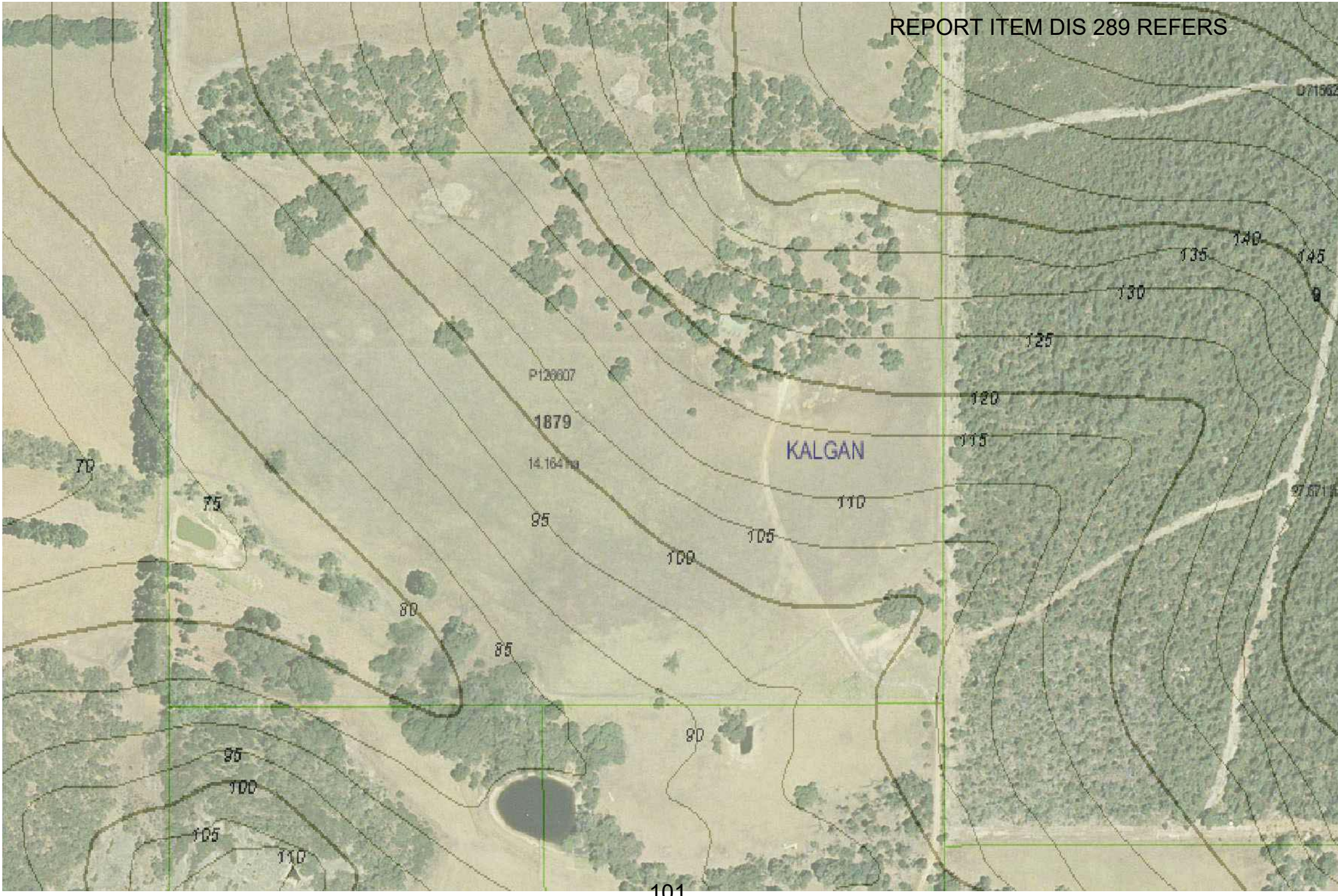
**STORMWATER MANAGEMENT**
**PROPOSED SUBDIVISION**
**LOT 1879 DAVIES ROAD, LOWER KALGAN**

Figure 1



LOT 1879 DAVIES ROAD, LOWER KALGAN

Figure 2






LOT 1879 DAVIES ROAD, LOWER KALGAN

Figure 3

# Attachment III

# Fire Management Plan

# FIRE MANAGEMENT PLAN

## LOT 1879 DAVIES ROAD
## KALGAN

AYTON BAESJOU
PLANNING

ABN: 15 061 140 172
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

# Contents

## 1. INTRODUCTION

Lot 1879 is located 16 km from the Albany City Centre via Lower King Road, Nanarup Road, Gull Rock Road and Davies Road.

The site comprises cleared pasture with areas of parkland clearing along the creekline in the south west and surrounding the existing dwellings.

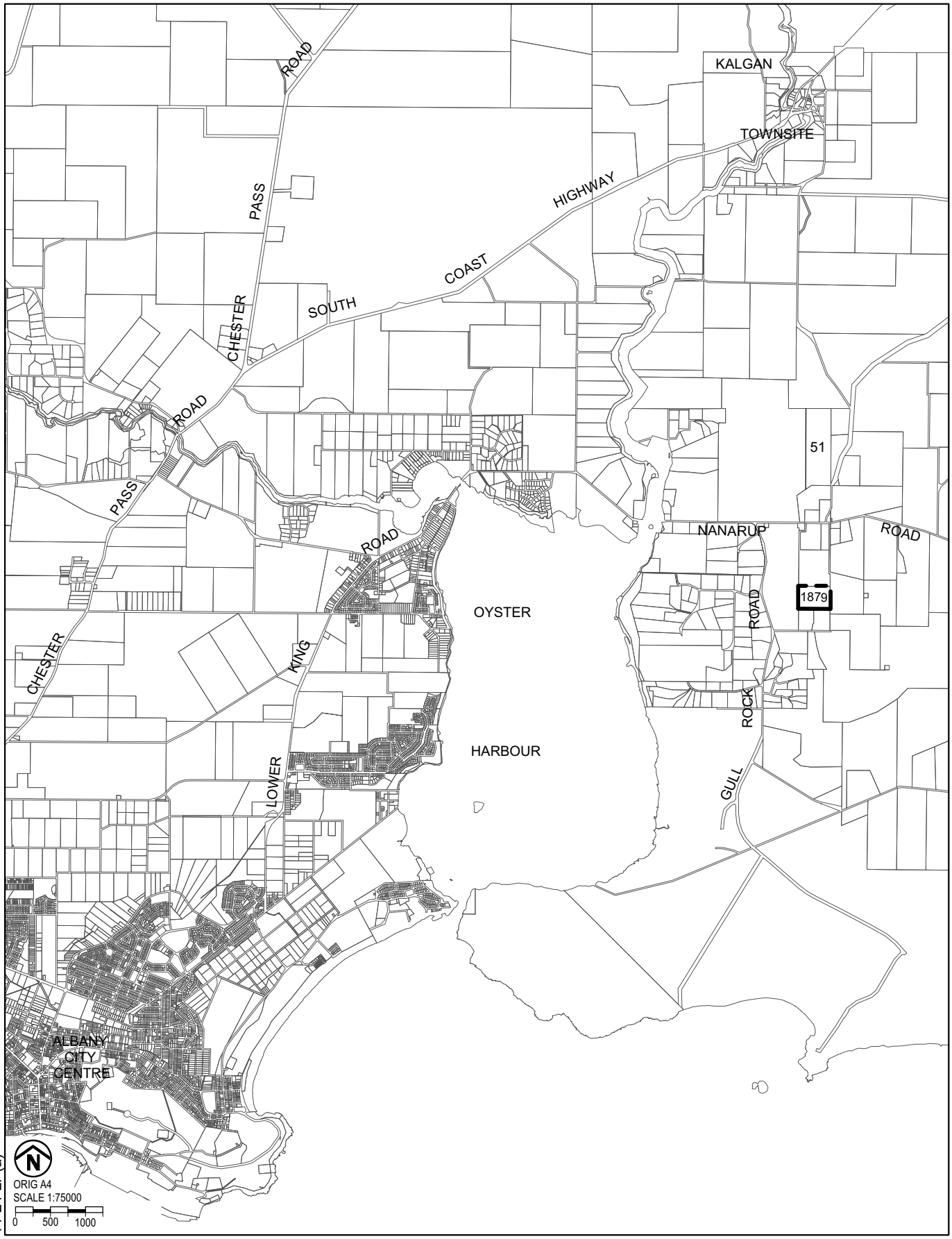
The purpose of this Fire Management Plan is to outline fire hazards, fire risks and following that, propose measures to address the hazards and reduce the risks as well as outlining an implementation plan to see those measures applied.

## 2. BACKGROUND & SUBDIVISION PROPOSAL

Lot 1879 is mostly cleared grazed pasture. There are two separate areas of parkland cleared tree cover of approximately 4000m² each, one to the east of the existing dwelling and the other in the south west along the minor drainage line in this area.

The land is surrounded to the north and east by Rural Residential zoned, cleared land which will be subdivided to lots of 1ha. To the south is cleared and parkland cleared grazing land whilst to the west is a rural lots, uncleared apart from a significant firebreak network along the boundaries (10m wide) and fire breaks which compartmentalise the site into approximately 5ha blocks.

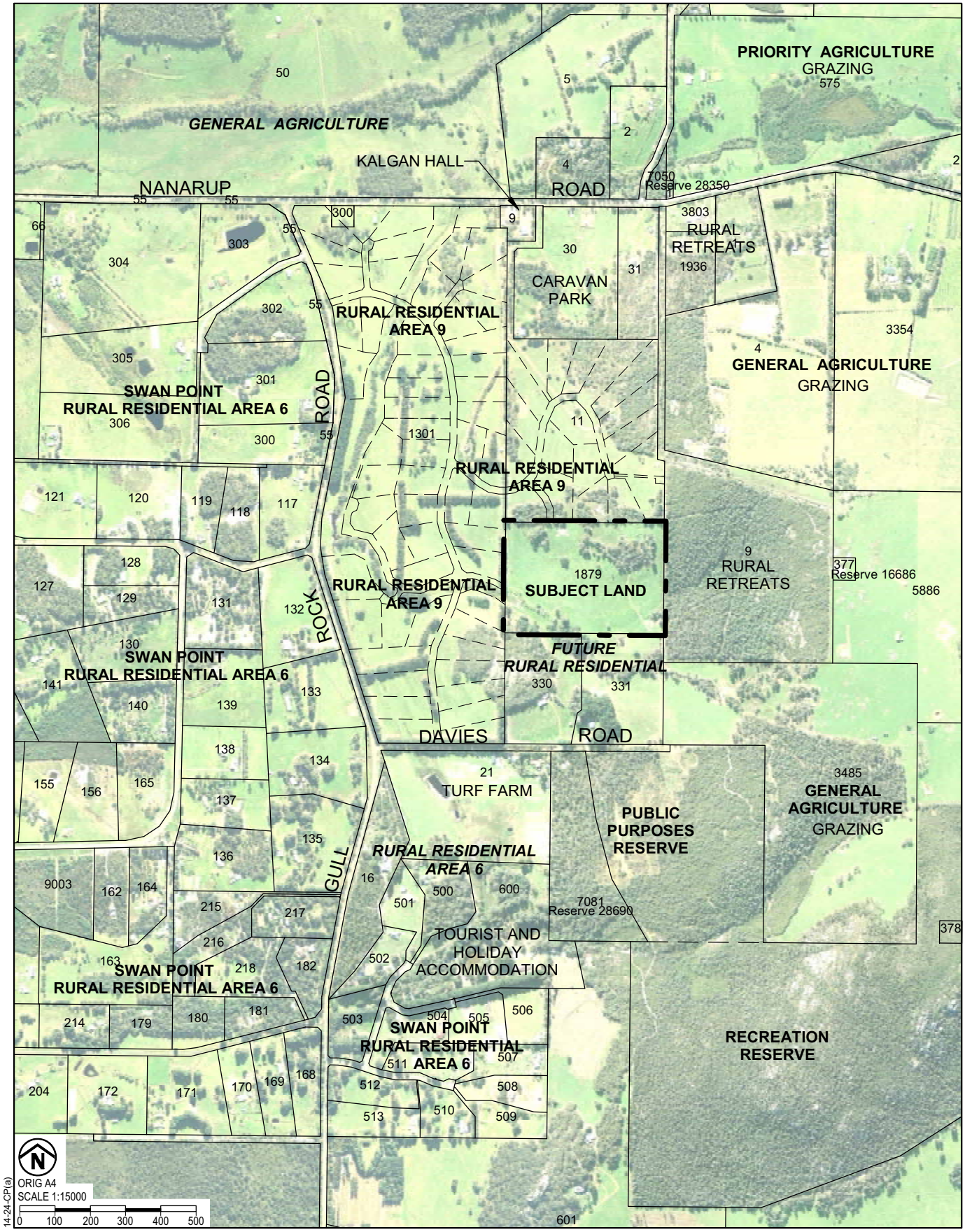
Lot 1879 will be included within the adjoining Rural Residential zone to provide for 1ha lots. As future strategies are further implemented, this zoning will also expand over the lots to the south.




14-24-LP(a)

AYTON BAESJOU
PLANNING
66 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

LOCATION PLAN
Lot 1879 Davies Road
Kalgan, City of Albany




AYTON BAESJOU
PLANNING
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494



CONTEXT PLAN
Lot 1879 Davies Road
Kalgan, City of Albany

Although the land currently has no gazetted legal road frontage practical side access is made via a formal Right of Carriageway over an adjoining property through to Davies Road.

In addition road and firebreak connections will be provided in two positions via the adjoining special rural zone.

The Subdivision Guide Plan and this plan, can make use of these connection points by using one to provide road access to the Rural Residential lots and the others can provide alternative/secondary access ways as needed.

As the lots will be within a Rural Residential zone, subdivision, development and ongoing land management provisions can be used to implement and ensure the maintenance of effective fire safety mechanisms.

The lot is in an area long identified for such subdivision and development and as a result the strategic implications of this move have been assessed and supported. The purpose then of this Fire Management Plan is to detail the local or lot scale hazard, risk and safety mechanisms to be applied.

## 3. BUSHFIRE HAZARD ASSESSMENT

See following figure for Bush Fire Hazard Ratings. In summary:

| Vegetation Type | Rating |
|---|---|
| Pasture | Low |
| Isolated Paddock Trees | Low |
| Parkland Cleared Areas | Moderate |
| Adjoining Low Forest | Extreme |

## 4. BUSHFIRE ATTACK LEVEL

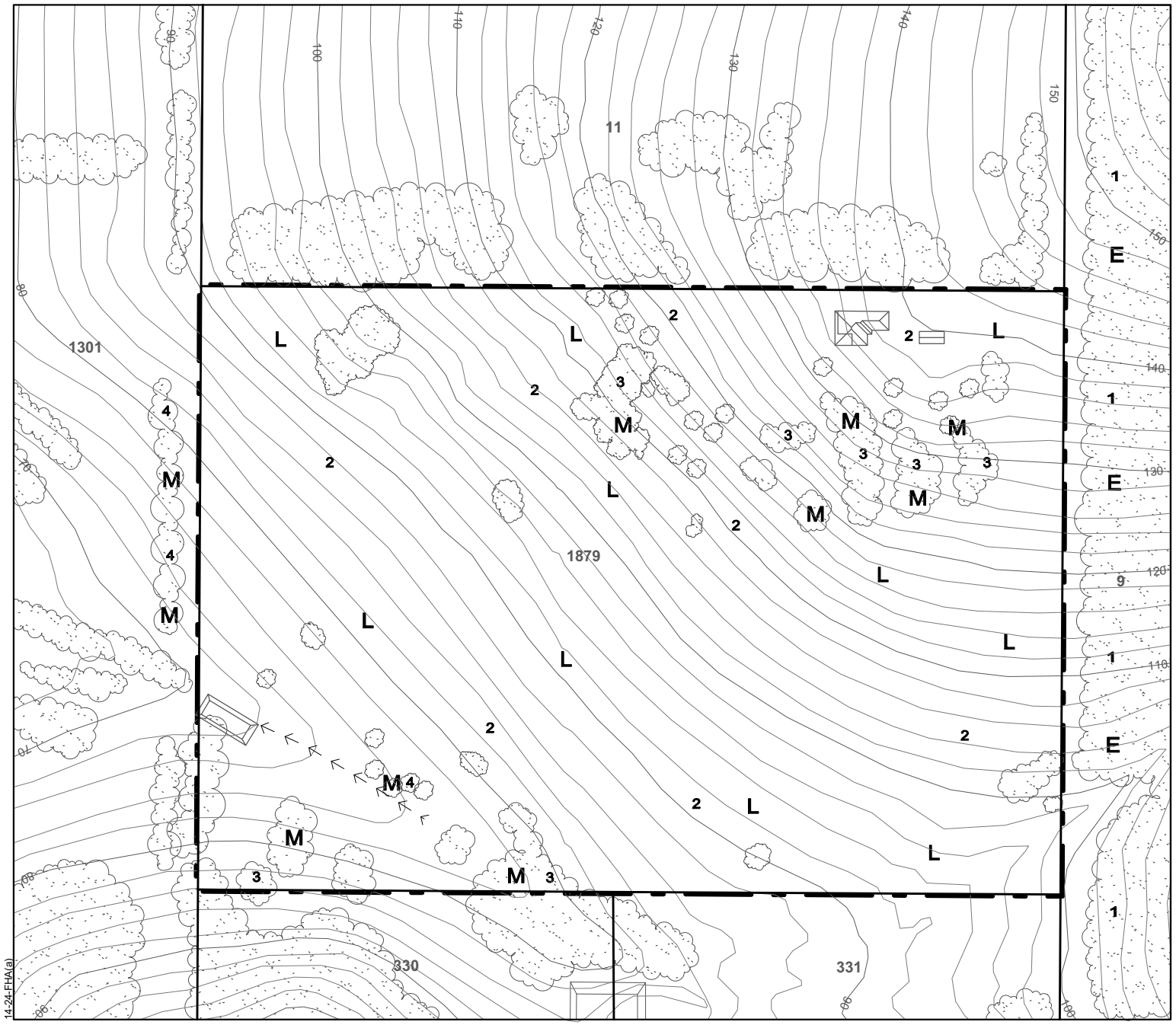
From the ratings in the Hazard Assessment the following maximum bushfire attack levels apply on the basis a 20m building protection zone is implemented, buildings are contained to the identified building envelope and Hazard Separation Areas (as outlined in following sections) are maintained.

| LOT | BAL |
|---|---|
| Lot 75 | BAL 19 |
| Lot 76 | BAL 19 |
| Lot 77 | BAL 19 |
| Lot 78 | BAL 19 |
| Lot 79 | BAL 12.5 – 19 |
| Lot 80 | BAL 12.5 – 19 |
| Lot 81 | BAL 12.5 |
| Lot 82 | BAL 12.5 |
| Lot 83 | BAL 12.5 |
| Lot 84 | BAL 12.5 |
| Lot 85 | BAL 12.5 |
| Lot 86 | BAL 12.5 |

The above Bushfire Attack Levels require specific construction requirements under AS3959. Refer to as 3959 Sections 3 & 5 for BAL 12.5 or sections 3 & 6 for BAL 19.

# FIRE HAZARD ASSESSMENT

Lot 1879 Davies Road
Kalgan, City of Albany




**LEGEND**

- Subject Land
- Existing Vegetation
- Existing Buildings
- Existing Dams
- Drainage Line

N

ORIG A4
SCALE 1:3000
0 10 20 30 40 50

| | | | |
|---|---|---|---|
| 1 | A | Low open forrest (04) | **E**xtreme |
| 2 | G | Pasture (26) | **L**ow |
| 3 | B | Low woodlands (06) | **M**oderate |
| 4 | B | Open woodlands / Shelter belt | **M**oderate |

AYTON BAESJOU PLANNING
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

14-24-FHA(a)

## 5. BUSHFIRE MITIGATION AND PROTECTION

See the following plan and the notes below for Bushfire Mitigation and Protection requirements. These combine to ensure the site and future dwellings enjoying a low to moderate hazard level.

### 5.1 Location

The subdivision/development is located on the land **that is not** subject to either an extreme bush fire hazard classification or requires construction standards to BAL – 40 or BAL – FZ. (A1.1)

### 5.2 Vehicular Access

Two different vehicular access routes, both of which connect to the public road network, will be available to all residents/the public at all times. (A2.1)

### 5.3 Water for Fire Fighting

The development is to be provided with a reticulated water supply, together with fire hydrants, in accordance with the specifications of the relevant water supply authority and FESA. (A3.1)

### 5.4 Siting of Development

Every building is to be provided with a maintained Building Protection Zone not less than 20m in width and where adjacent to a parkland cleared area, an additional width of at least 10m managed as a Hazard Separation Area.

In addition, a minimum setback of 40m containing managed pasture is provided to the adjoining Lot 9.

Every dwelling will require an appropriate construction standard as per the assessed Bushfire Attack Level.

# FIRE MANAGMENT PLAN

## Lot 1879 Davies Road
## Kalgan, City of Albany

EXISTING RURAL RESIDENTIAL ZONE

EXISTING RURAL RESIDENTIAL ZONE

11

1879

1301

330

331

POS

38 1.03ha
39 1.06ha
40 1.00ha
41 1.02ha
56 9735m
57 1.10ha
60 1.03ha
61 1.00ha
62 1.00ha
63 1.01ha
75 103ha BAL 19
76 1.03ha BAL 19
77 1.11ha BAL 19
78 1.01ha BAL 19
79 1.01ha BAL 19 BAL 12.5
80 1.02ha BAL 19 BAL 12.5
81 1.08ha BAL 12.5
82 1.00ha BAL 12.5
83 1.00ha BAL 12.5
84 1.01ha BAL 12.5
85 1.57ha BAL 12.5
86 1.00ha BAL 12.5

SFB

## LEGEND

- Subject Land
- Existing Vegetation
- Existing Buildings
- Existing Dams
- Indicative Building Envelopes
- Strategic Fire Break (SFB)
- Proposed Vegetation

N

ORIG A3
SCALE 1:2000
0 10 20 30 40 50

- SFBs to be provided at the time of subdivision and maintained by landowners.
- Buildings to be constructed to the noted Bushfire Attack Level (BAL) as per AS3959.
- Hydrants for firefighting to be provided at the time of subdivision.
- Building Protection Zones and Hazard Separation Areas to be implemented and maintained around buildings.

AYTON BAESJOU
PLANNING
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

14-24-FMP(a)

### 5.5 Development Design

Development Design including compliance with AS3959 under the relevant noted Bushfire Attack Levels and consequential building requirements meets development design requirements.

## 6. SUBDIVISIONAL & DEVELOPMENT REQUIREMENTS

### 6.1 Building & Location

Building and Construction requirements are set on a lot by lot basis and for a number of lots vary according to the buildings location within the building envelope (Refer to Plan):

| Construction Standard | Lot |
|---|---|
| BAL 12.5 | 81 - 86 |
| BAL 12.5 or 19 | 79, 80 |
| BAL 19 | 75-78 |

Buildings to be located within the identified building envelope.

Within building envelopes with a split BAL construction standard (Lots 79 & 80), where any dwelling partially or wholly intrudes into the BAL 19 area, the entire building is to be designed and constructed to meet this higher standard.

### 6.2 Access

Access is provided by a combination of public roadways, battleaxe legs, driveways and strategic fire access tracks as shown on the plan. Standards for the differing access way types are noted in Planning for Bushfire Protection (Edition 2). No locked gates are permitted on this network.

The access network is circular and ensures three different access routes connecting to the public road network are available at all times.

### 6.3 Water for Firefighting

Hydrants to be installed at the time of subdivision in accord with development policy.

### 6.4 Building Protection Zones and Hazard Separation

A width not less than 20m from all buildings shall be maintained as a Building Protection Zone as follows:

- Minimum 20m width measured from building wall;
- Fuel load reduced to and maintained at 2 tonnes/ha;
- Trees to be a minimum of 10m apart with no dead material;
- Branches are pruned from trunks for at least the first 2m;
- No tall shrubs or trees overhang buildings; and
- Fences and other structures within the Bushfire Protection Zone are built of non combustible materials.

In addition to these minimums, it remains an option for landowners to create and maintain wider building protections zones in existing cleared areas outside of the nominated building envelopes.

All pasture and parkland clearings within 10m (or 20m in the case of the eastern boundary of Lots 78 - 80) of a Building Protection Zone to be maintained as a Hazard Separation Area as follows:

- Fuel load to be reduced to and maintained at between 5-8 tonnes per ha;
- Trees to be a minimum of 10m apart; and
- Trees to be maintained devoid of dead materials (branches etc).

# 7. IMPLEMENTATION

## 7.1 Developer

On a stage by stage basis at the time of subdivision developer/subdivider is to:

- Construct roading, battleaxe legs and strategic fire access tracks;
- Prepare cleared, parkland cleared and hazard separation areas to hazard separation area standards and maintain same till time of transfer;
- Install street fire hydrants; and
- Advise prospective purchasers of management provisions, fire management responsibilities and the Homeowners Bushfire Survival Manual.

## 7.2 City of Albany

The City of Albany will be responsible for:

- Issuing Annual Fire Break/Fire Safety Notice;
- Maintaining Public Roads;
- Monitoring and enforcing compliance with Annual Fire Break/Fire Safety Notice, Special Provisions (Maintenance of Strategic Fire Access Tracks, Bushfire Protection Zone & Hazard Separation Area etc); and
- Applying AS3959 Bushfire Attack Level conditions to building approval and ensuring driveways are constructed and maintained as appropriate.

## 7.3 Landowners

On transfer of lots landowners become responsible for individual holdings. Landowners are responsible for:

- Maintaining any battleaxe legs and/or strategic fire access tracks on their property;
- Constructing and maintain required Building Protection Zones, Hazard Separation Areas and individual driveways;
- Constructing buildings in accord with the noted Bushfire Attack Level under AS3959; and
- Complying with Council's annual Fire Break/Fire Safety Notice.

## 8. CONCLUSION

This Fire Management Plan meets the guidelines contained within Planning for Bushfire Protection by meeting most of the acceptable solutions noted and where alternative responses are necessary (P4) appropriate responses (AS3959 Construction) are provided.

# Attachment IV

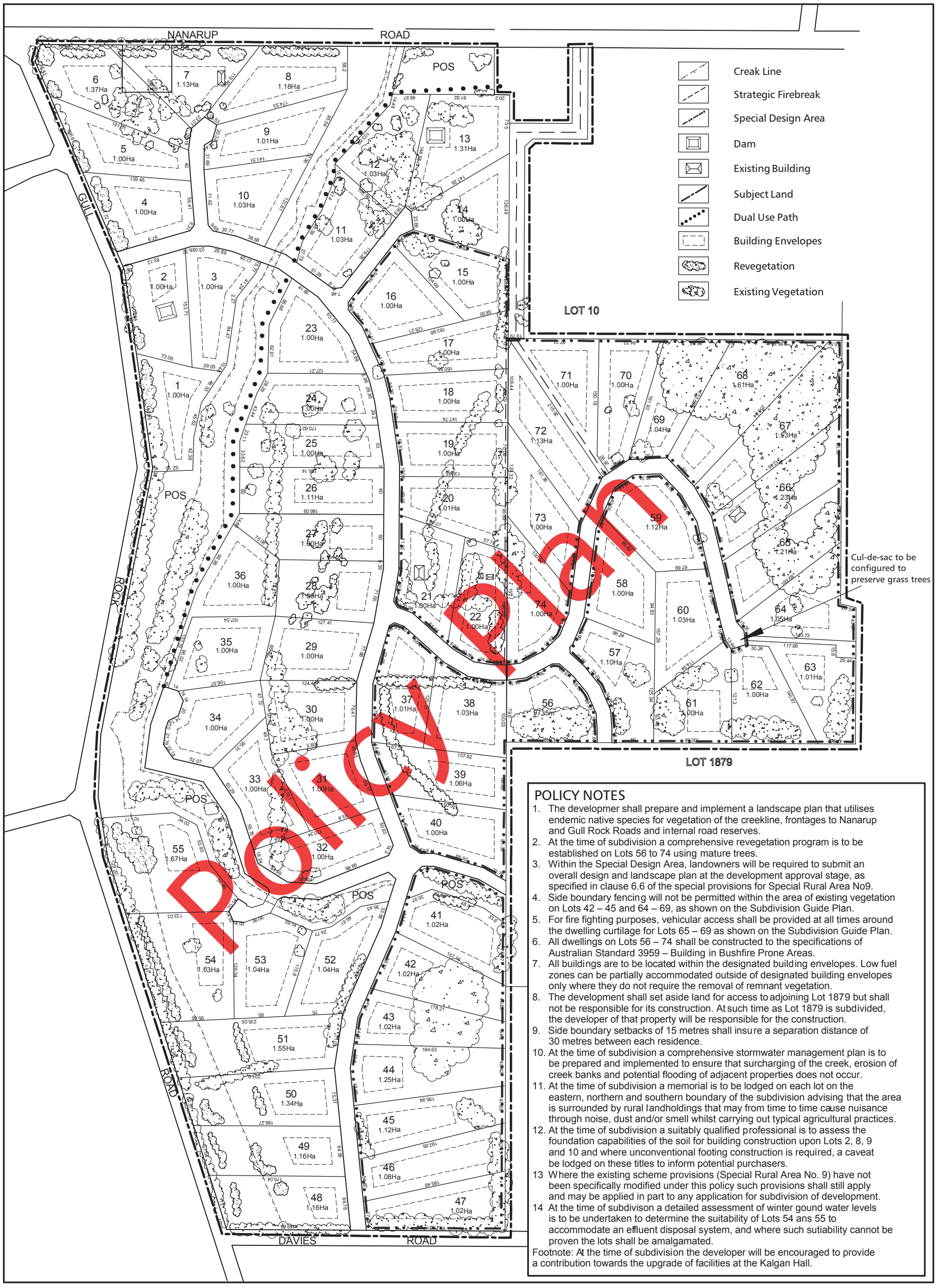
# City of Albany

# Rural Residential Area No. 9

# Special Provisions, Subdivision Guide Plan & Policy Plan

| No. | Specified Rural Residential Zone | Special Provisions Applying to Specified Rural Residential Zone |
|---|---|---|
| RR9 | Nanarup Road, Kalgan Rural Residential zone | 1. Subdivision of RR9 shall generally be in accordance with the Subdivision Guide Plan *RR9* endorsed by the CEO, with any minor variations approved by the Western Australian Planning Commission.<br>2. The minimum lot size shall be one hectare.<br>3. The following land uses are 'P' permitted uses—<br>• Single House<br>4. The following land uses are 'D' discretionary uses—<br>• Ancillary Accommodation;<br>• Bed and Breakfast/Farmstay;<br>• Home Occupation;<br>• Industry—Cottage;<br>• Public Utility; and<br>• Rural Pursuit (which shall be limited to existing cleared and pastured land only).<br>5. All development (including dwelling and outbuildings) and any low fuel zones shall be located outside of any development exclusion area, revegetation area and/or creekline protection area as shown on the Subdivision Guide Plan and shall achieve the following minimum setbacks—<br>i. 15 metres from Gull Rock or Nanarup Roads;<br>ii. 15 metres from all other lot boundaries; and<br>iii. 25 metres from any lot boundary with Location 1462.<br>6. No new access/egress points onto Nanarup Road will be permitted.<br>7. Within Special Design Areas (Lots 15-22, 37-47 & 56-74 as shown on the Subdivision Guide Plan), applicants will be required to submit an overall design and landscape plan which addresses—<br>(a) setbacks from property boundaries and creeklines;<br>(b) existing and proposed vegetation/revegetation;<br>(c) low lying, flood prone and stormwater disposal areas;<br>(d) low fuel zones;<br>(e) that cut and fill of the site shall be kept to a minimum with preference given to split level development and the breaking up of building mass;<br>(f) that only one out building shall be permitted with a maximum size of 65m$^2$ and maximum size of 65m$^2$ and maximum height to the eaves of 3 metres;<br>(g) driveways shall be designed to minimise visual impact and erosion by being aligned with the contours of the site and planted with trees and shrubs. Stormwater runoff shall be attenuated to ensure erosion does not occur; and<br>(h) the landscape plan shall indicate the number, type and location of shrubs and trees to be planted and maintained as a condition of Development Approval to effectively minimise the visual impact of all development on the site. |

ALL AREAS AND DIMENSIONS ARE SUBJECT TO SURVEY






## POLICY NOTES

1. The developmer shall prepare and implement a landscape plan that utilises endemic native species for vegetation of the creekline, frontages to Nanarup and Gull Rock Roads and internal road reserves.
2. At the time of subdivision a comprehensive revegetation program is to be established on Lots 56 to 74 using mature trees.
3. Within the Special Design Area, landowners will be required to submit an overall design and landscape plan at the development approval stage, as specified in clause 6.6 of the special provisions for Special Rural Area No9.
4. Side boundary fencing will not be permitted within the area of existing vegetation on Lots 42 – 45 and 64 – 69, as shown on the Subdivision Guide Plan.
5. For fire fighting purposes, vehicular access shall be provided at all times around the dwelling curtilage for Lots 65 – 69 as shown on the Subdivision Guide Plan.
6. All dwellings on Lots 56 – 74 shall be constructed to the specifications of Australian Standard 3959 – Building in Bushfire Prone Areas.
7. All buildings are to be located within the designated building envelopes. Low fuel zones can be partially accommodated outside of designated building envelopes only where they do not require the removal of remnant vegetation.
8. The development shall set aside land for access to adjoining Lot 1879 but shall not be responsible for its construction. At such time as Lot 1879 is subdivided, the developer of that property will be responsible for the construction.
9. Side boundary setbacks of 15 metres shall insure a separation distance of 30 metres between each residence.
10. At the time of subdivision a comprehensive stormwater management plan is to be prepared and implemented to ensure that surcharging of the creek, erosion of creek banks and potential flooding of adjacent properties does not occur.
11. At the time of subdivision a memorial is to be lodged on each lot on the eastern, northern and southern boundary of the subdivision advising that the area is surrounded by rural landholdings that may from time to time cause nuisance through noise, dust and/or smell whilst carrying out typical agricultural practices.
12. At the time of subdivision a suitably qualified professional is to assess the foundation capabilities of the soil for building construction upon Lots 2, 8, 9 and 10 and where unconventional footing construction is required, a caveat be lodged on these titles to inform potential purchasers.
13 Where the existing scheme provisions (Special Rural Area No. 9) have not been specifically modified under this policy such provisions shall still apply and may be applied in part to any application for subdivision of development.
14 At the time of subdivison a detailed assessment of winter gound water levels is to be undertaken to determine the suitability of Lots 54 ans 55 to accommodate an effluent disposal system, and where such sutiability cannot be proven the lots shall be amalgamated.

Footnote: At the time of subdivision the developer will be encouraged to provide a contribution towards the upgrade of facilities at the Kalgan Hall.

# SUBDIVISION GUIDE PLAN

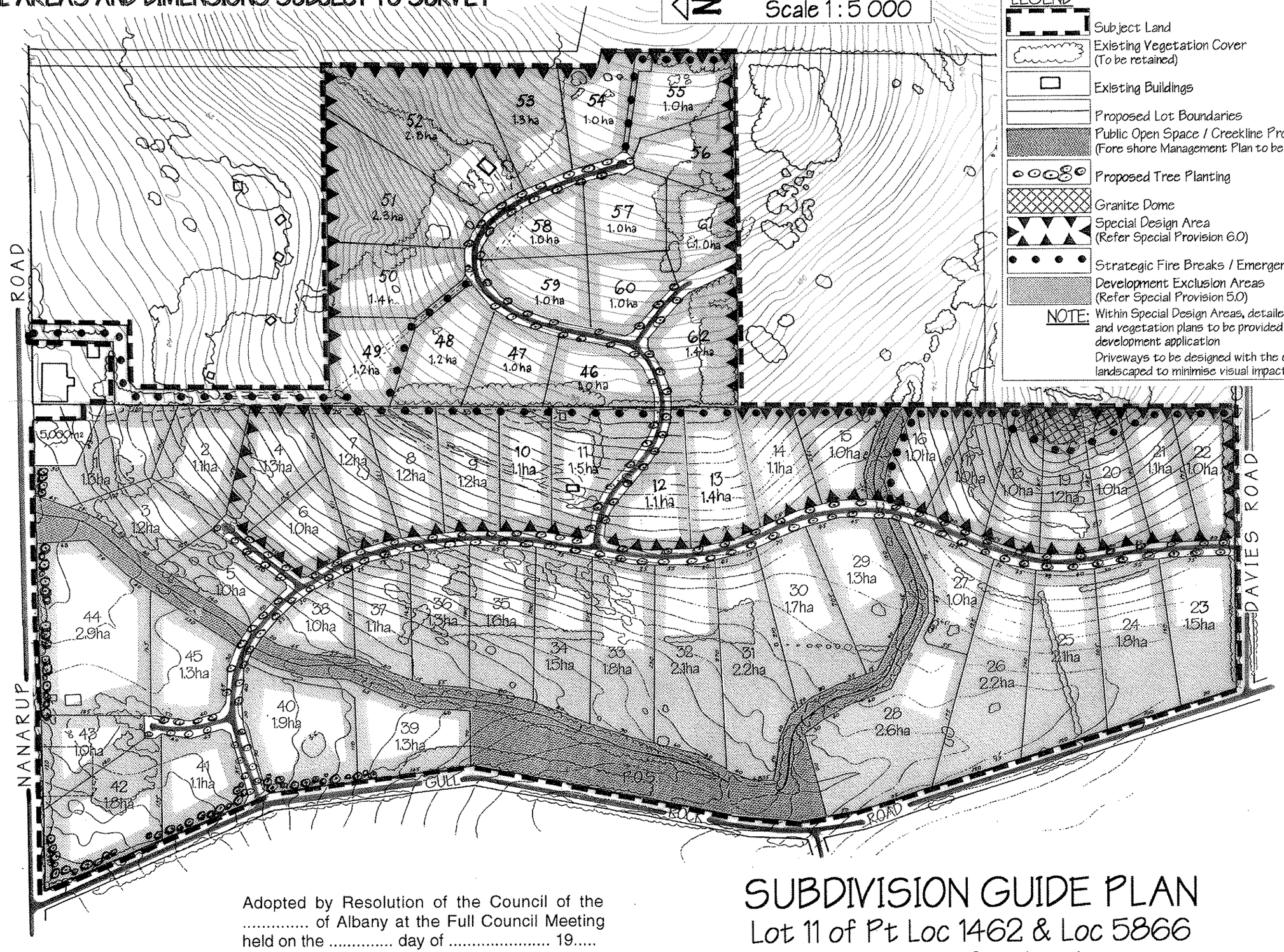
## Lots 11, 300, 1301 Nanarup Road / Gull Rock Road

Ayton Taylor Burrell
Consultants in Urban & Regional Planning
11 Duke St, Albany. Western Australia 6330
Phone: (08) 9842 2304 Fax: (08) 9842 1340

SCALE 1:5000
0 25 50 75 100 125
ORIG A3
03-05-SGP(a)
AUGUST 05

ALL AREAS AND DIMENSIONS SUBJECT TO SURVEY

Scale 1:5 000




LEGEND

- Subject Land
- Existing Vegetation Cover (To be retained)
- Existing Buildings
- Proposed Lot Boundaries
- Public Open Space / Creekline Protection Area (Fore shore Management Plan to be prepared)
- Proposed Tree Planting
- Granite Dome
- Special Design Area (Refer Special Provision 6.0)
- Strategic Fire Breaks / Emergency Access
- Development Exclusion Areas (Refer Special Provision 5.0)

NOTE: Within Special Design Areas, detailed landscape and vegetation plans to be provided with development application

Driveways to be designed with the contours and landscaped to minimise visual impact and erosion.

Adopted by Resolution of the Council of the ..... of Albany at the Full Council Meeting held on the ..... day of ..... 19.....

Chief Executive Officer.....

# SUBDIVISION GUIDE PLAN

## Lot 11 of Pt Loc 1462 & Loc 5866 Nanarup Road and Pt Loc 1569 Gull Rock Road.

**AYTON , TAYLOR & BURRELL**
Consultants in Town Planning and Civic Design
11 Duke Street, Albany. Western Australia 6330
Phone 08 9842 2304 Fax 08 9842 1340

Figure 3

**PLANNING AND DEVELOPMENT ACT 2005**

**CITY OF ALBANY**

**LOCAL PLANNING SCHEME No. 1**

**AMENDMENT No. 12**

The Albany City Council under and by virtue of the powers conferred upon it in that behalf by the Planning and Development Act 2005 hereby amends the above Local Planning Scheme by:

i) Rezoning Lot 1879 Davies Road, Lower Kalgan, Albany from the 'General Agriculture' zone to the 'Rural Residential' zone and 'Parks & Recreation' reserve.

ii) Incorporating Lot 1879 into Rural Residential Area No. 9, as set out in Schedule 14 – Rural Residential zones of the Scheme Text.

iii) Including a new provision within Rural Residential Area No. 9, as follows:

8. For Lots 75-86, building plans shall include an assessment of the foundation zone of the building area and include full details of proposed foundations to adequately accommodate foundation zone conditions.

iv) Including a new provision within Rural Residential Area No. 9, as follows:

9. For Lots 56-74, as shown on the Subdivision Guide Plan, all areas including pasture, parkland clearing, replanting and landscape areas shall be maintained as a Hazard Separation Area (refer to the Fire Management Plan).

v) Including a new provision within Rural Residential Area No. 9, as follows:

10. All dwellings on Lots 56-86 shall be constructed to the specifications of Australian Standard 3959 – Building in Bushfire Prone Areas. In the instance of lots 75-86, construction shall be to the requirements of the relevant Bushfire Attack Level (BAL) per the Fire Management Plan (BAL 12.5 or BAL 19).

vi) Applying the following Subdivision Guide Plan to Rural Residential Area No. 9 as follows.

vii) Amending the Scheme Maps accordingly.

ALL AREAS AND DIMENSIONS ARE SUBJECT TO SURVEY

NANARUP ROAD

ROCK ROAD

GULL ROAD

DAVIES

POS

SFB

## LEGEND

- Subject Land
- Existing Lot Boundaries
- Existing Vegetation Cover (To be retained)
- Existing Buildings
- Existing Dams
- Proposed Lot Boundaries
- Proposed Tree Planting
- POS / Creekline Protection Area (Foreshore Management Plan to be prepared)
- Development Exclusion Area (Refer Special Provision 5.0)
- Strategic Fire Break
- Special Design Area (Refer Special Provision 6.0)

## NOTES

Within Special Design Area, detailed landscape and vegetation plans to be provided with development application.
Driveways to be designed with the contours and landscaped to minimise visual impact and erosion.

ADOPTED BY RESOLUTION OF THE COUNCIL OF THE

_____ OF _____

AT THE _____ COUNCIL MEETING

ON THE _____ DAY OF _____ _____

CHIEF EXECUTIVE OFFICER _____

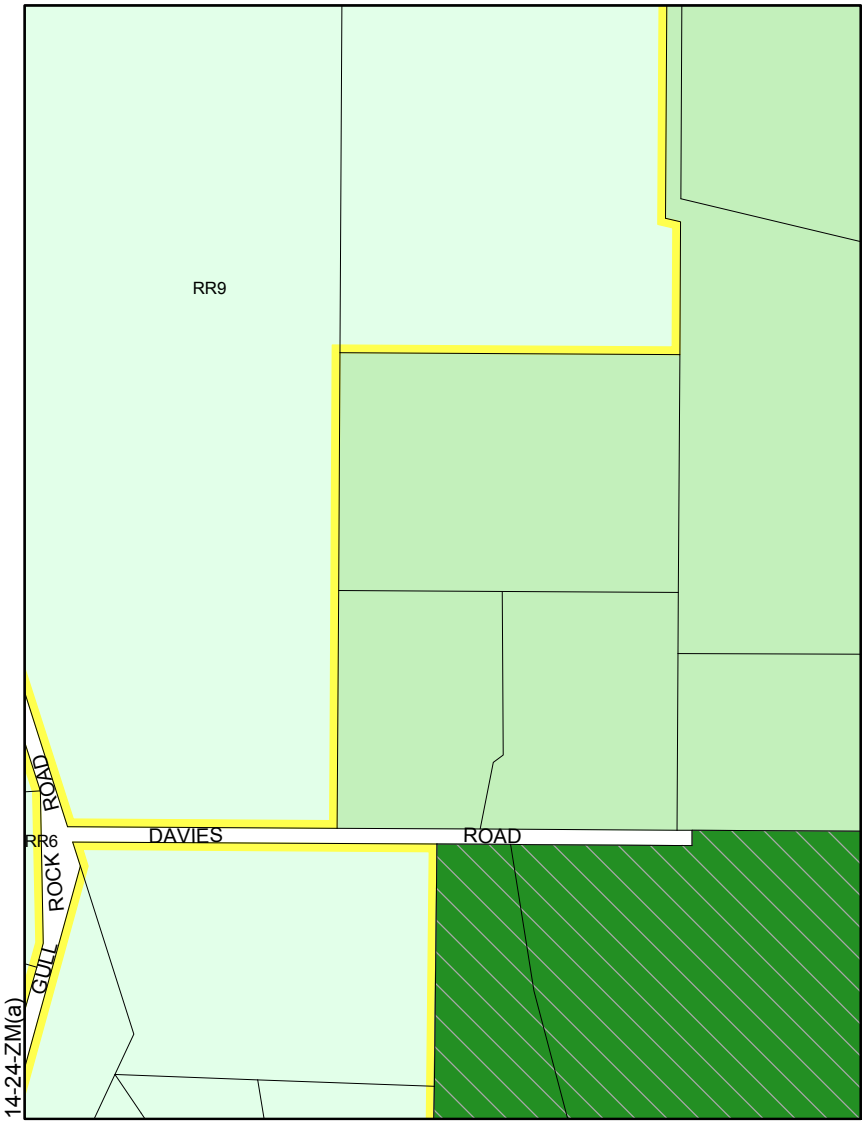
ORIG A3
SCALE 1:5000
0 25 50 75 100 125

14-24-SGP(a)

AYTON BAESJOU
PLANNING
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

# SUBDIVISION GUIDE PLAN
## Lots 11, 300 & 1301 Nanarup Road
## Lot 1879 Davies Road
## Kalgan, City of Albany

## Existing Zoning




**RESERVES**

Parks and Recreation

**ZONES**

General Agricultural

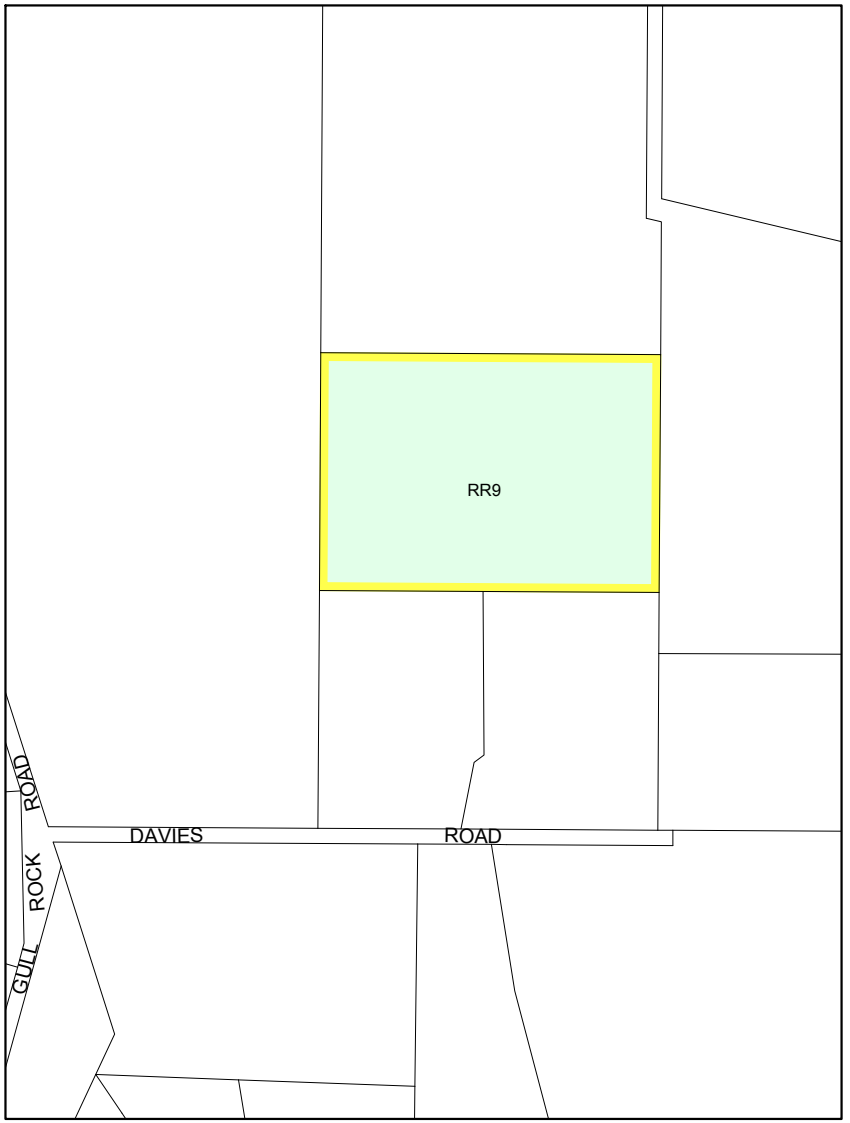
Rural Residential

N

ORIG A4
SCALE 1:10000

0 50 100 150 200 250

## Proposed Zoning




AYTON BAESJOU
PLANNING
11 Duke Street
Albany WA 6330
Ph 9842 2304 Fax 9842 8494

CITY OF ALBANY
LOCAL PLANNING SCHEME 1
AMENDMENT No. 12

**ADOPTION**

Adopted by resolution of the Council of the City of Albany at the meeting of the Council held on the _____day of _____ 20__ ____.

_____
**Mayor**

_____
**Chief Executive Officer**

**FINAL APPROVAL**

Adopted for final approval by resolution of the City of Albany at the Meeting of the Council held on the _____day of _____ 20_____ and the Common Seal of the City of Albany was hereunto affixed by the authority of a resolution of the Council in the presence of:

_____
**Mayor**

_____
**Chief Executive Officer**

Recommended/Submitted for Final Approval

_____
**Delegated Under S.16**
**of the PD Act 2005**

_____
**Date**

Final Approval Granted

_____
**Minister for Planning**

_____
**Date**

**Lot 1879 (No. 81)**
**Davies Road,**
**Kalgan, WA 6330**

# Site Soil Evaluation

BIO DIVERSE SOLUTIONS

Bio Diverse Solutions

20/10/2020

# DOCUMENT CONTROL

**TITLE**
Site Soil Evaluation Lot 1879 (No. 81) Davies Road, Kalgan, WA 6330
Author (s): Chiquita Cramer
Reviewer (s): Bert Quayle and Kathryn Kinnear
Job No.: AB0036-002
Client: Michael O'Dea

**REVISION RECORD**

| Revision | Summary | Revised By | Date |
|---|---|---|---|
| Draft Id 20/10/2020 | Internal QA review | K. Kinnear | 20/10/2020 |
| Final Id 20/10/2020 | Final issued to client | C. Cramer | 20/10/2020 |
| | | | |
| | | | |

Bio Diverse Solutions
29 Hercules Crescent
Albany WA 6330
08 9842 1575
www.biodiversesolutions.com.au
ABN 48 138 824 272

# Table of Contents



## APPENDICES

# 1 Introduction

Michael O'Dea (the Client) commissioned Bio Diverse Solutions to prepare a Site Soil Evaluation (SSE) to determine onsite effluent disposal suitability for the proposed subdivision of Lot 1879 (No. 81) Davies Road, Kalgan WA. This report details site soils under late winter conditions and suitability for on-site effluent disposal across the site in relation to the proposed subdivision at the above-mentioned address.

## 1.1 Alignment to Legislation, Policy and Guidelines

Bio Diverse Solutions has prepared this report aligned to the following legislation:

- State Planning Commission, Land Capability Assessment for Local Rural Strategies (1989);
- *Government Sewerage Policy (2019);*
- *Draft Country Sewerage Policy (Amended 2003);*
- *Health Act (1911)* and draft *Health Act (2008);*
- *Country Area Water Supply Act 1947;*
- Code of Practise for the design, manufacture and operation of Aerobic Treatment Units (2001); and
- Australian Standard (AS)1547-2012 – Onsite domestic wastewater management.

## 1.2 Objectives

The overall objectives of the SSE process are to:

- Assess the capacity of the site to sustainably manage sewage within lot boundaries;
- Identify public and environmental health risks of on-site sewage management especially the effect on groundwater and surface water on the site;
- Identify the most appropriate on-site system in consideration of site conditions and the nature of the proposed development; and
- Identify and implement a management program to minimise these risks if required.

# 2 Site Details

## 2.1 Location

The Subject Site is defined as Lot 1879 (No. 81) Davies Road, Kalgan within the municipality of the City of Albany. The site is bound by a new rural residential subdivision to the north, rural land to the south and west and a pocket of natural bushland to the east. The nearest roads are Davies Road to the south and Gull Rock Road to the west. The site is located in the suburb of Kalgan approximately 20 km north-east of the Albany CBD. The location of the Subject Site is shown on Figure 1.


**Figure 1: Location Plan**

## 2.2 Development Proposal

The Subject Site is zoned as “Rural Residential” under the City of Albany’s Local Planning Scheme (No. 1). It is proposed the Subject Site will be subdivided into 12 lots ranging in size from 1.0 to 1.3ha as shown on Figure 2. The site has an existing dwelling which is located on proposed Lot 3 (as shown on Figure 2), Proposed Lot 3 has an existing dwelling and an approved effluent disposal system and therefore does not require assessment for onsite effluent disposal suitability as no new buildings are proposed here.

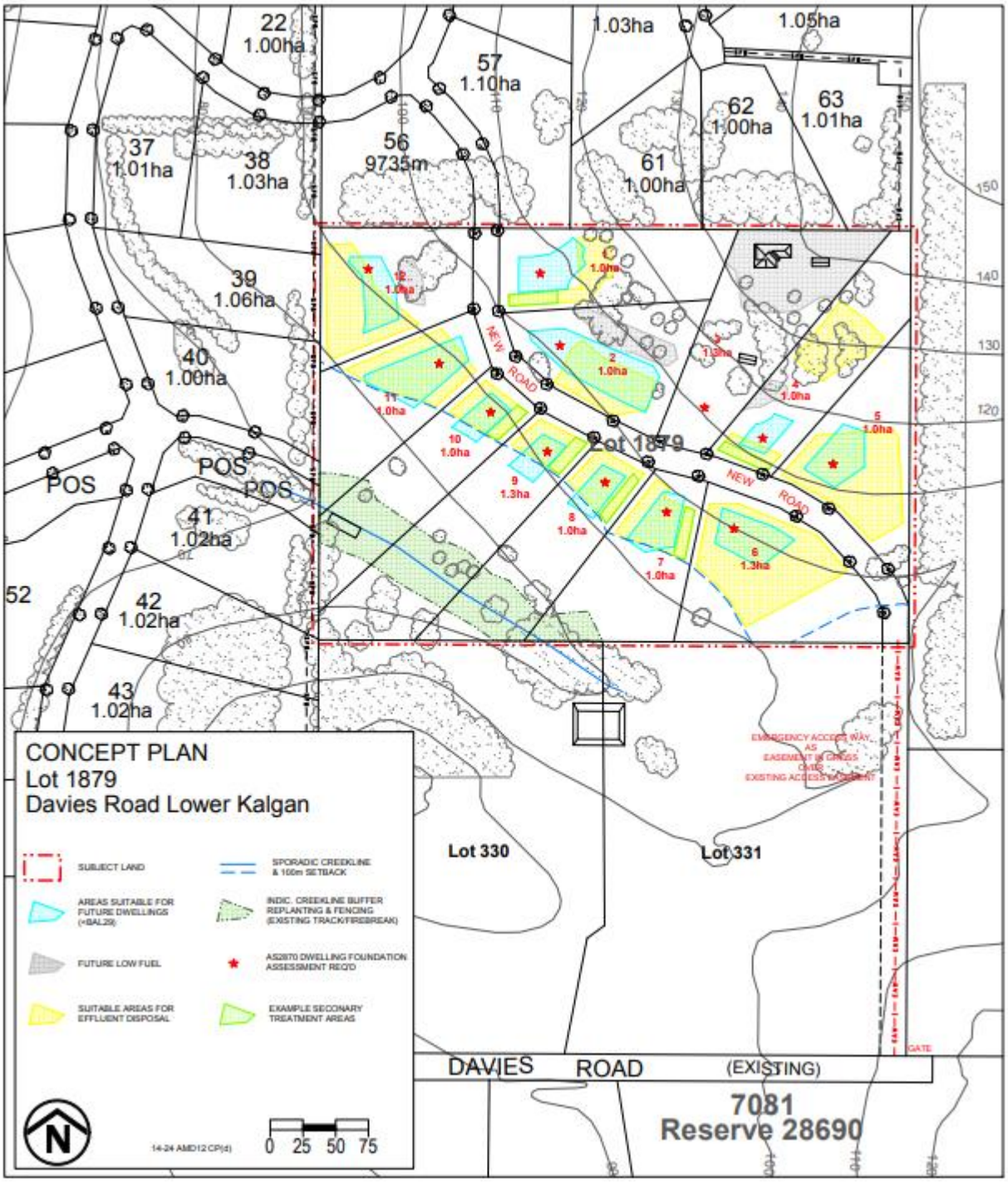



**Figure 2: Proposed Subdivision**

## 2.3 Current Land Use

Currently the Subject Site is utilised as a rural property consisting of open paddocks with an existing dwelling in the north-east corner of the site. There is a creek that runs through the south-west corner of the site that flows seasonally and pockets of native trees most of which is located in the north-east of the site adjacent to the existing dwelling.

# 3 Desktop Assessment

## 3.1 Topography and slope

The Subject Site slopes from 140 mAHD in the north east corner of the site to a low point of 75 mAHD in the south west corner of the site. The majority of the site has moderate slopes as it is situated on a hill (on average the site has 16% slopes. The topographic contours are shown on Figure 3.

## 3.2 Geology and Soils

Database searches using the NRInfo Portal (Department of Primary Industries and Regional Development, 2017) shows the Subject Site lies within the Mount Many Peaks System (242Mm) and is described as '*Granitic hills and headlands, on the southern edge of the Albany Sandplain Zone, with shallow gravel, bare rock grey shallow sandy duplex and sandy gravel. Low woodland, scrub heath and mosses and lichens on rocks*'.

A geotechnical investigation was conducted by Landform Research in 2004 to determine land capability for the site. Landform Research (2004) found three main soil types exist across the site;

**Brown Gravelly Loams** occur on the lower slopes in the east. These soils have yellow brown sandy gravel to 400 mm over lighter brown and yellow brown loam and clay subsoils. These loam soils are developed on the deep weathering profile of the granite/gneiss basement with laterite gravel shed from upslope and degeneration of the laterite soil profile added to the upper horizons. Slopes are moderate to steep.

**Brown Sand over Loam Duplex** occur on the lower slopes with sand to depths of approximately 300 mm over lighter brown and yellow brown loam and clay subsoils. The sands are medium grained quartz sand shed from weathering of granite up slope. Sand is more prominent at lower elevations along the creek line in the south west. These loam soils are developed on the deep weathering profile of the granite/gneiss basement with quartz sand shed from upslope being added to the upper soil horizons. Slopes are moderate to steep, becoming steeper upslope.

**Rocky Loam** occur where the basement granite has been exposed in the north and north east, brown loam and yellow brown loam with sandy surface horizons are present. Basement granite/gneiss rock outcrop is frequent and slopes tend to be steeper (Landform Research 2004).

The soil types identified by Landform Research are shown on Figure 3 and discussed in more detail in the Land Capability and Geotechnical Assessment (Landform Research, 2004) which has been included as Appendix B.

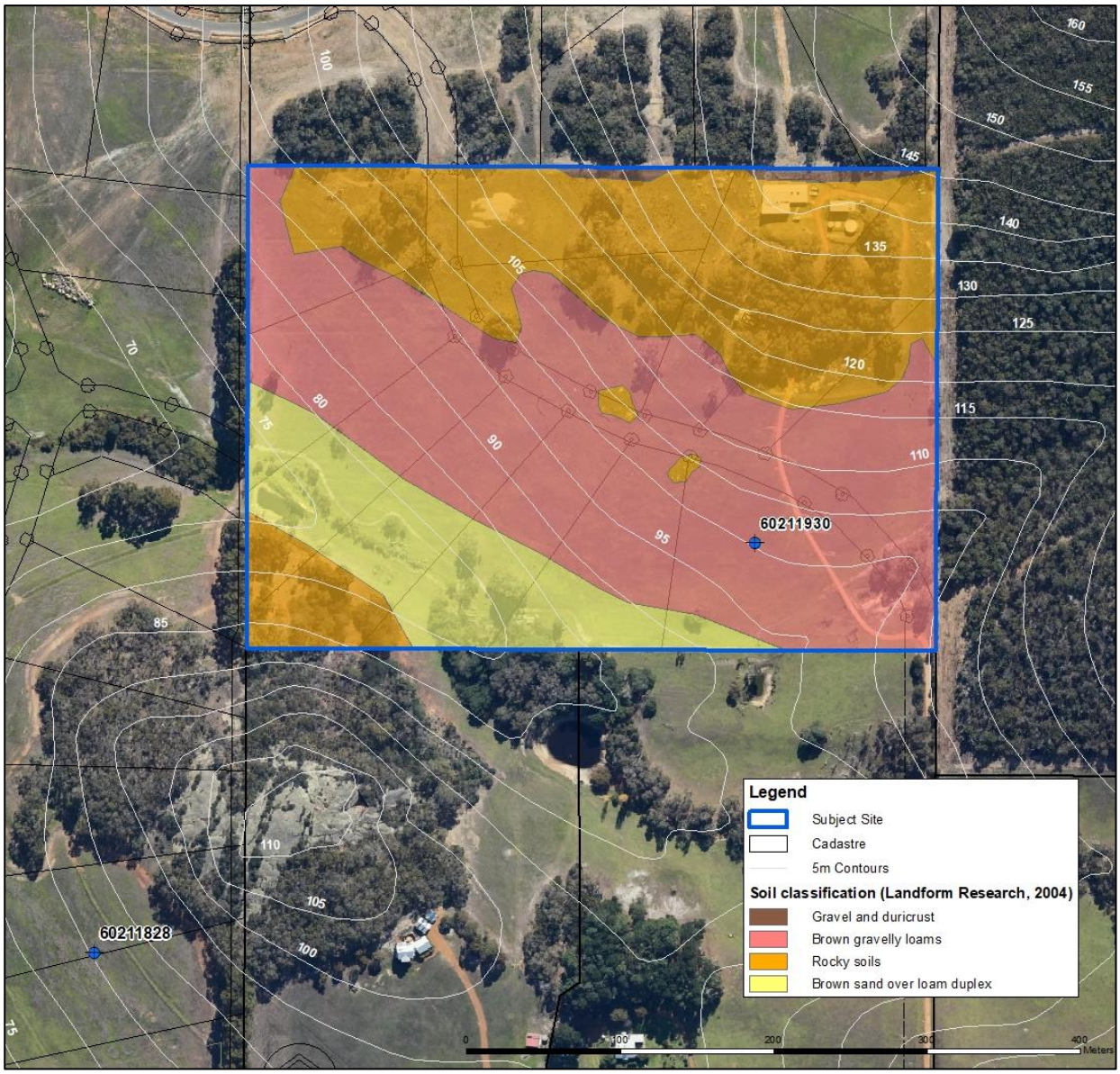



**Figure 3: Surface geology, topography, production bore locations**

### 3.3 Surface Hydrology

The site generally drains towards a creek located in the south west corner of the site. The creek carries seasonal flows from the site and lands upstream in a westerly direction, ultimately discharging to Oyster Harbour. There is one dam within the creek line adjacent to the western boundary of the Subject Site. Oyster Harbour is categorised by the Department of Water and Environmental Regulation as an Environmentally Sensitive Area.

### 3.4 Hydrogeology and Groundwater

Australian Geoscience Mapping and Department of Water 250K Hydrogeological mapping places the Subject Site within the following zones:

**Geological Time:** Proterozoic.
**Aquifer Description:** Fractured and weathered rocks - local aquifer, minor groundwater resources.

**Geological Description:** Granitoid rock, porphyritic and even-grained, generally weathered to clayey sand (outcrop).

According the Department of Water and Environmental Regulation Water Information Reporting map there is one bore located on the Subject Site (Site Ref. 60211930). The approximate location of the bore is shown on Figure 3. In the Site Details Report it states that the bore '*Runs dry in summer'.*

The nearest bore to the Subject Site is located approximately 270m south-west on a neighbouring property (Site Ref. 60211828), as shown on Figure 3. The Site Detail Report states that this bore '*Never runs dry'*.

Desktop analysis of the site indicates it is not located within a designated Public Drinking Water Source Area (PDWSA) as defined by the *Country Areas Water Supply Act 1947.* The closest designated PDWSA is located 14km to the east, being Angove Creek Catchment Area (Priority 1) (DoW, 2001).

### 3.5 Flooding Potential

The majority of the site sits high in the landscape and is not subjected to flooding. Areas adjacent to the creek may be subjected to flooding during a higher than average rainfall year, however it is evident that if flooding does occur here it is not likely to extend far from the creek line (up to approximately 20m either side) due to the moderately steep nature of the site. The building envelopes on the southern lots (lots 6-12) will be situated 100m from the creek line.

### 3.6 Environmentally Sensitive Areas

The Subject Site is located approximately 2.2km away from the nearest Environmentally Sensitive Area (ESA) (DWER,2020) being Oyster Harbour. This meets the usual requirement of 100m buffer from ESA's and as such the proposed subdivision and associated effluent disposal poses minimal risk to the Oyster Harbour ESA.

### 3.7 Sewerage Sensitive Areas

The Subject Site is not located in sewerage sensitive area. The Government Sewerage Policy (2019) outlines Sewerage Sensitive Areas as:

*'Land that drains to and is within two kilometres of Irwin Inlet, Wilson Inlet, Torbay Inlet, Manarup Lagoon, Lake Powell, Princess Royal Harbour and Oyster Harbour'.*
and
*'within one kilometre up-groundwater- gradient and 250 metres down-groundwater-gradient of a significant wetland; or where the groundwater gradient is unknown or seasonably variable within one kilometre of the significant wetland'.*

The Subject Site is just over 2kms from Oyster Harbour and therefore just outside of a sewage sensitive area as shown on Figure 4.

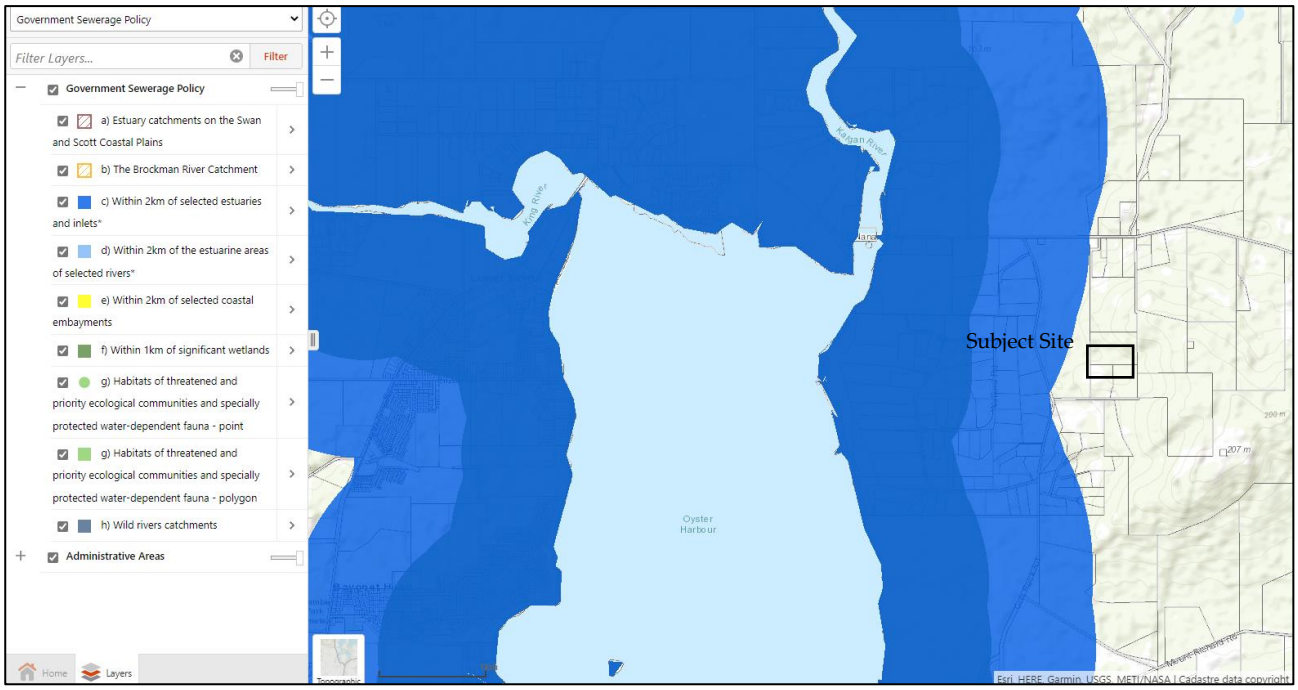



**Figure 4: Sewerage sensitive areas mapping (Department of Planning, Lands and Heritage**

# 4 Soil Testing

## 4.1 Site Soil Evaluation Method

A site soil investigation was conducted on the 29th September 2020 by Great Southern Geotechnics, the Geotechnical Investigation Report (GSG 2020) has been included as Appendix A. The Site Investigation was conducted under late winter conditions and included the construction of twelve boreholes to a depth of 2.0 metres on each lot, photographing and logging of soils to the depth of holes and inspection and measuring of the water table. The location of the boreholes was determined by the most likely location of the effluent disposal area on each lot given the environmental constraints of the site. The location of the twelve boreholes is shown on Figures 5. Figure 5 also shows the test pits previously constructed and logged as part of the Land Capability Assessment (Landform Research 2004).


**Figure 5: Test hole location plan**

Bore holes were excavated to a depth of 2.0 metres using Kubota KX41-3V mini excavator with a 300mm auger. The boreholes were logged and left open for a minimum of 1 hour to examine any water table or water seepage into the soil profile.

A sample of the sandy clay layer encountered across the site was tested for permeability in the laboratory using the falling head permeability test. An infield permeability test using the Talsma Hallam Method was not performed in this instance due to the high clay content and therefore expected low permeability in the area. Three samples of the sandy clay layer encountered adjacent to TP1, TP6 and TP10 were sent off to CSBP Laboratories for phosphorus retention index testing.

Analysis of the site for suitable onsite effluent disposal was undertaken with a desktop assessment of publicly available databases, review of previous reports applicable to the site and assessment of the site soils to the Government Sewerage Policy (2019) and AS1547-2012.

### 4.2 Soil Testing Results

The twelve boreholes revealed that soils across the Subject Site were relatively consistent and were generally classified as; sand with silt (topsoil), over a thin layer of sand or gravelly sand, over sandy clay. Multiple areas of rock outcrop were visible across the site and refusal due to base rock was encountered at various depths at TP2, TP4 and TP12.

Details of the site soils as classified by Great Southern Geotechnics is provided in Table 1 with the Site Investigation Report including test pit logs are shown in Appendix A.

**Table 1: Soil Testing Results**

| Test Pit | Depth (mm) | Soil Type | Soil Description |
|---|---|---|---|
| TP1 | 0-100mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 100-370mm | Gravelly sand | Light brown, fine to medium. Fine to coarse, sub-rounded to sub-angular gravel. |
| | 370-750mm | Sandy clay | Low to medium plasticity, light brown mottled orange. Fine to medium grained sand. |
| | 750-2000mm | Sandy clay | Low to medium plasticity, white mottled red. Fine to coarse, angular grained sand. |
| | | | **No water table was encountered.** |
| TP2 | 0-150mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 150-1050mm | Gravelly sand with clay | Low to medium plasticity, brown, fine to medium. Fine to medium, sub-rounded to sub-angular gravel. |
| | 1050mm | Refusal | |
| | | | **No water table was encountered.** |
| TP3 | 0-100mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 100-300mm | Gravelly sand | Light brown, fine to medium. Fine to coarse, sub-rounded to sub-angular gravel. |
| | 300-900mm | Sandy clay | Low to medium plasticity, light brown mottled orange. Fine to medium grained sand. |
| | 900-1600mm | Sandy clay | Low to medium plasticity, white mottled red. Fine to coarse, angular grained sand. |
| | | | **No water table was encountered.** |
| TP4 | 0-150mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 150-1050mm | Gravelly sand with clay | Low to medium plasticity, brown, fine to medium. Fine to medium, sub-rounded to sub-angular gravel. |
| | 1050mm | Refusal | |
| | | | **No water table was encountered.** |

**Table 1 continued**

| Test Pit | Depth (mm) | Soil Type | Soil Description |
|---|---|---|---|
| TP5 | 0-100mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 100-230mm | Gravelly sand | Light brown, fine to medium. Fine to coarse, sub-rounded to sub-angular gravel. |
| | 230-840mm | Sandy clay | Low to medium plasticity, light brown mottled orange. Fine to medium grained sand. |
| | 840-1600mm | Sandy clay | Low to medium plasticity, white mottled red. Fine to coarse, angular grained sand. |
| | | | **No water table was encountered.** |
| TP6 | 0-150mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 150-550mm | Sand | Light brown, fine to coarse, sub-angular to angular. |
| | 550-1300mm | Sandy clay | Low to medium plasticity, brown/orange. Fine to medium grained sand. |
| | 1300-2000mm | Sandy clay | Low to medium plasticity, grey/red mottled. Fine to medium grained sand. |
| | | | **No water table was encountered.** |
| TP7 | 0-100mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 100-220mm | Sand | Light brown, fine to coarse, sub-angular to angular. |
| | 220-1600mm | Sandy clay | Low to medium plasticity, brown/orange. Fine to medium grained sand. |
| | 1600-2000mm | Sandy clay | Low to medium plasticity, grey/red mottled. Fine to medium grained sand. |
| | | | **No water table was encountered.** |
| TP8 | 0-150mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 150-300mm | Sand | Light brown, fine to coarse, sub-angular to angular. |
| | 300-1200mm | Sandy clay | Low to medium plasticity, brown/orange. Fine to medium grained sand. |
| | 1200-2000mm | Sandy clay | Low to medium plasticity, grey/red mottled. Fine to medium grained sand. |
| | | | **No water table was encountered.** |
| TP9 | 0-100mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 100-400mm | Sand | Light brown, fine to coarse, sub-angular to angular. |
| | 400-1200mm | Sandy clay | Low to medium plasticity, brown/orange. Fine to medium grained sand. |
| | 1200-1600mm | Sandy clay | Low to medium plasticity, grey/red mottled. Fine to medium grained sand. |
| | | | **No water table was encountered.** |
| TP10 | 0-100mm | Sand with silt | Brown, fine to medium. Roots and root fibres. |
| | 100-350mm | Sand | Brown, fine to coarse, sub-angular to angular. |
| | 350-1300mm | Sandy clay | Low to medium plasticity, brown/orange. Fine to medium grained sand. |
| | 1300-2000mm | Sandy clay | Low to medium plasticity, grey/white/red mottled. Fine to medium grained sand. |
| | | | **No water table was encountered.** |
| TP11 | 0-150mm | Sand with silt | Grey, fine to medium. Roots and root fibres. |
| | 150-450mm | Sand | Brown, fine to coarse, sub-angular to angular. |
| | 450-1100mm | Sandy clay | Low to medium plasticity, brown/orange. Fine to medium grained sand. |
| | 1100-2000mm | Sandy clay | Low to medium plasticity, grey/white/red mottled. Fine to medium grained sand. |
| | | | **No water table was encountered.** |

**Table 1 continued**

| Test Pit | Depth (mm) | Soil Type | Soil Description |
|---|---|---|---|
| TP12 | 0-100mm | Sand with silt | Grey, fine to medium. Roots and root fibres. |
| | 100-250mm | Sand | Brown, fine to coarse, sub-angular to angular. |
| | 250-1000mm | Sandy clay | Low to medium plasticity, brown/orange. Fine to medium grained sand. |
| | 1000-1600mm | Sandy clay | Low to medium plasticity, grey. Fine to coarse, sub-angular to angular grained sand. |
| | 1600 | Refusal | **No water table was encountered.** |

## 4.3 Soil Permeability

Silts and clay soils generally record low permeability results whereas coarse sands record generally high permeability.

Laboratory permeability testing using the falling head method was conducted on a soil sample of sandy clay from TP6 (550-1300mm depth). The sandy clay profile found at TP6 (550-1300mm depth) was consistent with that found across the site at a similar depth, this is the approximate depth in which a primary treatment effluent disposal system would be situated.

Permeability results are shown in Appendix A, in summary the permeability rate of the sandy clay was found to be $1.32x10^{-10}$ m/sec , which is classified as a very low permeability.

## 4.4 Soil Phosphorus Retention Index

Phosphorous retention Index (PRI) is the ability of soils to absorb and treat nutrients within the soil (i.e. Soil microbe disinfecting ability). Soils with a PRI less than 1 have a very poor ability to treat effluent waters, whilst soils with a PRI of >5 having a high ability to treat effluent waters (nutrients). PRI testing was conducted on soil samples from TP1, TP6 and TP10 the PRI results are presented in Table 2.

**Table 2: PRI Results**

| Borehole | Depth (mm) | Soil Type | Phosphorus Retention Index |
|---|---|---|---|
| TP1 | 370 - 750 | Sandy clay | >1000 |
| TP6 | 550 – 1300 | Sandy clay | >1000 |
| TP10 | 350-1300 | Sandy clay | >1000 |

PRI results from the sandy clay layer found across the site was found to be significantly high (>1000) as shown in Table 2. A high PRI is favourable when installing effluent disposal systems due to the high ability of the soil to fix nutrients and heavy metals found within the effluent.

# 5 Site Suitability

The health and environmental requirements for wastewater treatment and disposal for developments not serviced by deep sewerage systems are contained in the *Government Sewerage Policy*, (DPLH, 2019). The Subject Site is situated in an area that does not have deep or reticulated sewerage. The *Government Sewerage Policy* (DPLH, 2019) states minimum requirements apply for all on-site sewage disposal systems. Table 2 outlines a summary of policy and compliance of the site to minimum requirements.

The areas on proposed lots 1-2 and 4-12 deemed suitable for onsite effluent disposal are shown on Figure 6. Lot 3 was not assessed for onsite effluent disposal suitability as no new buildings are proposed here.


**Figure 6: Suitable areas for onsite effluent disposal**

A minimum 5m buffer to neighbouring lots was applied to reduce potential contamination across the lots.

Whilst there is a moderate slope across the site, particularly so in the proposed northern lots the minimum grade requirements (1:5) for onsite disposal as outlined in Table 3 of the Draft Government Sewerage Policy is not exceeded across any of the proposed 12 lots.

Soil testing completed by Great Southern Geotechnics generally shows sand with silt (topsoil), over a thin layer of sand or gravelly sand, over sandy clay. Laboratory testing conducted on the sandy clay show a very low permeability and a very high PRI. The expected slow draining capacity of the soil and high PRI will assist the process of nutrients being fixed by soil microbes without perching given an adequate land application area for sandy clays (equivalent to clay loams according to the Government Sewerage Policy (2019) classifications).

Groundwater was not encountered in any of the 12 boreholes to the depth of the holes (2 metres).

A 100m buffer to the creek line in the south-west was applied to prevent contamination from effluent disposal to the creek and subsequently Oyster Harbour.

Several areas of rock out crop were identified across the site as shown on Figure 6. Effluent disposal on shallow rock outcrop shall be avoided to prevent perching and transportation of contaminates horizontally across the top of the base rock. At least 1500mm of separation between ground level and base rock shall be provided. TP4 and TP2 on Lots 1 and 4 respectively showed base rock at 1050mm BGL effluent disposal shall be avoided here. Alternative areas that achieved over 1500mm separation to base rock on Lots 1 and 4 were identified (TP11 and TP12).

**Table 3: Minimum requirements for all on-site wastewater disposal systems and design specific standards**

| Site Feature | Minimum Requirement | Requirement met |
|---|---|---|
| Separation from waterways | a wellhead protection zone or on Crown land within a reservoir protection zone;<br>100 metres of the high-water mark of a reservoir or 100 metres of any bore used for public drinking water supply where: — a wellhead protection zone or reservoir protection zone has not been assigned;<br>or — where existing lots would be rendered undevelopable by the wellhead protection zone | Yes<br>The Subject Site is not located within the vicinity of a Priority Drinking Water Source Area (PDWA) and associated wellheads. The nearest PDWA (Angove Creek) is approximately 18kms away. |
| | 30 metres of a private bore used for household/ drinking water purposes. | Yes<br>There is one private production bore located on proposed lot 6, if this bore remains and is utilised 30m to the lot's effluent disposal area can be achieved.<br>The nearest private bore outside of the Subject Site is 200m south-west of the Subject Site as shown on Figure 3. |
| | 100 metres of a waterway or significant wetland and not within a waterway foreshore area or wetland buffer. The separation distance should be measured outwards from the outer edge of riparian or wetland vegetation. | Yes<br>A 100m buffer to the creek in the south west of the Subject Site has been applied. All proposed effluent disposal areas are located outside of the 100m creek buffer as shown on Figure 6. The creek contains very little riparian vegetation therefore 100m buffer from the creek line was applied. |
| | 100 metres of a drainage system that discharges directly into a waterway or significant wetland without treatment. | Yes<br>A 100m buffer to the creek in the south west of the Subject Site has been applied. All areas deemed suitable for onsite effluent disposal are located outside of the 100m creek buffer as shown on Figure 6. |
| | Any area subject to inundation and/or flooding in a 10 per cent Annual Exceedance Probability (AEP) rainfall event. | The majority of the Subject Site is situated high in the landscape and is not subjected to flooding, there may be some flooding surrounding the creek line in the south-west of the Subject Site in a 10% AEP rainfall year, however it is proposed the building envelopes and land application areas be located a minimum 100m from the creek line, which places them much higher in the landscape and not subjected to flooding. |

| Site Feature | Minimum Requirement | Requirement met |
|---|---|---|
| Separation from groundwater – outside of public drinking water source areas. | Where land is not within a public drinking water source area or a sewage sensitive area, the discharge point of the on-site sewage system should be located the following distances above the highest groundwater level:<br>• for loams and heavy soils, at least 0.6 metres<br>• for gravels, at least one metre<br>• for sands, at least 1.5 metres. Where a nutrient retentive secondary treatment system is used, at least 0.6 metres. | Yes<br>The groundwater was not encountered across the site to a depth of 2m. |
| Land Application Area | A land application area should be provided for all development in accordance with tables 2 and 3 of this schedule for the disposal of sewage. | Yes<br>The land application area is to be a minimum of 620m$^2$ for primary treatment and 257m$^2$ for secondary treatment as determined by the Government Sewage Policy, AS/NZS 1547:2012 and discussed in Section 6.<br>Refer to Figure 7 for possible location of the land application area, noting that the land application area can be placed anywhere within the area deemed suitable for effluent disposal. The land application area should be confirmed upon final placement of the dwelling at building and planning approval stages. |
| | The land application area includes the area restricted to the distribution of treated sewage only and should be kept free of any temporary or permanent structures. | Yes<br>To be determined upon final placement of the houses. The land application areas must be placed so that requirements are met. Site plans to be forwarded to CoA/DoH at building and planning approval stages. Refer to example Figure 8. |
| | Activities within the land application area shall not interfere with the function of the current and future land application system and people should avoid potential contact with effluent residues. Unless allowed for in the design, the land application area) should:<br>• not be built on or paved in a manner which precludes reasonable access;<br>• not be subject to vehicular traffic (other than a pedestrian-controlled lawnmower);<br>• not be subject to regular foot traffic such as pathways and clothes line areas; and<br>• should be kept in a manner which enables servicing and maintenance of the disposal system. | Yes<br>To be determined upon final placement of the houses. The land application areas must be placed so that requirements are met. Site plans to be forwarded to CoA/DoH at building and planning approval stages. Refer to example Figure 8. |

**Table 3 continued.**

| Site Feature | Minimum Requirement | Requirement met |
|---|---|---|
| Gradient of the land application area | Where slope exceeds one in five (1:5), the land application area should be engineered to prevent run-off from the land application area. Surface contours should be provided on the site plan. | Yes<br>Proposed lots 1-12 are situated on moderately sloped land that does not exceed 1:5 gradient.<br>Natural and finished gradients of land application areas shall not exceed 1:5 gradient. Site plan to be forwarded to CoA/DoH prior to approval. |
| Location of land application area within building envelope | Local government may approve the location of land application areas outside building envelopes where proposed location meets requirements outlined above. | Noted |

# 6 Land Application

All twelve lots contain suitable areas for onsite effluent disposal as demonstrated in Section 5 and shown on Figures 6 and 7. The Government Sewerage Policy identifies the minimum land application area for primary treatment in clay loams (best described by the sandy clays identified on site) as 620m$^2$ and using secondary treatment the minimum land application area as 257m$^2$. Figure 7 shows an example location of the land application area for either primary or secondary treatment depending on available space on each proposed lot.

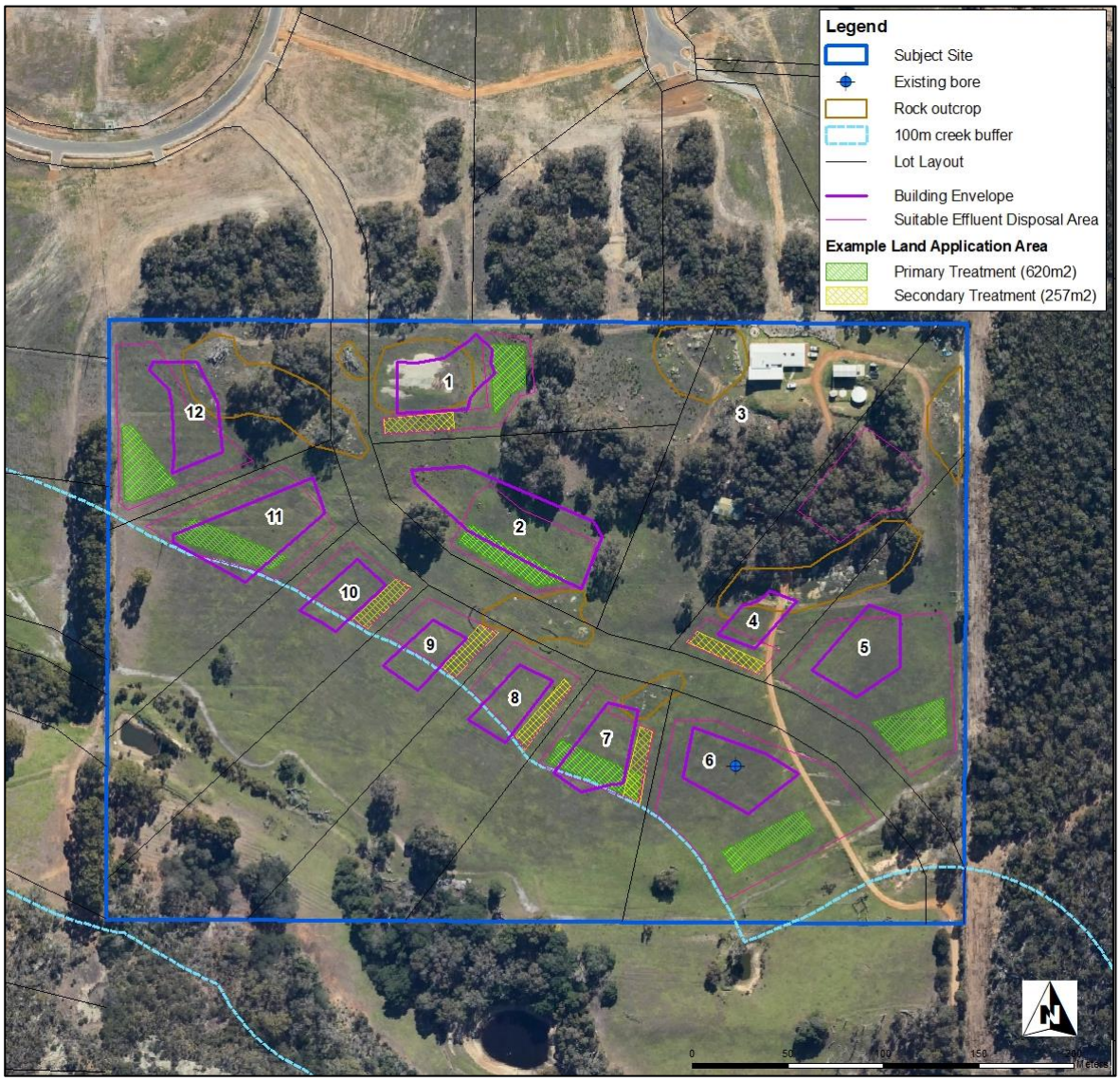



**Figure 7: Example Land Application Areas for proposed lots**

Most of the proposed lots can achieve a land application area using primary treatment (sub-surface irrigation) only as shown on Figure 7. It is however likely that Lots 4, 8, 9 and 10 will require secondary treatment to reduce the land application area and ensure there is sufficient space for the proposed buildings and land application areas.

On the lots where space is not an issue it is recommended that a secondary system is not required given the lots are not within a sewage sensitive area and the groundwater was not encountered to 2 metres depth. In addition the housing density here is low, there is no nearby PDWSAs and the high clay content in the soils ensures a high rate of nutrient and heavy metal fixation.

The land application area for the southernmost lots (1 to 6) shall be located at least 100m from the creek line to prevent possible contamination of the creek and subsequently Oyster Harbour.

The determination of the land application area in the northern most lots (Lots 1 - 5) shall include further geological investigation at the building stage to ensure that effluent disposal systems are not located on rock outcrop. There shall be at least 1500mm separation from the ground surface to the bedrock to allow adequate infiltration and treatment of effluent.

It is recommended that the land application areas for primary treatment (sub-surface infiltration) for the twelve lots be located down gradient of the proposed dwellings as shown on Figure 8. However in instances where this cannot be achieved there are alternative options to deal with this.

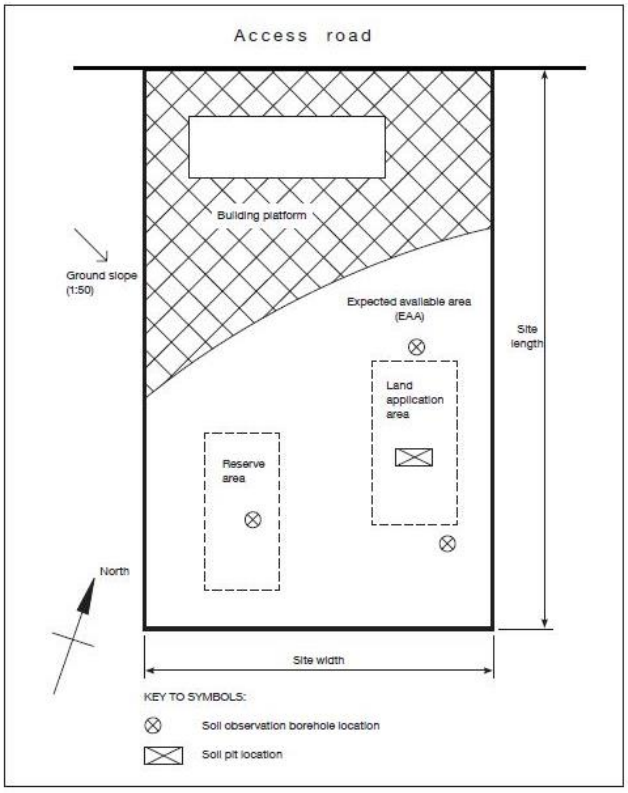



**Figure 8: Generalised site plan for a single lot (AS/AZS 1547: 2012).**

Upon final placement of the house and permanent infrastructure the new lot owner is to provide all applicable information (e.g. land application area, on-site effluent system etc.) to the CoA/ Department of Health for approval prior to installation of the system. This assessment does not include meeting the objectives of the Code of Practice for On-site Sewerage management with detailed loadings and design capacity of the effluent system to be provided by the owner (to the relevant agencies) at time of building approval stages.

# 7 References

Australian Standard AS1547:2012 Onsite domestic wastewater management. Sai Global Licence to Bio Diverse Solutions, 2015.

Artiola J, Pepper I.L, and Brusseau, M (2004). Environmental Monitoring and Characterisation. Elsevier.

Climate Commission (2010) Climate Change Impacts, website accessed 15-11-11 from http://climatecommission.gov.au/topics/western-australia-climate-change-impacts/

Department of Planning, Lands and Heritage (2019) Government Sewerage Policy, Government of Western Australia.

Department of Water 1:250 000 Hydrogeology Map Series (2001) Mapping dataset, Government of Western Australia.

Department of Water Public Drinking Water Source Areas (PDWSA) (2001) Mapping dataset, Government of Western Australia

Great Southern Geotechnics (2019) Site Investigation Report No 3065/1 Lot 18 (#215) Mead Road, Kalgan. Unpublished report prepared for a subdivision application.

Landform Research (2004) Land Capability and Geotechnical Assessment. Unpublished report prepared for a subdivision application.

University of Western Australia (UWA) Permeability Notes EG& G (AMEC2121) Prof. Martin Fahey. Downloaded October 2013 from
w2.civil.uwa.edu.au

## Appendices

**Appendix A – Geotechnical Investigation Report (Great Southern Geotechnics, 2020)**

**Appendix B – Land Capability and Geotechnical Assessment (Landform Research, 2004)**

# Attachment III

# Biodiverse Solutions

# Fire Management Plan

# Bushfire management plan/plan amendment addressing the Bushfire Protection Criteria coversheet

REPORT ITEM DIS 289 REFERS

Site address: Lots 1879 (No. 81) Davies Road, Kalgan

Site visit: Yes ☑ No ☐

Date of site visit (if applicable): Day 11 Month 02 Year 2020

Report author or reviewer: Jason Benson

WA BPAD accreditation level (please circle):

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

If accredited please provide the following.

BPAD accreditation number: BPAD - 37893 Accreditation expiry: Month 08 Year 2021

Bushfire management plan version number: Final

Bushfire management plan date: Day 21 Month 07 Year 2021

Client/business name: Ayton Baesjou Planning

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

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

None of the above ☑

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

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

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

Signature of report author or reviewer 

Date 21/07/2021

**Lot 1879 (No. 81)**
**Davies Road**
**Kalgan WA 6330**

# Bushfire Management Plan

BIO DIVERSE SOLUTIONS

21 July 2021

Bio Diverse Solutions

## DOCUMENT CONTROL

### TITLE

Title: Bushfire Management Plan – Lot 1879 (No. 81) Davies Road, Kalgan
Author (s): Jason Benson and Kathryn Kinnear
Reviewer (s): K. Kinnear
Job No.: AB0036
Client: Ayton Baesjou Planning

### REVISION RECORD

| Revision | Summary | Prepared by: | Reviewed By | Date |
|---|---|---|---|---|
| Draft Id 26/02/2020 | Internal QA review | J.Benson | K. Kinnear | 26/02/2020 |
| Draft Id 28/02/2020 | Issued to client for review | K. Kinnear | B. Quale | 28/02/2020 |
| Final Id 20/07/2021 | Final internal review | J.Benson | K. White | 20/07/2021 |
| Final Id 21/07/2021 | Internal technical review | J.Benson | K. Kinnear | 21/07/2021 |
| Final Id 21/07/2021 | Final Issued to client | J.Benson | K. Kinnear | 21/07/2021 |

*The recommendations and measures contained in this assessment report are based on the requirements of the Australian Standards 3959 – Building in Bushfire Prone Areas, WAPC SPP3.7, Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017) and CSIRO's research into Bushfire behaviour. These are considered the minimum standards required to balance the protection of the proposed dwelling and occupants with the aesthetic and environmental conditions required by local, state and federal government authorities. They DO NOT guarantee that a building will not be destroyed or damaged by a bushfire. All surveys and forecasts, projections and recommendations made in this assessment report and associated with this proposed dwelling are made in good faith on the basis of the information available to the fire protection consultant at the time of assessment. The achievement of the level of implementation of fire precautions will depend amongst other things on actions of the landowner or occupiers of the land, over which the fire protection consultant has no control. Notwithstanding anything contained within, the fire consultant/s or local government authority will not, except as the law may require, be liable for any loss or other consequences (whether or not due to negligence of the fire consultant/s and the local government authority, their servants or agents) arising out of the services rendered by the fire consultant/s or local government authority.*

BIO DIVERSE SOLUTIONS

BPAD Bushfire Planning & Design Accredited Practitioner Level 1

Bio Diverse Solutions
29 Hercules Crescent
Albany WA 6330

## CONTENTS



## LIST OF TABLES



## LIST OF FIGURES



## LIST OF APPENDICES

# 1. Executive Summary

Ayton Baesjou Planning commissioned Bio Diverse Solutions (Bushfire Consultants) to prepare a Bushfire Management Plan (BMP) to guide all future bushfire management for the Structure Plan (SP) area and the proposed subdivision Lot 1879 (No. 81) Davies Road, Kalgan within the City of Albany. The development site is approximately 14.1ha (1 existing lot into approximately 12 lots with a minimum size of 1ha) and is within a designated bushfire prone area (OBRM, 2019).

The subject site was assessed as having internal areas of Forest Type A, Scrub Type D, Grassland Type G, Low Threat Vegetation and Non-vegetated Areas and it is expected that in the future this vegetation will be maintained in a low threat state. It will meet AS 3959-2018 requirements and will be maintained in a low fuel condition as per the City of Albany Fire Management Notice. Indicative Bushfire Attack Level (BAL) ratings of BAL-29 or lower are achievable on each of the proposed lots. With onsite vegetation modification, the southernmost existing house can achieve a BAL-29 Asset Protection Zone (APZ). The northernmost existing house is currently subject to BAL FZ. However, it is noted that this is a legacy of a previous building approval and the house is constrained by nearby existing land uses and cannot achieve BAL-29 within the existing lot boundary. The subdivision of Lot 1878, the implementation of this BMP and the creation of nearby low fuel areas (APZ) for the existing buildings and future buildings will increase bushfire safety for the existing buildings. Any future proposed buildings on-site would be developed to achieve BAL-29 or lower to be compliant with the Guidelines (WAPC, 2017).

Access will be provided via the construction of a new road and an emergency access way linking Gull Rock Road with Davies Road. Future occupants will have the option to travel via Davies Road, Gull Rock Road and Mount Richard Road to the south and Gull Rock Road and Nanarup Road to the north.

Reticulated water is available at Nanarup Road to the north (Hydrant supply) and is within the 20-minute turnaround requirement. The Kalgan Fire brigade has adequate turnaround areas to accommodate 3.4 fire appliances and the appliances are stored at the Kalgan shed, enabling a fast response to any bushfire events in the area. The existing buildings on the subject site have an existing 120,000L steel rain water supply tank and 2 x 23,500L plastic rainwater tanks. Any new buildings will require a minimum of 92000L capacity.

**Table 1: Bushfire protection criteria applicable to the site**

| Element | Acceptable Solution | Applicable or not Yes/No | Meets Acceptable Solution |
|---|---|---|---|
| Element 1 – Location | A1.1 Development Location | Yes | Compliant - BAL 29 or less can be applied to future lots in subdivision |
| Element 2 – Siting and Design | A2.1 Asset Protection Zone | Yes | Compliant - BAL 29 APZ possible on future lots. Southernmost house Compliant. Northernmost house Non-Compliant legacy issue |
| Element 3 – Vehicular Access | A3.1 Two Access Routes | Yes | Compliant - Two access points to two different destination available |
| | A3.2 Public Road | Yes | Compliant |
| | A3.3 Cul-de-sac | N/A | N/A |
| | A3.4 Battle axe | N/A | N/A |
| | A3.5 Private driveways | Yes | Compliant, temporary |
| | A3.6 Emergency Access Way | Yes | Compliant |
| | A3.7 Fire Service Access Ways | N/A | N/A |
| | A3.8 Firebreaks | Yes | Compliant on parent lot, not applicable to future lots |
| Element 4 – Water | A4.1 Reticulated areas | N/A | N/A |
| | A4.2 Non-reticulated areas | Yes | Compliant |
| | A4.3 Individual lots in non-reticulated areas | N/A | N/A |

# 2. Proposal Details

Ayton Baesjou Planning commissioned Bio Diverse Solutions (Bushfire Consultants) to prepare a Bushfire Management Plan (BMP) to guide all future bushfire management for a SP and future proposed subdivision of Lot 1879 (No. 81) Davies Road, Kalgan within the City of Albany. This BMP has been prepared to assess the subject site to the current and endorsed Guidelines for Planning in Bushfire Prone Areas Vers 1.3 (WAPC, 2017) and State Planning Policy 3.7 (WAPC, 2015).

Such planning takes into consideration standards and requirements specified in various documents such as Australian Standard (AS) 3959-2018, Western Australian Planning Commission (WAPC) Guidelines for Planning in Bushfire Prone Areas Vers 1.3 (WAPC, 2017) and State Planning Policy 3.7 (WAPC, 2015). These policies, plans and guidelines have been developed by WAPC to ensure uniformity to planning in designated "Bushfire Prone Areas" and consideration of the relevant bushfire hazards when identifying or investigating land for future development.

## 2.1. Location

The subject site is described as Lot 1879 (No. 81) Davies Road, Kalgan is approximately 14.1ha and located approximately 24km north-east of the City of Albany CBD in the locality of Kalgan. The Subject Site has 2 existing dwelling with some remnant vegetation on the north, north-east, east, south and south-western extents of the property. The location of the Subject Site is shown on Figure 1.


**Figure 1: Location Plan**

## 2.2. Development Proposal

The proposal is to sub divide existing lot 1879 (No. 81) Davies Road into approximately 12 lots with a minimum size of 1ha refer to the table below and Figure 2 Structure Plan.

**Table 2: Existing and proposed lot sizes**

| Existing Lot | 1879 | | Area (ha) | | 14.164 |
|---|---|---|---|---|---|
| Subdivision - Proposed Lots | | | | | |
| Lot | Area (ha) | Lot No | Area (ha) | Lot No | Area (ha) |
| 1 | 1 | 5 | 1 | 9 | 1.3 |
| 2 | 1 | 6 | 1.3 | 10 | 1 |
| 3 | 1.3 | 7 | 1 | 11 | 1 |
| 4 | 1 | 8 | 1 | 12 | 1 |

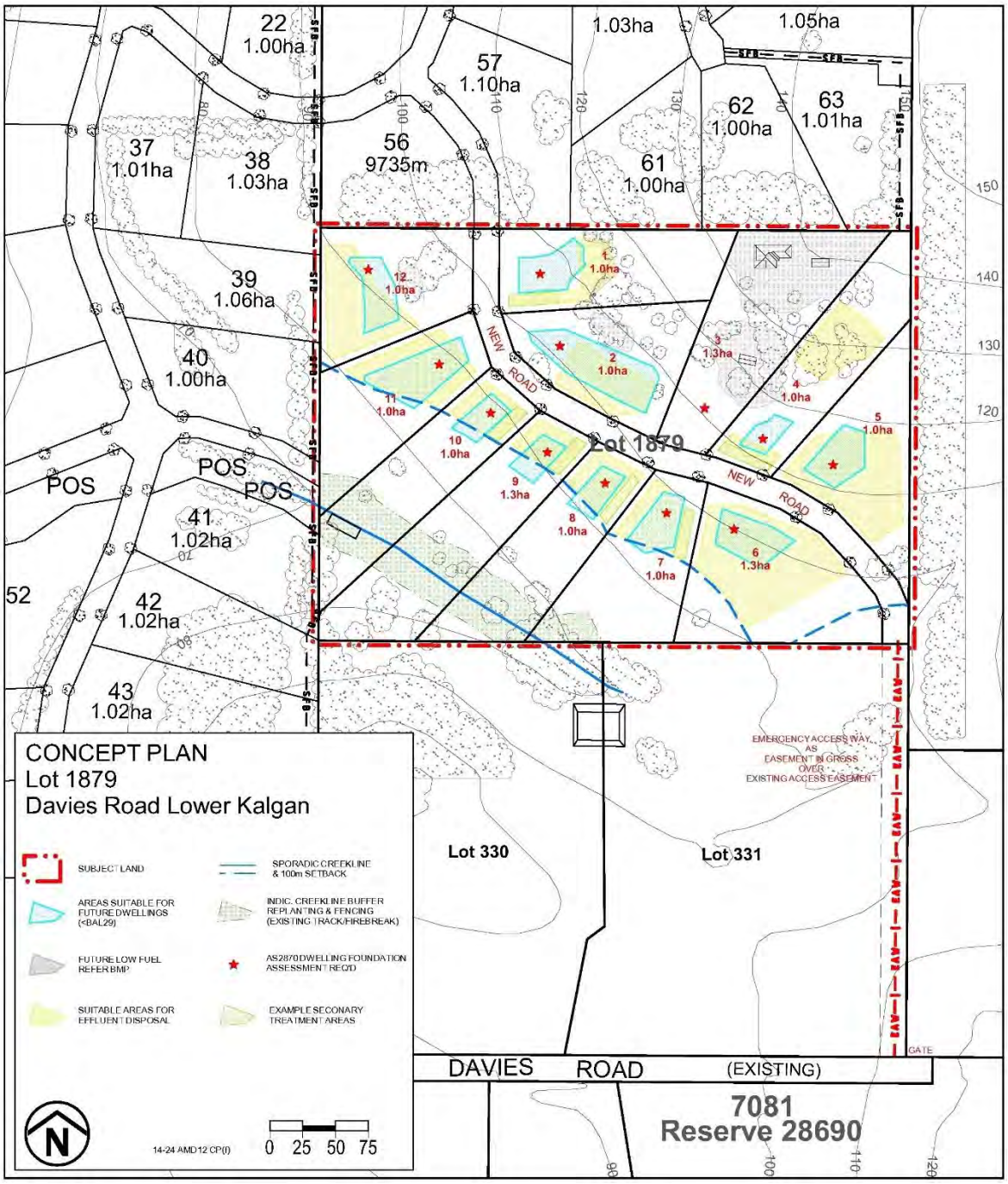



**Figure 2: Concept Plan**

The publicly released Bushfire Prone Area Mapping (DFES, 2017) shows the Subject Site is located within a Bushfire Prone Area (situated within 100m of >1 ha of bushfire prone vegetation). Refer to Figure 3, Bushfire Prone Area Mapping.


**Figure 3: Bushfire Prone Area Mapping (SLIP, 2019)**

## 2.3. Statutory Framework

This document has been prepared to assist in the subdivision application for Lot 1879 Davies Road, Kalgan.

This document and the recommendations contained within are aligned to the following policy and guidelines:

- *Planning and Development Act 2005*;
- *Planning and Development Regulations 2009;*
- *Planning and Development (Local Planning Scheme) Regulations 2015;*
- State Planning Policy 3.7 Planning in Bushfire Prone Areas;
- Guidelines for Planning in Bushfire Prone Areas;
- *Building Act 2011;*
- *Building Regulations 2012;*
- Building code of Australia (National Construction Code);
- *Fire and Emergency Services Act 1998*.
- AS 3959-2018 “Construction of Buildings in Bushfire Prone Areas” current and endorsed standards;
- *Bushfires Act 1954*; and
- City of Albany Annual Fire Management Notice.

## 2.4. Suitably Qualified Bushfire Consultant

This BMP has been jointly prepared by Jason Benson and Kathryn Kinnear. Jason Benson has 8 years operational fire experience with the (formerly) DEC (between 2002-2012) and has the following accreditation in bushfire management:

- Heavy Duty Fire Appliance Operator;
- Wildfire Suppression 1 & 2;
- Prescribed Burning Operations;
- Fire and Incident Operations;
- Structural Modules – Hydrants and hoses, Introduction to Structural Fires, and Fire extinguishers; and
- Ground Controller.

Jason Benson is an accredited Level 2 Bushfire Practitioner (Accreditation No: BPAD37893) and has been an accredited Bushfire Consultant for 5 years. Jason is a suitably qualified Bushfire Practitioner to prepare this Bushfire Management Plan (BMP).

Kathryn Kinnear (nee White), has 10 years operational fire experience with the (formerly) DEC (1995-2005) and has the following accreditation in bushfire management:

- Incident Control Systems;
- Operations Officer;
- Prescribed Burning Operations;
- Fire and Incident Operations;
- Wildfire Suppression 1, 2 & 3;
- Structural Modules – Hydrants and hoses, Introduction to Structural Fires, and Fire extinguishers; and
- Ground Controller.

Kathryn Kinnear currently has the following tertiary Qualifications:

- BAS Technology Studies & Environmental Management;
- Diploma Business Studies; and
- Graduate Diploma in Environmental Management.

Kathryn Kinnear is an accredited Level 2 Bushfire Practitioner (Accreditation No: BPAD30794). Bio Diverse Solutions are Silver Corporate Members of the Fire Protection Australia Association and Kathryn is a suitably qualified Bushfire Practitioner to prepare this Bushfire Management Plan.

## 2.5. Objectives

The objectives of this BMP are to assess the present and future bushfire risks associated with the existing site and for the proposed subdivision. The BMP aims to reduce the occurrence of, and minimise the impact of bushfires, thereby reducing the threat to life, property and the environment. It also aims to guide the subdivision design by assessing the proposed subdivision according to the Bushfire Protection Criteria Acceptable Solutions as outlined in the Guidelines for Planning in Bushfire Prone Areas Vers 1.3 (WAPC, 2017).

The BMP objectives are to:

- Achieve consistency with objectives and policy measures of SPP 3.7 (WAPC, 2015);
- Classify the vegetation in accordance with the AS3959-2018;
- Assess any building requirements to AS3959-2018 (current and endorsed standards) and BAL Construction;
- Assess the subdivision proposal against the Bushfire Protection Criteria Acceptable Solutions as outlined in the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017);
- Understand and document the extent of the bushfire risk and hazards pertinent to the Subject Site;
- Prepare bushfire management measures within the Subject Site with due regard to people, property, infrastructure and the environment; and
- Nominate individuals and organisations responsible for fire management and associated works for implementation within the Subject Site.

# 3. Environmental Considerations

## 3.1. Native vegetation – modification and clearing

Some areas of remnant native vegetation are present within the subject site. However, have been grazed from past agricultural uses. Vegetation modification within the proposed subdivision will be required to ensure all building envelopes can achieve BAL-29 or lower, see Future Low Fuel Areas on Figure 4 Vegetation Classes. The existing buildings within the subject site will have in place APS's to ensure where possible the houses can achieve BAL-29, this will require the modification of some native vegetation. For the remainder of the proposed lots the majority of onsite vegetation is sown pasture and is classified Grassland. It is expected that in the future this will be maintained as low threat vegetation. It will meet AS 3959-2018 s2.2.3.2 requirements and the City of Albany Fire Management Notice.

## 3.2. Re-vegetation/Landscape Plans

There is no revegetation proposed for the subdivision at this stage.

# 4. Bushfire Assessment Results

## 4.1. Assessment Inputs

Bushfire Assessment inputs for the site has been calculated using the Method 1 procedure as outlined in AS3959-2018. This incorporates the following factors:

- WA adopted Fire Danger Index (FDI), being FDI 80;
- Vegetation Classes;
- Slope under classified vegetation; and
- Distance between proposed development site and classified vegetation.

A site inspection was undertaken on the 11th of February 2020 by Jason Benson to assess the current land use, topography/slope, vegetation and conditions of the site and its surroundings. Photographs of the Subject Site and surrounding areas were taken and have been presented in this report.

### 4.1.1. Vegetation classification AS3959-2018

All vegetation within 150m of the site / proposed development was classified in accordance with Clause 2.3 and Exclusions as per Clause 2.2.3.2 of AS 3959-2018. Each plot is representative of the Vegetation Classification to AS3959-2018 Table 2.3 and shown on the Vegetation Classification Mapping (Figure 4), Page 8 and full plot data information Appendix 1 of this document.

| Plot No | Vegetation Type | Effective Slope |
|---|---|---|
| 1 | Low fuel or non-vegetated 2.2.3.2(e) | N/A |
| 2 | Low fuel or non-vegetated 2.2.3.2(f) | N/A |
| 3 | Forest Type A | Upslope / Flat |
| 4 | Forest Type A | Downslope >0 to 5 degrees |
| 5 | Forest Type A | Downslope >5 to 10 degrees |
| 6 | Grassland Type G | Upslope / Flat |
| 7 | Grassland Type G | Downslope >0 to 5 degrees |
| 8 | Grassland Type G | Downslope >5 to 10 degrees |
| 9 | Grassland Type G | Downslope >10 to 15 degrees |
| 10 | Scrub Type D | Downslope >0 to 5 degrees |
| 11 | Scrub Type D | Upslope / Flat |
| 12 | Low fuel or non-vegetated 2.2.3.2(a) | N/A |

Existing Dwelling 1

Existing Dwelling 2

Figure 4: Vegetation Classes Mapping

Albany Office:
29 Hercules Crescent
Albany, WA 6330
(08) 9842 1575

Denmark Office:
7/40 South Coast Highway
Denmark, WA 6333
(08) 9848 1309

Esperance Office:
2A/113 Dempster Street
Esperance, WA 6450
(08) 9072 1382

BPAD Bushfire Planning & Design Accredited Practitioner Level 2

BIO DIVERSE SOLUTIONS

Overview Map Scale 1:100,000

**Legend**

- Subject Site
- 100m Assessment Boundary
- 150m Assessment Boundary
- Existing Dwelling
- Asset Protection Zone (APZ)
- Future Low Fuel
- Cadastre
- 5m Contours
- Separation Distance
- Slopes Degrees
- Photo Point
- Proposed Lots
- Proposed Building Envelope
- Vegetation/Plot Boundary

**Vegetation**

- Forest Type A
- Scrub Type D
- Grassland Type G
- Low fuel or non vegetated 2.2.3.2

Scale
1:3,000 @ A3
GDA MGA 94 Zone 50

**Data Sources**
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

*CLIENT*
Ayton Baesjou
Lot 1879 (No. 81) Davies Road (and Gull Rock Road)
Kalgan, WA 6330

## Vegetation Classes

| BAL Assessor | QA Check | Drawn by |
|---|---|---|
| JB | KK | CV |
| **STATUS** | **FILE** | **DATE** |
| FINAL | AB0036 | 15/07/2021 |

### 4.1.2. Fire Danger Index

The Western Australian adopted FDI is 80 as outlined in AS3959-2018 and endorsed by Australasian Fire and emergency Services Authorities Council. The FDI input for this project is also therefore 80.

### 4.1.3. Slope Under Classified Vegetation

Slope under classifiable vegetation (Effective Slope) was assessed in accordance with Section 2.2.5 of AS3959-2018. Table 3 below summarises the slopes assigned to each plot of classifiable vegetation for the BAL calculation.

**Table 3: Effective slope allocation to classified vegetation**

| Plot Number | Vegetation Classification | Effective Slope |
|---|---|---|
| 1 | Excluded 2.2.3.2 (e) | N/a |
| 2 | Excluded 2.2.3.2 (f) | N/a |
| 3 | Forest Type A | Flat/upslope |
| 4 | Forest Type A | Downslope >0-5 degrees |
| 5 | Forest Type A | Downslope >5-10 degrees |
| 6 | Grassland Type G | Flat/upslope |
| 7 | Grassland Type G | Downslope >0-5 degrees |
| 8 | Grassland Type G | Downslope >5-10 degrees |
| 9 | Grassland Type G | Downslope >10-15 degrees |
| 10 | Scrub Type D | Downslope >0-5 degrees |
| 11 | Scrub Type D | Flat/upslope |
| 12 | Excluded 2.2.3.2 (a) | N/a |

Plots 1, 2 and 12 are allocated exclusion Clauses 2.2.3.2 and therefore do not have an effective slope allocation.

## 4.2. Assessment Outputs

### 4.2.1. BAL Calculation AS3959-2018 (BAL Contour Plan)

A Method 1 BAL calculation (in the form of BAL contours) has been completed for the proposed subdivision in accordance with AS 3959-2018 methodology. The BAL rating gives an indication of the level of bushfire attack (i.e. the radiant heat flux) that may be received by proposed buildings and subsequently informs the standard of building construction required to increase building tolerance to potentially withstand such impacts in line with the assessed BAL. The assessed BAL ratings for the subdivision developments are depicted as BAL contours, as shown on Figure 5.

**COMMENTS ON BAL CALCULATIONS/METHODOLOGY:**

- Method 1 (AS3959-2018) Simplified procedure was used for vegetation classification and BAL Assessment process;
- The BAL Contour Plan was prepared by an Accredited Level 2 Bushfire Planning Practitioner (BPAD37893);
- The BAL Contour Map has been prepared in accordance with Department of Planning (WAPC) Guidelines for Planning in Bushfire Prone Areas (Version 1.3, 2017);
- Subdivision based on plan of subdivision as supplied by proponent, see Figure 2);
- Subject site is located in a Bushfire Prone Area, see Figure 5 (SLIP, 2019);
- Internal Grassland areas (part of Plot 6, Plot 8 and Plot 9) have been excluded from the BAL Contour mapping and setback distances shown on the BAL Contour map to indicate requirements to achieve BAL-29 or lower;
- Parts of Plot 3 and Plot 5 Forest surrounding the proposed building envelopes have been excluded from BAL contouring as these areas will be modified to a low threat state to ensure each building envelope achieves BAL-29 or lower, see Future Low Fuel Areas on Figure 4 Vegetation Classes Map;
- Parts of Plot 3 and Plot 5 Forest which are within the Existing Buildings Asset Protection Zones are excluded from the BAL Contour assessment as it expected that this vegetation will be managed in a low threat state; and
- Existing dwellings are shown in the BAL Contour plan (Figure 5), site works to achieve a BAL-29 APZ for both existing houses is indicated on the Vegetation Classes map (Figure 4). Fuel modification to understorey and midstorey is to meet APZ standards.

**Note on internal grassland areas**:

The lot contains significant areas of internal grasslands which are mapped as bushfire hazards (refer to Vegetation Classes Map). For practical purposes and to assist in identifying areas of 'least risk', the internal grasslands (part of Plot 6, Plot 8 and Plot 9) have been excluded from BAL Contour Mapping as it is expected that in the future these areas will be managed in a low threat state. Setback distances to these areas are to be as per AS3959-2018 and the following to apply:

**Plot 6 – Grassland Upslope/Flat**

8-<12m for BAL 29
12-<17m for BAL 19
17-<50m for BAL 12.5

**Plot 8 – Grassland >5-10 degrees**

10-<16m for BAL 29
16-<23m for BAL 19
23-<50m for BAL 12.5

**Plot 9 – Grassland >10-15 degrees**

12-<18m for BAL 29
18-<26m for BAL 19
26-<50m for BAL 12.5

When the final placement of the dwelling is known APZ areas are to apply as per the allocated BAL for the dwelling.

| Plot No | Vegetation Type | Effective Slope |
|---|---|---|
| 1 | Low fuel or non-vegetated 2.2.3.2(e) | N/A |
| 2 | Low fuel or non-vegetated 2.2.3.2(f) | N/A |
| 3 | Forest Type A | Upslope / Flat |
| 4 | Forest Type A | Downslope >0 to 5 degrees |
| 5 | Forest Type A | Downslope >5 to 10 degrees |
| 6 | Grassland Type G | Upslope / Flat |
| 7 | Grassland Type G | Downslope >0 to 5 degrees |
| 8 | Grassland Type G | Downslope >5 to 10 degrees |
| 9 | Grassland Type G | Downslope >10 to 15 degrees |
| 10 | Scrub Type D | Downslope >0 to 5 degrees |
| 11 | Scrub Type D | Upslope / Flat |
| 12 | Low fuel or non-vegetated 2.2.3.2(a) | N/A |

Existing Dwelling 1

Existing Dwelling 2

Setbacks for internal grassland for proposed buildings within the development area

Plot 6 – Grassland Upslope/Flat
8-<12m for BAL 29
12-<17m for BAL 19
17-<50m for BAL 12.5

Plot 8 – Grassland >5-10 degrees
10-<16m for BAL 29
16-<23m for BAL 19
23-<50m for BAL 12.5

Plot 9 – Grassland >10-15 degrees
12-<18m for BAL 29
18-<26m for BAL 19
26-<50m for BAL 12.5

0 25 50 75 100 Meters

6131400
6131300
6131200
6131100
6131000

591500 591600 591700 591800 591900

**Figure 5: BAL Contour Plan**

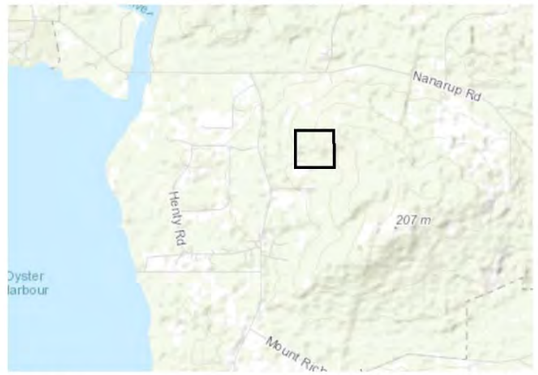
Albany Office:
29 Hercules Crescent
Albany, WA 6330
(08) 9842 1575

Denmark Office:
7/40 South Coast Highway
Denmark, WA 6333
(08) 9848 1309

Esperance Office:
2A/113 Dempster Street
Esperance, WA 6450
(08) 9072 1382

BPAD Bushfire Planning & Design Accredited Practitioner Level 2

BIO DIVERSE SOLUTIONS




Overview Map Scale 1:100,000

**Legend**

- Subject Site
- 100m Assessment Boundary
- 150m Assessment Boundary
- Existing Dwelling
- BAL-29 Developable Area
- Proposed Lots
- Proposed Building Envelope
- Vegetation/Plot Boundary

**BAL Contours**

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

Scale
1:1,750 @ A3
GDA MGA 94 Zone 50

**Data Sources**
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

*CLIENT*
Ayton Baesjou
Lot 1879 (No. 81) Davies Road (and Gull Rock Road)
Kalgan, WA 6330

## BAL Contour Plan

| *BAL Assessor* | *QA Check* | *Drawn by* |
|---|---|---|
| **JB** | **KK** | **CV** |
| *STATUS* | *FILE* | *DATE* |
| **FINAL** | **AB0036** | **15/07/2021** |

**Table 4: BAL Allocation Plan of subdivision**

| Method 1 BAL Determination | | | | |
|---|---|---|---|---|
| **Vegetation Type (Table 2.3)** | **Slope (Table 2.4.3)** | **Distance to Vegetation (m)** | **Highest BAL Contour** | **Modified BAL Contour** |
| Plot 3<br>Forest Type A | Flat/upslope | 0m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 4<br>Forest Type A | Downslope >0-5 degrees | 5m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 5<br>Forest Type A | Downslope >5-10 degrees | 0m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 6<br>Grassland Type G | Flat/upslope | 0m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 7<br>Grassland Type G | Downslope >0-5 degrees | 0m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 8<br>Grassland Type G | Downslope >5-10 degrees | 0m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 9<br>Grassland Type G | Downslope >10-15 degrees | 0m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 10<br>Scrub Type D | Downslope >0-5 degrees | 0m | BAL-FZ | BAL-29 or lower can prevail |
| Plot 11<br>Scrub Type D | Flat/upslope | 0m | BAL-FZ | BAL-29 or lower can prevail |

Note: Separation distances are taken from the subject site boundary and some of the classified vegetation is located internal to the subject site. Therefore, has no separation from these areas. Vegetation onsite is under the control of the landowner and therefore can be removed or modified to a low threat state. As a result, onsite vegetation (Part of Plot 6 Grassland, Plot 8 Grassland, Plot 9 Grassland and part of Plot 3 and Plot 5 Forest which are within the Existing Buildings Asset Protection Zones and surrounding the proposed building envelopes, see Future Low Fuel Areas on Figure 4 Vegetation Classes Map) have been excluded from the BAL Contour mapping over the Lot as this vegetation will be removed or modified to a low threat state. Vegetation offsite is not within the control of the landowner and therefore the vegetation cannot be removed or modified. As a result, the BAL impact from these vegetation areas is unable to be reduced.
With internal vegetation modification all of the proposed building envelopes can achieve BAL-29 or lower.

### 4.2.2. Habitable Buildings on the Subject Site – BAL Rating

**Table 5: BAL Ratings for Existing Habitable Dwellings**

| Existing Habitable Buildings | Current BAL Rating | Achievable BAL Rating within the Lot |
|---|---|---|
| Existing Dwelling 1 | BAL-FZ | BAL-FZ |
| Existing Dwelling 2 | BAL-FZ | BAL-29 |

Note: The site assessment has determined that both of the existing dwellings are currently subject to a Bushfire Attack Level of BAL-FZ. However, in conducting the assessment it has been determined that a lower BAL rating is achievable. Existing Dwelling 2 (southernmost building) can achieve a BAL-29 APZ within the lot boundary. Existing Dwelling 1 (northernmost building) can achieve a BAL-29 APZ to the south, east and west but due to a legacy in a previous building approval can only achieve BAL-FZ due to offsite vegetation to the north. However, the BAL-FZ impact on Existing Dwelling 1 is minimal, only impacting the northwest corner of the building. The majority of the building is located within BAL-29 and BAL-40 areas and with future development of the land to the north this may reduce the BAL-FZ and BAL-40 impact.

# 5. Identification of bushfire hazard issues

The identified bushfire risks associated with the subject site is the continuous vegetation to the north-east, east and south-east of the subject site. These areas present as predominantly Forest Type A and downslope in relation to the whole of the subdivision area. Under hot, dry and unstable conditions (Severe to catastrophic/bushfire weather) the subject site is most at risk from bushfire from this direction.

To the north, south and west there are patches of forest vegetation which is outside of the subject site boundary and is not within the control of the landowner and therefore the vegetation cannot be removed or modified.

Some areas of remnant vegetation are patchy throughout the subject site although these areas of vegetation have a modified understorey, the vegetation has been classified Forest Type A based on the dense overstorey, precautionary principle applied and could pose a bushfire risk to existing and future dwellings, it is expected that these areas of vegetation will be modified to ensure each new lot can have sufficient BAL-29 developable space and that the existing buildings will have to the extent possible within the lot a BAL-29 APZ.

The predominant onsite vegetation is Grassland Type G and is expected in the future to be managed as low threat vegetation or in a non-vegetated state. Post construction of the subdivision the majority of the internal area will be a Moderate to Low BHL and each new lot will have the ability to construct a new habitable dwelling to BAL-29 or lower.

If the subdivision is approved, ongoing management of vegetation compliance is regulated via the BMP for the site and the City of Albany Annual Fire Management Notice. Bushfire management measures external to the site are not required as part of this proposal.

Strategic fire breaks and access are noted in existence to the north, west and east of the subdivision area. A new road and an emergency access way will be constructed linking Gull Rock Road to the north-west and Davies Road to the south.

**Water Supply**

Reticulated water is available at Nanarup Road to the north (Hydrant supply) and is within the 20-minute turnaround requirement. The Kalgan Fire brigade has adequate turnaround areas to accommodate 3.4 fire appliances and the appliances are stored at the Kalgan shed, enabling a fast response to any bushfire events in the area. The existing buildings on the subject site have an existing 120,000L steel rain water supply tank and 2 x 23,500L plastic rainwater tanks. Any new buildings will require a minimum of 92000L capacity. It is further recommended that each dwelling has a standalone 10,000L tank for firefighting requirements (noted not a requirement of the guidelines, a recommendation from the practitioner).

**Access**

Access will be provided via the construction of a new road and an Emergency Access Way (EAW) linking Gull Rock Road with Davies Road, future occupants will have the option to travel via Davies Road, Gull Rock Road and Mount Richard Road to the south and Gull Rock Road and Nanarup Road to the north.

Secondary access via public roading is an issue with this area and the adjoining rural residential subdivision. This issue has been analysed and resolved with the City of Albany and adjoining landowners in discussion with DFES. Secondary access for the adjoining rural residential lots is required but cannot be achieved without the development of Lot 1879.

Discussions with the adjoining landowners show that conversion of the existing 20m wide access easement linking Lot 1879 and Davies Road into an EAW can be achieved. Conversion of the access easement into a public road cannot be achieved due to tenure issues. The ability to use the subdivision application process to construct public road access is limited given the absence of Lot 331 development potential as per the planning strategy.

The City of Albany (CoA) confirms practical and technical reasons why provision of an EAW connecting to Davies Road is preferred over a public road. This link would create a safety issue in the funnelling of extra traffic through to Davies Road which is narrow, tight, and steep, the link is un-necessary from a traffic flow and destination access perspective. Additional everyday traffic on Davies Road would also interrupt its quiet rural nature/existing residents, it is undesirable to have additional traffic using the Davies – Gull Road intersection. All rural residential everyday traffic should use the adjoining estate roads which were planned for and will be constructed for this purpose.

The CoA requires (and special provisions governing the subdivision can ensure) the EAW will be constructed to a min 6m wide all-weather gravel standard with specific access control and drainage measures, meeting the minimum technical requirements established by the guidelines, See Table 7 Vehicular Access Technical Requirements (WAPC, 2017). The alignment within the clear 20m reserve allows for all Table 7 requirements to be met including trafficable surface, horizontal and vertical clearance, grade weight capacity crossfall and curve radius. These requirements will be specified in the BMP and can be reinforced within subdivision provisions.

An EAW is strongly preferred over a public road, as Davies Road cannot accommodate more traffic. Landholders are agreeable and the subdivision will be contingent on the conversion of the existing 20m wide access easement linking Lot 1879 and Davies Road into an EAW. DFES has indicated "in principle" support for this arrangement on the basis it is formalised in this BMP, see Appendix 3 - DFES Email Supporting Proposed EAW in Principle.

# 6. Assessment to the bushfire protection criteria

The Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017) outlines bushfire protection criteria which subdivision and development proposals are assessed for compliance. The bushfire protection criteria (Appendix 4, WAPC, 2017) are a performance based criteria utilised to assess bushfire risk management measures and they outline four elements, being:

- Element 1: Location
- Element 2: Siting and Design of Development;
- Element 3: Vehicle Access; and
- Element 4: Water.

The plan of subdivision(s) and subdivision plan area will be assessed as one and are required to meet the "Acceptable Solutions" of each Element of the bushfire mitigation measures (WAPC, 2017). The proposals will be assessed against the bushfire protection criteria Acceptable Solutions for Elements A1, A2, A3 and A4, refer to Table 6.

**Table 6: Bushfire protection criteria applicable to the site**

| Element | Acceptable Solution | Applicable or not Yes/No | Structure Plan meets Acceptable Solution |
|---|---|---|---|
| Element 1 – Location | A1.1 Development Location | Yes | Compliant<br>The proposed subdivision achieves compliance by ensuring future buildings can be located in an area that will upon completion be exposed to a BAL Rating of no higher than BAL-29. This can be achieved by with appropriate positioning, design and onsite vegetation management.<br>An assessment of the vegetation and the location of the existing habitable dwellings within the subject site has determined that both of the existing dwellings are currently subject to a Bushfire Attack Level of BAL-FZ. However, in conducting the assessment it has been determined that a lower BAL rating is achievable. Existing Dwelling 2 (southernmost building) can achieve a BAL-29 APZ within the lot boundary. Existing Dwelling 1 (northernmost building) can achieve a BAL-29 APZ to the south, east and west but due to a legacy in a previous building approval can only achieve BAL-FZ due to offsite vegetation to the north. However, the BAL-FZ impact on Existing Dwelling 1 is minimal, only impacting the northwest corner of the building. The majority of the building is located within BAL-29 and BAL-40 areas and with future development of the land to the north this may reduce the BAL-FZ and BAL-40 impact.<br>Proposal meets Acceptable Solution A1.1 |
| Element 2 – Siting and Design | A2.1 Asset Protection Zone (APZ) | Yes | Compliant<br>The proposal can meet compliance by ensuring future building work on the lot/s can have established around them an APZ of the required dimensions to achieve BAL-29 or lower. APZ areas are contained solely within the individual lots and will be managed to WAPC standards as presented in Appendix A of this report. Future landowner/s will have the responsibility of continuing to manage the required APZ in a low threat state including ongoing compliance with the local government's annual firebreak notice.<br>Existing Dwelling 2 (southernmost building) can achieve a BAL-29 APZ within the lot boundary. Existing Dwelling 1 (northernmost building) can achieve a BAL-29 APZ to the south, east and west but due to a legacy in a previous building approval can only achieve BAL-FZ due to offsite vegetation to the north. However, the BAL-FZ impact on Existing Dwelling 1 is minimal, only impacting the northwest corner of the building. The majority of the building is located within BAL-29 and BAL-40 areas and with future development of the land to the north this may reduce the BAL-FZ and BAL-40 impact.<br>Proposal meets Acceptable Solution A2.1 |

**Table 6 cont.**

| Element | Acceptable Solution | Applicable or not Yes/No | Structure Plan meets Acceptable Solution |
|---|---|---|---|
| Element 3 – Vehicular Access | A3.1 Two Access Routes | Yes | Compliant<br>The proposal can meet compliance by ensuring the construction of an internal road network will provide access and egress to two different destinations. Access will be provided via the construction of a new road and an emergency access way linking Gull Rock Road with Davies Road, future occupants will have the option to travel via Davies Road, Gull Rock Road and Mount Richard Road to the south and Gull Rock Road and Nanarup Road to the north, see detailed explanation in section 5 of this report.<br>Proposal meets Acceptable Solution A3.1 |
| | A3.2 Public Road | Yes | Compliant<br>The new public road will be constructed to the technical requirements established in the guidelines, it will have a minimum 6m wide trafficable and be constructed to withstand all weather conditions. Detailed civil deigns to be approved by the CoA prior to construction and to minimum standards as outlined in Table 7, column 1.<br>Proposal meets Acceptable Solution A3.2 |
| | A3.3 Cul-de-sacs | Yes | Compliant<br>The proposed new access will have a Cul-de-sac (turnaround) head at the south-eastern end of the public road. However, this will be the start of the EAW, which will provide two-way access for all residence.<br>Proposal meets Acceptable Solution A3.3. |
| | A3.4 Battle axes | No | No Battle axes are proposed. Not assessed to A3.4. |
| | A3.5 Private driveways | Yes | Compliant<br>Internal driveways are to be installed to the lots by the new lot owner when building locations are defined. New private driveways in will to meet minimum technical requirements as shown Table 7, column 2. Appropriate turn around areas will be provided for driveway >50m in length.<br>Proposal meets Acceptable Solution A3.5. |

**Table 6 cont.**

| Element | Acceptable Solution | Applicable or not Yes/No | Structure Plan meets Acceptable Solution |
|---|---|---|---|
| | A3.6 Emergency Access Ways | Yes | Compliant<br>An Emergency Access Way of approximately 311m in length is proposed to provide an alternative route onto Davies Road in the event of an emergency. The EAW will meet the technical requirements established in the guidelines, see Table 7, column 3. See detailed explanation of why an EAW is preferred over a public road in section 5 of this report.<br>Proposal meets Acceptable Solution A3.6 |
| | A3.7 Fire Service Access Ways | No | No FSA's are proposed. Not assessed to A3.7. |
| | A3.8 Firebreaks | Yes | Compliant<br>Firebreaks were noted on the subject site and mostly compliant with the CoA Fire Management Notice. New lots are to be managed to the current CoA Fire Management Notice.<br>Proposal meets Acceptable Solution A3.8. |
| Element 4 – Water | A4.1 Reticulated areas | No | A reticulated water supply is not currently available to the subject site. Not assessed to A4.1. |
| | A4.2 Non-reticulated areas | Yes | Compliant<br>Reticulated water is available at Nanarup Road to the north (Hydrant supply) and is within the 20-minute turnaround requirement. The existing buildings on the subject site have an existing 120,000L steel rain water supply tank and 2 x 23,500L plastic rainwater tanks. Any new buildings will require a minimum of 92000L capacity. It is further recommended that each dwelling has a standalone 10,000L tank for firefighting requirements fitted with camlock valves for ease of extraction.<br>Plan of subdivision is deemed compliant to this Acceptable Solution |
| | A4.3 Individual lots in non-reticulated areas | No | Not assessed to A4.3. |

**Table 7: Vehicular Access Technical Requirements (WAPC, 2017)**

| Technical requirements | Public Road | Private Driveways | Emergency Access Ways (EAW) |
|---|---|---|---|
| **Minimum trafficable surface (m)** | *6 | 4 | *6 |
| **Horizontal clearance (m)** | 6 | 6 | 6 |
| **Vertical clearance (m)** | 4.5 | 4.5 | 4.5 |
| **Maximum grades** | 1 in 10 | 1 in 10 | 1 in 10 |
| **Minimum weight capacity (t)** | 15 | 15 | 15 |
| **Maximum crossfall** | 1 in 33 | 1 in 33 | 1 in 33 |
| **Curves minimum inner radius (m)** | 8.5 | 8.5 | 8.5 |
| **Maximum Length** | N/A | 50m | 600m |

*Denotes the width can include a 4m wide paving with one metre wide constructed road shoulders

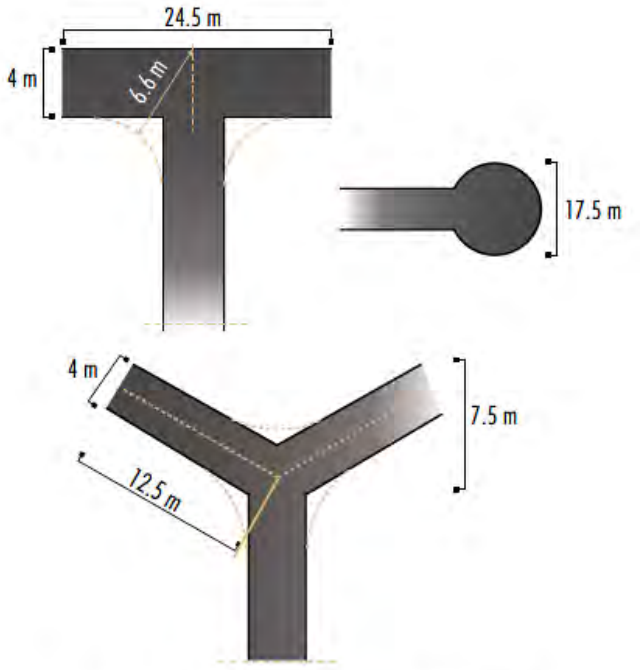



**Figure 22:** Design requirements for a private driveway longer than 50 metres
Turning areas should allow type 3.4 fire appliances to turn safely

**Figure 6: Driveway Turnaround Standards**

# 7. Other Fire Mitigation Measures

## 7.1. Evaporative air conditioners

Evaporative air conditioning units can catch fire as a result of embers from bushfires entering the unit. These embers can then spread quickly through the home causing rapid destruction. It can be difficult for fire-fighters to put out a fire in the roof spaces of homes.

It is also recommended that land owners:

- Ensure that suitable external ember screens are placed on roof top mounted evaporative air conditioners compliant with AS3959-2018 (current and endorsed standards) and that the screens are checked annually; and
- Maintain evaporative air conditioners regularly as per DFES recommendations, refer to the DFES website for further details:
  http://www.dfes.wa.gov.au

## 7.2. Barrier Fencing

In November 2010 the Australian Bushfire CRC issued a "Fire Note" (Bushfire CRC, 2010) which outlined the potential for residential fencing systems to act as a barrier against radiant heat, burning debris and flame impingement during bushfire. The research aimed to observe, record, measure and compare the performance of commercial fencing of Colourbond steel and timber (treated softwood and hardwood).

The findings of the research found that:

".. *Colourbond steel fencing panels do not ignite and contribute significant heat release during cone calorimeter exposure"* (exposure to heat)

*.."Colourbond steel (fencing) had the best performance as a non-combustible material. It maintained structural; integrity as a heat barrier under all experimental exposure conditions, and it did not spread flame laterally and contribute to fire intensity during exposure"*

It is also noted that non-combustible fences are recommended by WAPC (APZ standards: Fences and sheds within the APZ are constructed using non-combustible materials e.g. colourbond iron, brick, limestone, metal post and wire). The developer will be encouraged to build Colourbond or non-combustible fences where applicable.

**Table 8: Required Separation Distance from Classified Vegetation to Achieve BAL-29 (BAL-29 APZ)**

| BAL-29 Asset Protection Zone | | | | |
|---|---|---|---|---|
| **Vegetation Plot** | **Applied Vegetation Classification** | **Effective Slope (degrees)** | **BAL Rating** | **Required Separation Distance (metres)** |
| 1 | Excluded 2.2.3.2 (e) | N/A | **BAL-29** | - |
| 2 | Excluded 2.2.3.2 (f) | N/A | | - |
| 3 | Forest Type A | Upslope/Flat | | 21 |
| 4 | Forest Type A | 0-5˚ D/S | | 27 |
| 5 | Forest Type A | 5-10˚ D/S | | 33 |
| 6 | Grassland Type G | Upslope/Flat | | 8 |
| 7 | Grassland Type G | 0-5˚ D/S | | 9 |
| 8 | Grassland Type G | 5-10˚ D/S | | 10 |
| 9 | Grassland Type G | 10-15˚ D/S | | 12 |
| 10 | Scrub Type D | 0-5˚ D/S | | 15 |
| 11 | Scrub Type D | Upslope/Flat | | 13 |
| 12 | Excluded 2.2.3.2 (a) | N/A | | - |

# 8. Responsibilities for implementation

## 8.1. Future Lot owner's Responsibility

It is recommended the future property owners shall be responsible for the following:

**Table 9: Implementation actions future lot owners**

| Future Lot owner– Ongoing management | | | | |
|---|---|---|---|---|
| **No** | **Implementation Action** | **Initial** | **Annual** | **All times** |
| 1 | Build to AS3959-2018 as it applies to their property. | ✓ | | |
| 2 | Maintain individual lot fuels in accordance with the City of Albany Fire Break Notice and WAPC APZ standards (Appendix 2). | | ✓ | |
| 3 | Construct private driveways to the standards stated in Table 7. | ✓ | | |
| 4 | Install a 92,000L rain water supply tank on lot prior to occupancy and 10,000L standalone water supply for firefighting purposes. | ✓ | | |

## 8.2. Developer's responsibility

It is recommended the developer be responsible for the following:

**Table 10: Implementation actions current land owners/developer**

| Developer – Prior to issue of titles | | |
|---|---|---|
| **No** | **Implementation Action** | **Subdivision Clearance** |
| 1 | Ensure prospective buyers are aware of the BAL Contour Plan and the applicable BAL to their property through provision of BAL Contour Plan. Update the BAL contour plan and provide certification of BAL Contour prior to lodgement of titles (post construction). | ✓ |
| 2 | Maintain balance of land in accordance with the CoA Fire Break Notice and the provisions of the BMP. | ✓ |
| 3 | Prior to sale of the subject lots, each individual lot is to be compliant with the relevant local government's annual firebreak notice issued under s33 of the Bushfires Act 1954. | ✓ |
| 4 | Construct all vehicle access in the subdivision to the minimum standards as outlined in Table 7. | ✓ |
| 5 | Establish the APZ on the lots to the dimensions and standard stated in the BMP. This is the responsibility of the developer. | ✓ |
| 6 | Implement low fuel areas as per Figure 4 Vegetation Classes Map to ensure future buildings can achieve BAL-29 or lower within the proposed building envelopes. | |
| 7 | Construct EAW to Davies Road to the minimum standards as outlined in Table 7. | ✓ |

## 8.3. Local Government Responsibility

It is recommended the local government be responsible for the following:

**Table 11: Implementation actions City of Albany**

| LGA– Clearance of conditions | | |
|---|---|---|
| **No** | **Implementation Action** | **Subdivision Clearance** |
| 1 | Request for the update of the BAL contour plan and certification of BAL Contour prior to clearance of titles (post construction). | ✓ |
| 2 | Ensure vehicle access standards are achieved as per Table 7. | ✓ |
| 3 | Ensure water supply tanks are installed as suggested in this BMP. | ✓ |
| 4 | Monitor landowner compliance with the Bushfire Management Plan and the annual City of Albany Firebreak Notice. | ✓ |

# 9. Disclaimer

*The recommendations and measures contained in this assessment report are based on the requirements of the Australian Standards 3959-2018 – Building in Bushfire Prone Areas, WAPC State Planning Policy 3.7 (WAPC, 2015), WAPC Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017), and CSIRO's research into Bushfire behaviour. These are considered the minimum standards required to balance the protection of the proposed dwelling and occupants with the aesthetic and environmental conditions required by local, state and federal government authorities. They DO NOT guarantee that a building will not be destroyed or damaged by a bushfire. All surveys and forecasts, projections and recommendations made in this assessment report and associated with this proposed dwelling are made in good faith on the basis of the information available to the fire protection consultant at the time of assessment. The achievement of the level of implementation of fire precautions will depend amongst other things on actions of the landowner or occupiers of the land, over which the fire protection consultant has no control. Notwithstanding anything contained within, the fire consultant/s or local government authority will not, except as the law may require, be liable for any loss or other consequences (whether or not due to negligence of the fire consultant/s and the local government authority, their servants or agents) arising out of the services rendered by the fire consultant/s or local government authority.*

**AS3959-2018 disclaimer:** It should be borne in mind that the measures contained within this Standard (AS3959-2018) cannot guarantee that a building will survive a bushfire event on every occasion. This is substantially due to the unpredictable nature and behaviour of fire and extreme weather conditions.

Building to AS39590-2018 is a standard primarily concerned with improving the ability of buildings in designated bushfire prone areas to better withstand attack from bushfire thus giving a measure of protection to the building occupants (until the fire front passes) as well as to the building itself.
(AS3959, 2018)

**SECTION 8: Certification**
I hereby certify that I have undertaken the assessment of the above site and determined the Bushfire Attack Level stated above in accordance with the requirements of AS 3959-2018 and the Guidelines for Planning in Bushfire Prone Areas Ver 1.3 (WAPC, 2017).

SIGNED, ASSESSOR: ..... DATE: 21/07/2021

Jason Benson Bio Diverse Solutions
Accredited Level 2 Bushfire Practitioner (Accreditation No: BPAD37893)

## 10. References

AS3959-2018 Australian Standard, *Construction of buildings in bushfire-prone areas*, Building Code of Australia, Primary Referenced Standard, Australian Building Codes Board and Standards Australia.

City of Albany Management Notice 2020/2021, accessed from: Fire Management Notice » City of Albany

Office of Bushfire Risk management (OBRM) (2019). Map of Bushfire Prone Areas. Data retrieved from State Land Information Portal (SLIP) https://maps.slip.wa.gov.au/landgate/bushfireprone/

Western Australian Planning Commission (WAPC) (2015). State Planning Policy 3.7 Planning in Bushfire Prone

Western Australian Planning Commission (WAPC) (2017). Guidelines for Planning in Bushfire Prone Areas Version 1.3. Western Australian Planning Commission and Department of Planning WA, Government of Western Australia.

**Appendices**

**Appendix 1 – Vegetation Classifications to AS3959-2018**

**Appendix 2 – APZ standards to apply**

**Appendix 3 – DFES Email Supporting Proposed EAW in Principle**

**Appendix 1**

**Vegetation Classifications to AS3959-2018**

# Vegetation classification to AS3959-2018

| Site Details | | | |
|---|---|---|---|
| **Address:** | Lot 1879 (No. 81) Davies Road | | |
| **Suburb:** | Kalgan | **State:** | W.A. |
| **Local Government Area:** | City of Albany | | |
| **Stage of WAPC Planning** | Structure Plan | | |

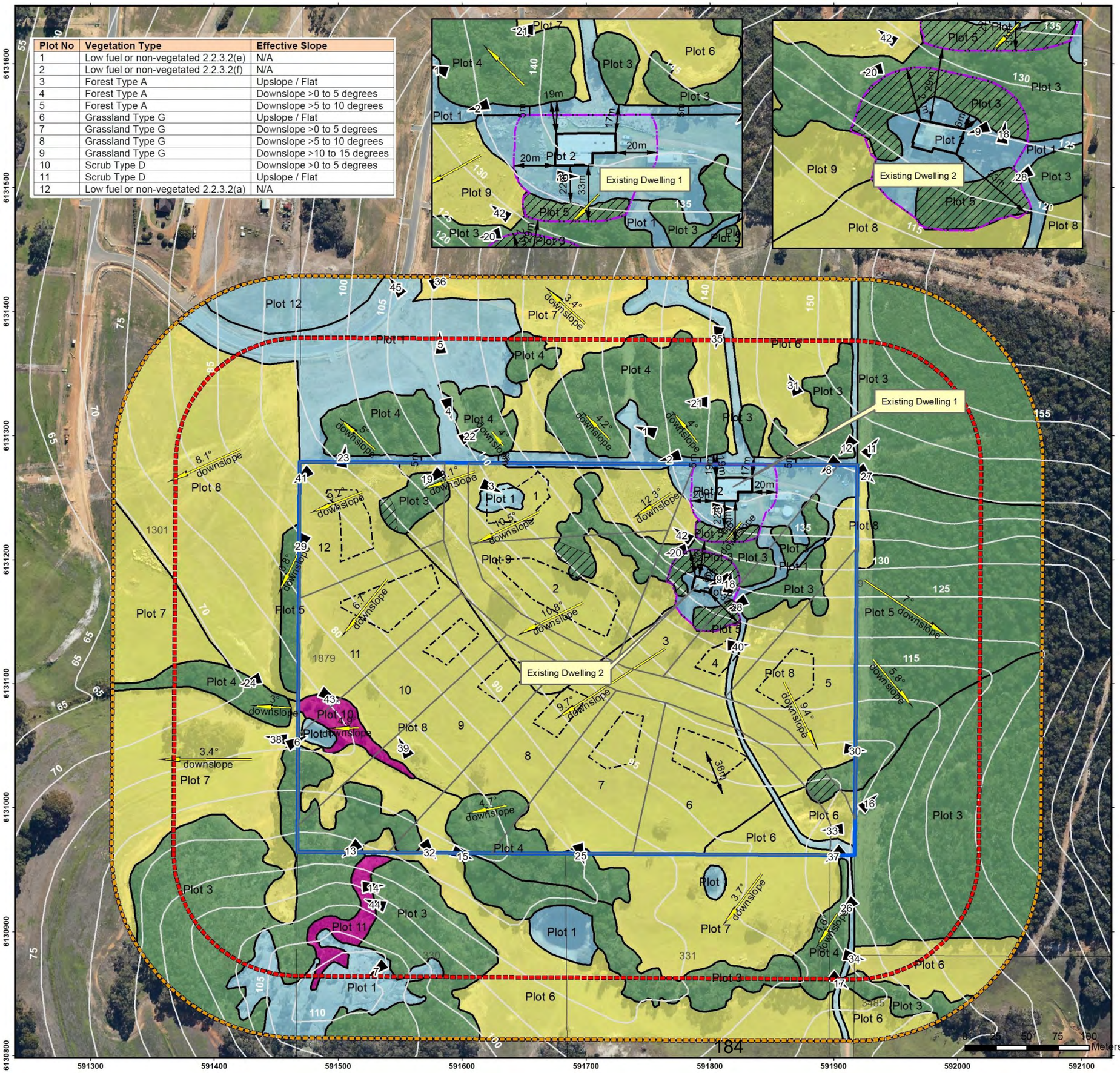
| BMP Plan Details | | | |
|---|---|---|---|
| **Report / Job Number:** | AB0036 | **Report Version:** | Draft |
| **Assessment Date:** | 11 February 2020 | **Report Date:** | 14 July 2021 |
| **BPAD Practitioner** | Jason Benson | **Accreditation No.** | BPAD 37893 |

**Vegetation Classification**

Site assessment occurred on the 11th February 2020 by Jason Benson (BPAD 37893). All vegetation within 150m of the site / proposed development was classified in accordance with Clause 2.2.3 of AS 3959-2018. Each distinguishable vegetation plot with the potential to determine the Bushfire Attack Level is identified in the following pages and shown on the Vegetation Classes Map Page 3.

| Plot number | Vegetation Type (Table 2.3) | Slope (Table 2.4.3) |
|---|---|---|
| 1 | Excluded 2.2.3.2 (e) | N/a |
| 2 | Excluded 2.2.3.2 (f) | N/a |
| 3 | Forest Type A | Flat/upslope |
| 4 | Forest Type A | Downslope >0-5 degrees |
| 5 | Forest Type A | Downslope >5-10 degrees |
| 6 | Grassland Type G | Flat/upslope |
| 7 | Grassland Type G | Downslope >0-5 degrees |
| 8 | Grassland Type G | Downslope >5-10 degrees |
| 9 | Grassland Type G | Downslope >10-15 degrees |
| 10 | Scrub Type D | Downslope >0-5 degrees |
| 11 | Scrub Type D | Flat/upslope |
| 12 | Excluded 2.2.3.2 (a) | N/a |

| Plot No | Vegetation Type | Effective Slope |
|---|---|---|
| 1 | Low fuel or non-vegetated 2.2.3.2(e) | N/A |
| 2 | Low fuel or non-vegetated 2.2.3.2(f) | N/A |
| 3 | Forest Type A | Upslope / Flat |
| 4 | Forest Type A | Downslope >0 to 5 degrees |
| 5 | Forest Type A | Downslope >5 to 10 degrees |
| 6 | Grassland Type G | Upslope / Flat |
| 7 | Grassland Type G | Downslope >0 to 5 degrees |
| 8 | Grassland Type G | Downslope >5 to 10 degrees |
| 9 | Grassland Type G | Downslope >10 to 15 degrees |
| 10 | Scrub Type D | Downslope >0 to 5 degrees |
| 11 | Scrub Type D | Upslope / Flat |
| 12 | Low fuel or non-vegetated 2.2.3.2(a) | N/A |



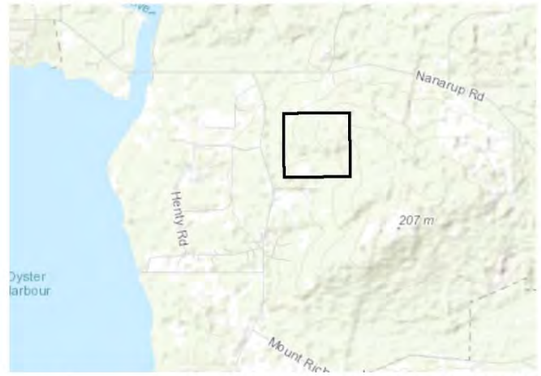

Albany Office:
29 Hercules Crescent
Albany, WA 6330
(08) 9842 1575

Denmark Office:
7/40 South Coast Highway
Denmark, WA 6333
(08) 9848 1309

Esperance Office:
2A/113 Dempster Street
Esperance, WA 6450
(08) 9072 1382

BPAD Bushfire Planning & Design
Accredited Practitioner Level 2

BIO DIVERSE SOLUTIONS




**Legend** Overview Map Scale 1:100,000

- Subject Site
- 100m Assessment Boundary
- 150m Assessment Boundary
- Existing Dwelling
- Asset Protection Zone (APZ)
- Future Low Fuel
- Cadastre
- 5m Contours
- Separation Distance
- Slopes Degrees
- Photo Point
- Proposed Lots
- Proposed Building Envelope
- Vegetation/Plot Boundary

**Vegetation**

- Forest Type A
- Scrub Type D
- Grassland Type G
- Low fuel or non vegetated 2.2.3.2

Scale
1:3,000 @ A3
GDA MGA 94 Zone 50

**Data Sources**
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

*CLIENT*
Ayton Baesjou
Lot 1879 (No. 81) Davies Road (and Gull Rock Road)
Kalgan, WA 6330

## Vegetation Classes

| *BAL Assessor* | *QA Check* | *Drawn by* |
|---|---|---|
| **JB** | **KK** | **CV** |
| *STATUS* | *FILE* | *DATE* |
| **FINAL** | **AB0036** | **15/07/2021** |

| Plot | 1 | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (e) |
|---|---|---|---|


**Location:** Internal to the site and external in adjacent lots to the north and south.

**Description:** Hardstand areas, rocky outcrops, roads, driveways, firebreaks and dams. Excluded as per AS3959 exclusion clause 2.2.3.2 (e).

*Photo Id 1: View to the west north-west towards granite outcrop located to the north of the subject site.*

| Plot | 1 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (e) |
|---|---|---|---|


**Additional Photo of Plot 1.**

*Photo Id 2: View to the west along firebreak within the subject site and on the adjacent lot to the north.*

| Plot | 1 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (e) |
|---|---|---|---|


**Additional Photo of Plot 1.**

*Photo Id 3: View to the east south-east towards granite outcrop located within the subject site near the northern boundary.*

| Plot | 1 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (e) |
|---|---|---|---|


**Additional Photo of Plot 1.**

*Photo Id 4: View facing south towards cleared vegetation to the north of the subject site.*

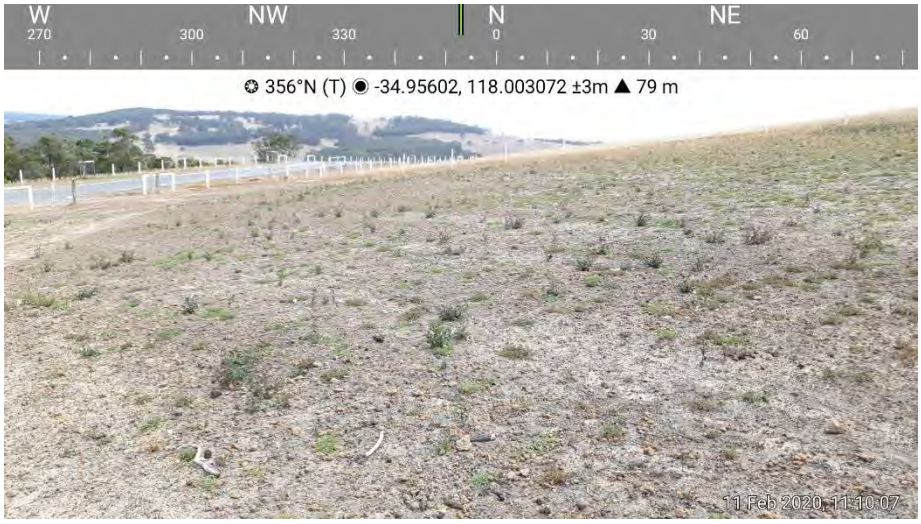
| Plot | 1 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (e) |
|---|---|---|---|
|  | | | **Additional Photo of Plot 1.** |

*Photo Id 5: View facing north towards cleared vegetation to the north of the subject site.*

| Plot | 1 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (e) |
|---|---|---|---|
|  | | | **Additional Photo of Plot 1.** |

*Photo Id 6: View to the north-east towards dam located on the western boundary of the subject site.*

| Plot | 1 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (e) |
|---|---|---|---|


**Additional Photo of Plot 1.**

*Photo Id 7: View to the south-west towards granite outcrop located on the adjacent lot to the south of the subject site.*

| Plot | 2 | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (f) |
|---|---|---|---|


**Location:** Internal to the site in the north-eastern corner of the subject site.

**Description:** Maintained gardens and lawns in APZ area surrounding existing buildings. Excluded as per AS3959 exclusion clause 2.2.3.2 (f).

**Available fuel loading:** <2 t/ha.

*Photo Id 8: View to the south-west through asset protection zone surrounding the existing building in the north-eastern corner of the subject site.*

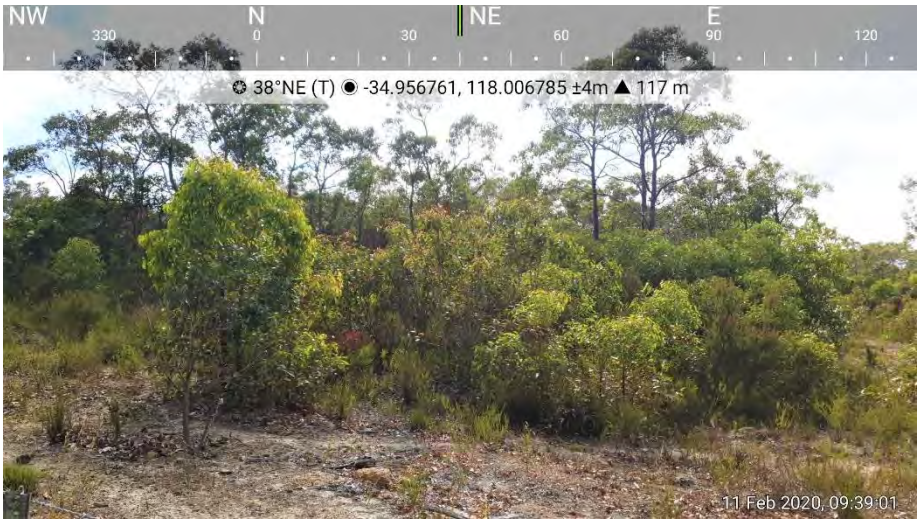
| Plot | 2 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (f) |
|---|---|---|---|
|  | | | **Additional Photo of Plot 2.** |

*Photo Id 9. View to the west south-west through asset protection zone surrounding the existing building in the north-east of the subject site.*

| Plot | 2 cont. | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (f) |
|---|---|---|---|
|  | | | **Additional Photo of Plot 2.** |

*Photo Id 10: View to the east through asset protection zone surrounding the existing building in the north-east of the subject site.*

| Plot | 3 | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|




**Location:** North-east, south-east, south and south-west of the subject site.

**Separation Distance:** 0m to the boundary of the subject site in the north-east, south-east, south and south-west.

**Description:** Jarrah, Marri, Peppermint, Casuarina, Balga's, Leucopogon and Acacia in the north-east and south-east and Jarrah, Marri, Blue Gum, Acacia and other Eucalypt species in the south-west. Vegetation consists of dense foliage cover with a multilayered scrub understorey.

**Average vegetation height:** 8-16m.

**Vegetation Coverage:** 30-70% foliage cover.

**Available fuel loading**: 25-35t/ha.

**Effective slope:** Upslope/flat.

*Photo Id 11: View facing north-east towards forest vegetation located to the north-east of the subject site.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|


**Additional Photo of Plot 3.**

*Photo Id 12: View facing south-west towards forest vegetation located to the north-east of the subject site.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 3.** |

*Photo Id 13: View facing south-west towards forest vegetation located to the south-west of the subject site.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 3.** |

*Photo Id 14: View facing east towards forest vegetation located on the adjacent lot to the south of the subject site.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 3.** |

*Photo Id 15: View facing east south-east towards forest vegetation located on the adjacent lot to the south of the subject site.*

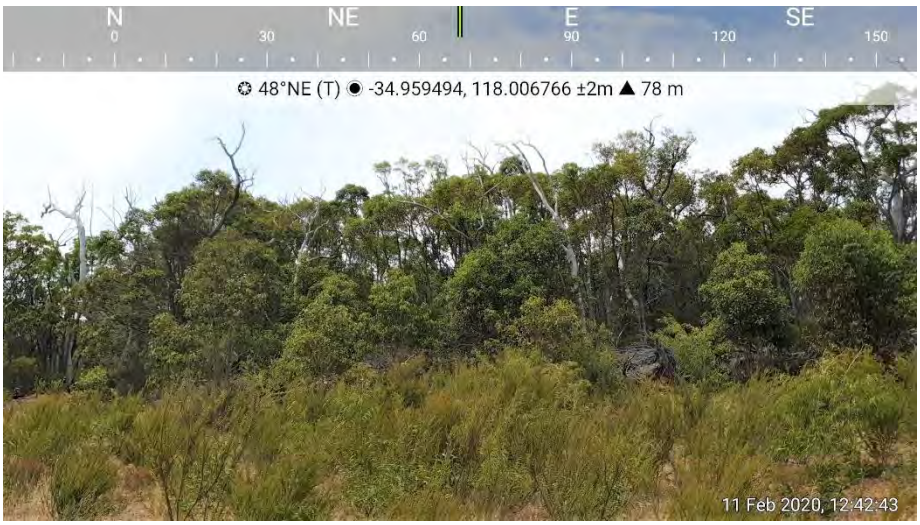
| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 3.** |

*Photo Id 16: View facing east north-east towards forest vegetation located to the south-east of the subject site.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 3.** |

*Photo Id 17: View facing south-east towards forest vegetation within creek line adjacent to the private driveway located to the south-east of the subject site.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 3.**<br><br>Note: This area of vegetation has a modified understorey, this vegetation has been classified Forest Type A based on the dense overstorey, precautionary principle applied. |

*Photo Id 18: View facing north through remnant forest vegetation located internal to the subject site to the south of the existing house.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|


**Additional Photo of Plot 3.**

Note: This area of vegetation has a modified understorey, this vegetation has been classified Forest Type A based on the dense overstorey, precautionary principle applied.

*Photo Id 19: View facing south-west through remnant forest vegetation located internal to the subject site to the west of the existing house.*

| Plot | 3 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|


**Additional Photo of Plot 3.**

Note: This area of vegetation has a modified understorey, this vegetation has been classified Forest Type A based on the dense overstorey, precautionary principle applied.

*Photo Id 20: View facing west through remnant forest vegetation located internal to the subject site to the south-west of the existing house.*

| Plot | 4 | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|


**Location:** North, south and west of the subject site.

**Separation Distance:** 0m to the south and 5m from the boundary of the subject site in the north.

**Description:** Jarrah, Marri, Balga's, Leucopogon and Acacia in the north, Wattie Trees within creek line to the west and Jarrah, Marri, Acacia and non-native plant species to the south. Vegetation consists of dense foliage cover with a multilayered scrub understorey.

**Average vegetation height:** 6-15m.

**Vegetation Coverage:** 30-70% foliage cover.

**Available fuel loading**: 25-35t/ha.

**Effective slope:** Downslope 0-5 Degrees.

*Photo Id 21: View facing west towards forest vegetation located on the adjacent lot to the north of the subject site.*

| Plot | 4 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|


**Additional Photo of Plot 4.**

*Photo Id 22: View facing north-east towards forest vegetation located on the adjacent lot to the north of the subject site.*

| Plot | 4 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 4.** |

*Photo Id 23: View facing north towards forest vegetation located on the adjacent lot to the north of the subject site.*

| Plot | 4 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 4.** |

*Photo Id 24: View facing west towards forest vegetation within creek line located to the west of the subject site.*

| Plot | 4 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 4.** |

*Photo Id 25: View facing south towards forest vegetation within creek line located internal and external to the subject site on the southern boundary.*

| Plot | 4 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 4.**<br><br>Note: This area of vegetation has a modified understorey, this vegetation has been classified Forest Type A based on the dense overstorey, precautionary principle applied. |

*Photo Id 26: View facing south-west towards forest vegetation located on the adjacent lot to the south-east of the subject site.*

| Plot | 5 | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|


**Location:** Internal to the subject site to the north-east and north and external on the eastern and western sides of the subject site.

**Separation Distance:** 0m.

**Description:** Patches of remnant vegetation with Jarrah and Marri trees internal to the subject site with dense canopy with minimal understorey. The eastern patch of vegetation consists of Jarrah and Marri forest with dense foliage cover with a multilayered scrub understorey and the forest vegetation to the west of the subject site consists of two rows of Blue Gums.

**Average vegetation height:** 8-16m.

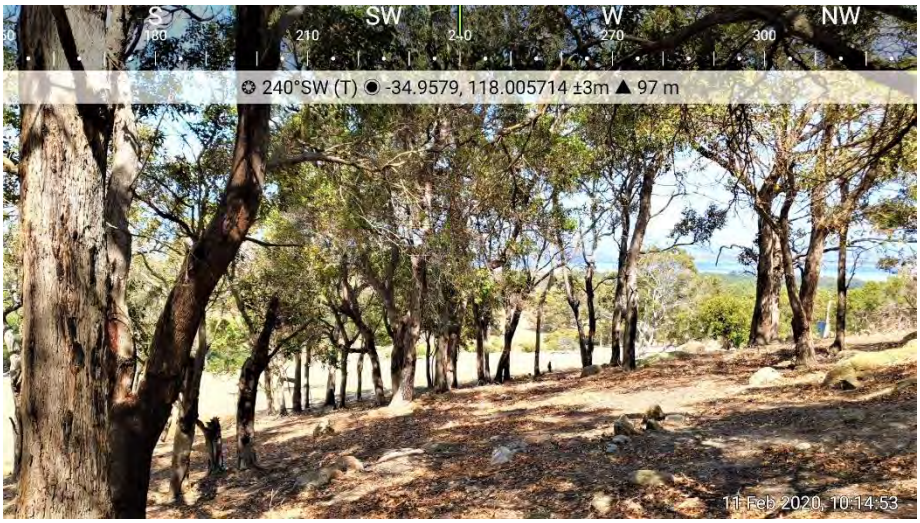
**Vegetation Coverage:** 30-70% foliage cover.

**Available fuel loading**: 25-35t/ha.

**Effective slope:** Downslope >5-10 Degrees.

*Photo Id 27: View facing south-east towards forest vegetation located to the east of the subject site.*

| Plot | 5 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|




**Additional Photo of Plot 5.**

Note: This area of vegetation has a modified understorey, this vegetation has been classified Forest Type A based on the dense overstorey, precautionary principle applied.

*Photo Id 28: View facing south-west through remnant forest vegetation located internal to the subject site to the south of the existing house.*

| Plot | 5 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 5.**<br><br>Note: This area of vegetation is two rows of Blue Gums and cannot be excluded as a windbreak, this vegetation has been classified Forest Type A based on the dense overstorey, precautionary principle applied. |

*Photo Id 29: View facing south south-west toward row of Blue Gum Trees located on the boundary of the adjacent property to the west of the subject site.*

| Plot | 5 cont. | Classification or Exclusion Clause | Forest Type A |
|---|---|---|---|
|  | | | **Additional Photo of Plot 5.** |

*Photo Id 30: View facing east towards forest vegetation located to the east of the subject site.*

| Plot | 6 | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|


**Location:** North-east, south and south-east of the subject site.

**Separation Distance:** 0m.

**Description:** Partially grazed mixed grasses and weeds.

**Average vegetation height:** 100-300mm.

**Vegetation Coverage:** <10% Trees.

**Available fuel loading:** 4.5t/ha.

**Effective slope:** Upslope/Flat.

*Photo Id 31: View facing north north-west through grassland vegetation located on adjacent lot to the north-east of the subject site.*

| Plot | 6 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|


**Additional Photo of Plot 6.**

*Photo Id 32: View facing south-east through grassland vegetation located on adjacent lot to the south of the subject site.*

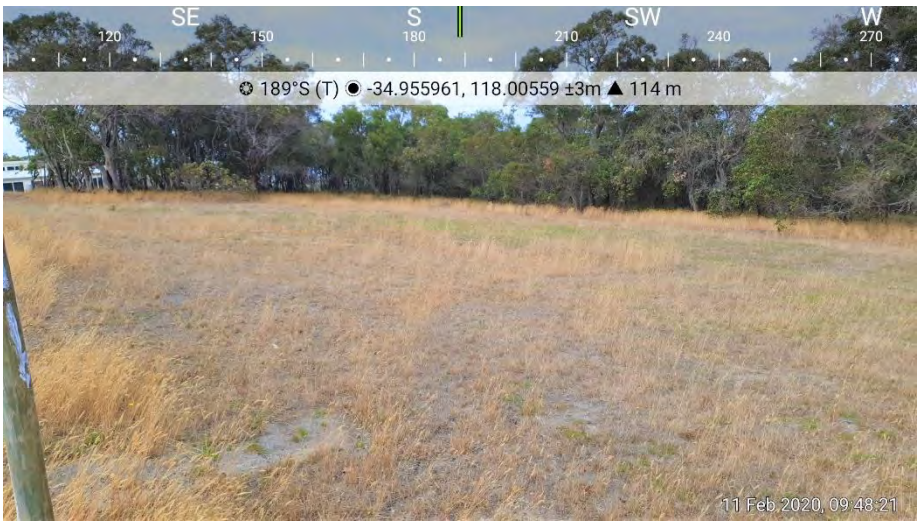
| Plot | 6 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|
|  | | | **Additional Photo of Plot 6.** |

*Photo Id 33: View facing west through grassland vegetation located in the south-east corner of the subject site.*

| Plot | 6 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|
|  | | | **Additional Photo of Plot 6.** |

*Photo Id 34: View facing east through paddock area on adjacent lot to the south-east of the subject site.*

| Plot | 7 | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|




**Location:** North, south and west of the subject site.

**Separation Distance:** 0m from the subject site lot boundary.

**Description:** Partially grazed mixed grasses and weeds.

**Average vegetation height:** 100-300mm.

**Vegetation Coverage:** <10% Trees.

**Available fuel loading:** 4.5t/ha

**Effective slope:** Downslope >0-5 Degrees.

*Photo Id 35: View facing south through grassland vegetation on adjacent lot to the north of the subject site.*

| Plot | 7 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|


**Additional Photo of Plot 7.**

*Photo Id 36: View facing north-east through grassland vegetation on adjacent lot to the north of the subject site.*

| Plot | 7 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|
|  | | | **Additional Photo of Plot 7.** |

*Photo Id 37: View facing south-west through grassland vegetation on adjacent lot to the south of the subject site.*

| Plot | 7 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|
|  | | | **Additional Photo of Plot 7.** |

*Photo Id 38: View facing west through paddock area on adjacent lot to the south-west of the subject site.*

| Plot | 8 | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|


**Location:** Internal to the subject site and external to the subject site to the west.

**Description** Partially grazed mixed grasses and weeds.

**Average vegetation height:** 100-300mm.

**Vegetation Coverage:** <10% trees.

**Available fuel loading:** <4.5t/ha.

**Effective slope:** Downslope >5-10 Degrees.

*Photo Id 39: View facing north north-west through paddock area in the south west of the subject site.*

| Plot | 8 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|


**Additional Photo of Plot 8.**

*Photo Id 40: View facing east through paddock area internal to the subject site in the east.*

| Plot | 8 cont. | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|
|  | | | **Additional Photo of Plot 8.** |
| *Photo Id 41: View facing south-west through paddock area on adjacent lot to the west of the subject site.* | | | |

| Plot | 9 | Classification or Exclusion Clause | Grassland Type G |
|---|---|---|---|
|  | | | **Location:** Internal to the subject site to the north.<br>**Description** Partially grazed mixed grasses, weeds and sedges.<br>**Average vegetation height:** 100-300mm.<br>**Vegetation Coverage:** <10% trees.<br>**Available fuel loading:** <4.5t/ha.<br>**Effective slope:** Downslope >10-15 Degrees. |
| *Photo Id 42: View facing north-west through paddock area internal to the subject site in the north.* | | | |

| Plot | 10 | Classification or Exclusion Clause | Scrub Type D |
|---|---|---|---|


**Location:** Internal to the subject site to the south-west.

**Separation Distance:** 0m.

**Description:** Sydney Golden Wattle and Tea Tree in wet area adjacent to dam.

**Average vegetation height:** 2-4m.

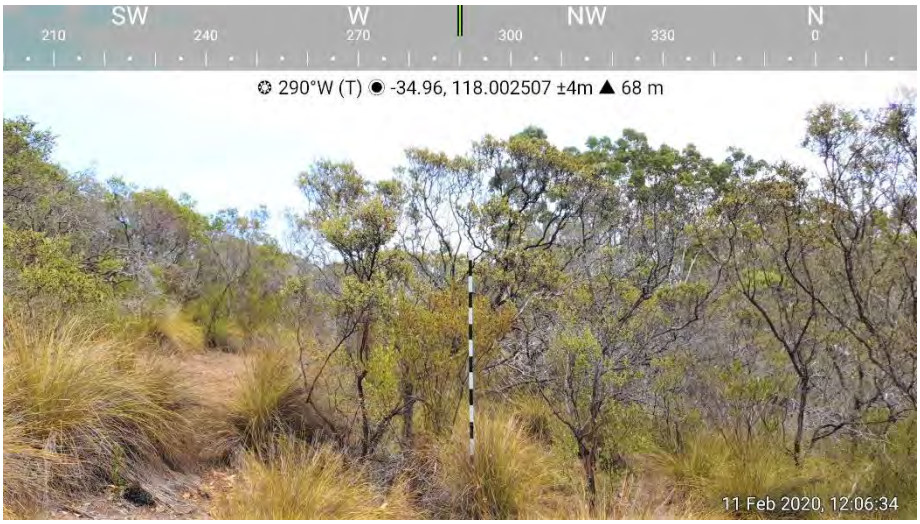
**Vegetation Coverage:** >30% foliage cover.

**Available fuel loading**: 25t/ha.

**Effective slope:** Downslope >0-5 degrees.

*Photo Id 43: View facing south-east towards scrub vegetation internal to the subject site to the southwest. Note: 1.8m height staff.*

| Plot | 11 | Classification or Exclusion Clause | Scrub Type D |
|---|---|---|---|




**Location:** External to the subject site to the south-west.

**Separation Distance:** 0m to the southern boundary of the subject site.

**Description:** Low vegetation associated with granite outcrop consisting of Leucopogon, Tea Tree species and stunted Eucalypts, understorey of low scrubs and sedges.

**Average vegetation height:** 2-4m.

**Vegetation Coverage:** >30% foliage cover.

**Available fuel loading**: 25t/ha.

**Effective slope:** Upslope/Flat.

*Photo Id 44: View facing west north-west towards scrub vegetation external to the subject site to the south. Note: 1.8m height staff.*

| Plot | 12 | Classification or Exclusion Clause | Low fuel or non-vegetated areas exclusion 2.2.3.2 (a) |
|---|---|---|---|


**Location:** North of the subject site.

**Description:** Areas of vegetation classified as Grassland >100m for the subject site.

As per exclusion clause 2.2.3.2 (a) of AS3959-2018.

*Photo Id 45: View facing north-west towards grassland vegetation located >100m from the boundary of the subject site to the north.*

**COMMENTS ON VEGETATION CLASSIFCATIONS:**

- Distances from vegetation were made based on surface fuels to edge of lot (subject site) boundary;
- Effective slopes were measured in the field using a Nikon Forestry Pro and represented on the respective plots;
- Method 1 (AS3959-2018) Simplified procedure was used for vegetation classification Assessment process;
- All vegetation was classified within the subject site and within 150m of the lot boundaries to AS3959 Table 2.3; and
- The perimeter of the vegetation was measured using field GPS and notations on field GIS maps.

**CERTIFICATION**

I hereby certify that I have undertaken the assessment of the above site and determined the Bushfire Attack Level stated above in accordance with the requirements of AS 3959-2018 (Incorporating Amendment Nos 1, 2 and 3).

SIGNED, ASSESSOR: ..... 20/07/2021

Jason Benson, Bio Diverse Solutions
Accredited Level 2 BAL Assessor (Accreditation No: BPAD37893)

**REVISION RECORD**

| Revision | Summary | Revised By | Date |
|---|---|---|---|
| Draft Id 20/02/2020 | Draft for QA | Kathryn Kinnear | 20/02/2020 |
| Final Id 20/07/2021 | Final Report | Jason Benson | 20/07/2021 |

**Appendix 2**
**WAPC Asset Protection Zone (APZ) standards to apply**

**Standards for an Asset Protection Zone (APZ) (WAPC, 2017)**

**Fences**: Within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.

**Objects**: Within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.

**Fine Fuel load:** Combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare.

**Trees (> 5 metres in height):** Trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy. See Figure 11 (WAPC Figure 16, Appendix 4) below.

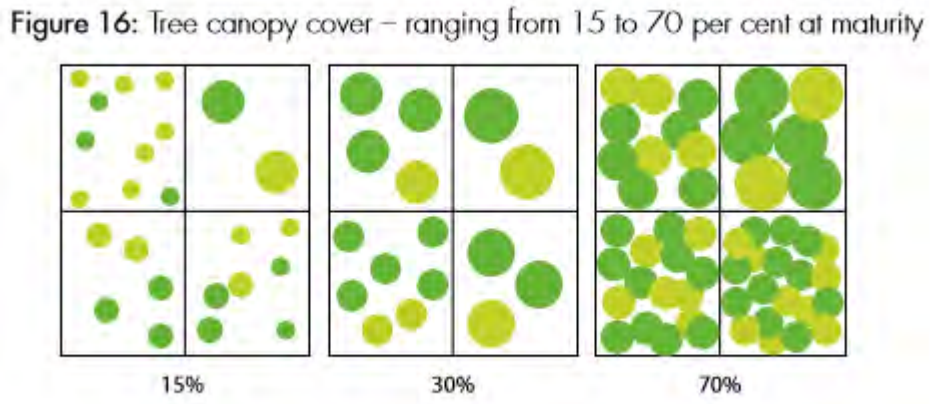



**Figure 11 – Tree Canopy Cover**

(WAPC, 2017)

**Shrubs (0.5 metres to 5 metres in height):** Should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.

**Ground covers (<0.5 metres in height):** Can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs. –

**Grass:** Should be managed to maintain a height of 100 millimetres or less.

**Appendix 3**
**DFES Email Supporting Proposed EAW in Principle**

REPORT ITEM DIS 289 REFERS

# Draft Structure Plan - Lot 1879 Davies Rd, Kalgan - DFES Response V2

Bert Quayle

Tue 11/05/2021 10:37 AM

To: Bert Quayle <Bert@aytonbaesjou.com.au>;

---

**From:** DFES Land Use Planning <advice@dfes.wa.gov.au>
**Sent:** Wednesday, 20 November 2019 10:47 AM
**To:** Adrian Nicoll <adriann@albany.wa.gov.au>
**Subject:** Draft Structure Plan - Lot 1879 Davies Rd, Kalgan - DFES Response V2

Our Ref: D10605

Good morning Adrian

Thank you for seeking our comments regarding above draft structure plan.

As previously discussed, it is difficult for us to provide a formed position without seeing the detail within a BMP.

Notwithstanding the above, I can confirm that we support 'in principle' the solution proposed in your email relating to the creation of an EAW from the subject site south to Davies Road to allow residents within the proposed structure plan area to have two points of access to two different destinations. It is critical that the proponent (and City) develop justification for why through public road access cannot be provided to Davies Road.

We encourage the proponent to develop this solution further in a BMP, in consultation with affected landowners and the City of Albany to ensure this solution is achievable and compliant with the technical requirements of Table 6 of the Guidelines.

Ultimately discretion will need to applied by the decision maker for this structure plan, taking into account the above issues.

I hope this provides some assistance with your discussions with the proponent and affected landowners.

Kind regards

**Sandeep Shankar**
**Senior Land Use Planning Officer | Land Use Planning**

Albert Facey House | 469 Wellington St, Perth WA 6000
**T:** 08 6551 4080 | **E:** advice@dfes.wa.gov.au | **W:** dfes.wa.gov.au


**Acknowledgement of Country:** DFES acknowledges the traditional custodians throughout Western Australia and their continuing connection to the land, waters and community. We pay our respects to all members of the Aboriginal communities and their cultures; and to Elders both past and present.



---

**From:** Adrian Nicoll <adriann@albany.wa.gov.au>
**Sent:** Monday, 28 October 2019 16:42 PM
**To:** DFES Land Use Planning <advice@dfes.wa.gov.au>
**Cc:** Bert Quayle <Bert@aytonbaesjou.com.au>
**Subject:** (PLEASE TRACK AS A RESUB) RE: Draft Structure Plan - Lot 1879 Davies Rd, Kalgan - DFES Response

Hi Sandeep or other,

Wondering if the DFES has any fundamental issues with the attached draft access arrangement.

As discussed previously, the Lot 1879 is being designed for Rural Residential (1ha) development. In the first instance, the consultant is attempting to negotiate appropriate access arrangements.

We have assessed various access arrangements for the subject lot and belief that the best scenario may involve a public road and EAW combination…as per attached.

- Apparently landholders (Lot 331 and Lot 1879) are agreeable to the conversion of the existing 20m wide access easement linking Lot 1879 and Davies Road into an EAW.
- A developed public road linking through to Davies Rd is considered to be un-necessary from a traffic flow and destination access perspective. Rural residential everyday traffic can use the adjoining estate roads which were planned for and will be constructed for this purpose.
- The EAW is to be constructed to a min 6m wide all-weather gravel standard with specific access control and drainage measures.
- The alignment within the clear 20m reserve allows for all Table 6 requirements to be met including trafficable surface, horizontal and vertical clearance, grade weight capacity cross-fall and curve radius. These requirements can be specified in the BMP and can be reinforced within subdivision provisions.

Many Thanks

Adrian

**Adrian Nicoll** / Senior Planning Officer - Strategic Planning

adriann@albany.wa.gov.au
(08) 6820 3050
www.albany.wa.gov.au
PO BOX 484, Albany, WA, 6331
102 North Road,Yakamia

21
1.00ha

22
1.00ha

74
1.00ha

58
1.00ha

57
1.10ha

60
1.03ha

65
1.21ha

64
1.05ha

62
1.00ha

63
1.01ha

61
1.00ha

56
9735m

37
1.01ha

38
1.03ha

39
1.06ha

40
1.00ha

41
1.02ha

42
1.02ha

43
1.02ha

44
1.25ha

45
1.12ha

46
1.08ha

47
1.02ha

POS

POS

POS

330

Lot 1879
Air Photo 2019

NEW ROAD

Future Rural Residential Lots
Min 1ha
SUBJECT TO PLANNING
FOLLOWING IDENTIFICATION
OF EMERGENCY ACCESS

Future Rural Residential Lots
Min 1ha
SUBJECT TO PLANNING
FOLLOWING IDENTIFICATION
OF EMERGENCY ACCESS

NEW ROAD

EMERGENCY ACCESS WAY
AS
EASEMENT IN GROSS
OVER
EXISTING ACCESS EASEMENT

EMERGENCY ACCESS WAY
AS
EASEMENT IN GROSS
OVER
EXISTING ACCESS EASEMENT

Lot 331

DAVIES ROAD (EXISTING)

7081
Reserve 28690

21

SFB

EAW

# Schedule of Submissions and Recommendations
## LOCAL PLANNING SCHEME AMENDMENT No.12 – Lot 1879 Davies Road, Kalgan.

| No. | Address | Summary of Submissions<br>***Note: This is a broad summary of the submissions only.***<br>***A copy of the submissions in full has been provided to the Council as a separate document.*** | City Recommendation | City Justification |
|---|---|---|---|---|
| **LOCAL PLANNING STRATEGY** | | | | |
| 1. | City of Albany | The advertised amendment document references the City's 2010 Local Planning Strategy. | **It is recommended that the amendment document is modified to make reference to the City's 2019 Local Planning Strategy.** | N/A |
| **INFRASTRUCTURE** | | | | |
| 2. | ATCO Gas | No objection. | Note comment from ATCO Gas.<br><br>No modifications recommended. | N/A |
| 3. | Water Corporation | No objection. | Note comment from Water Corporation.<br><br>No modifications recommended. | N/A |
| 4. | Telstra | No objection. Developers are now responsible for telecommunications infrastructure on all developments, i.e. conduits, pits and the cost of the cable installation by Telstra or other carrier. | Note comment from Telstra.<br><br>No modifications recommended. | N/A |
| 5. | Department of Health | The Department of Health has no objection to the Local Planning Scheme Amendment with regard to the Government Sewerage Policy. | Note comment from the Department of Health.<br><br>No modifications recommended. | N/A |
| **AGRICULTURE** | | | | |
| 6. | Department of Agriculture and Food (WA). | The Department of Agriculture and Food acknowledges that the size of the Lot (15 ha), the slope of the land and surrounding rural residential land use, infers a lower priority for future intensive agri-industry development.<br><br>It is acknowledged that the gradient / slope over much of Lot 1879 are mostly unsuitable for intensive annual or perennial horticultural. | Note comment from the Department of Agriculture and Food (WA) pertaining to incompatibility of the land for intensive annual or perennial horticultural.<br><br>No modifications recommended. | N/A |
| 7. | Department of Agriculture and Food (WA). | Referring to a figure / map on page 24 of the Scheme Amendment document - the proposed Lot 75 is annotated as being 103 ha - this is an error that is repeated across several of the plans. | Note comment from DAFWA.<br><br>**It is recommended that a guide/concept plan is included in the amendment document to show corrections and opportunities and constraints including bushfire hazards, scheme setback requirements, steep slopes, buffer to creek, revegetation, veg protection and suitable building envelope size and location.** | N/A |

| | | | | |
|---|---|---|---|---|
| **ENVIRONMENT** | | | | |
| 8. | Environmental Protection Authority. | Not necessary to provide any advice or recommendations. | Note comment from the Environmental Protection Authority.<br><br>No modifications recommended. | N/A |
| 9. | Department of Parks and Wildlife. | No comment. | Note comment from the Department of Parks and Wildlife.<br><br>No modifications recommended. | N/A |
| 10. | Department of Water and Environmental Regulation | DWER notes additional information provided on late winter soil testing and depth to groundwater and has no further comments regarding this.<br><br>In relation to management of a waterway within the site, DWER does not agree with retention in private ownership.<br><br>Private ownership will not provide for long term protection of the waterway which can only be realised through public ownership and management.<br><br>Incorporation into the existing foreshore reserve and public open space is the preferred option as it allows for consistent management practices throughout the reserve. | Note comment relating to management of a waterway.<br><br>**It is recommended that a low lying area located on the southern boundary of the subject lot is revegetated, fenced and managed in private ownership (15m either side of centreline of creek area). It is recommended that this information is shown on a guide/concept plan, as a component of the amendment document, and later transferred to an endorsed Local Structure Plan.**<br><br>**It is recommended that the scheme resolution i) is amended as follows (so that the creek area is not reserved for parks and recreation):**<br><br>***Rezoning Location 1879 Davies Road, Lower Kalgan from the 'General Agriculture' zone to the 'Rural Residential' zone ~~and 'Parks & Recreation' Reserve~~.*** | There is a low lying area located on the southern boundary of the subject site. The low lying area is subject to intermittent water flow following periodic rain events.<br><br>The water flow area is majority undefined and with little or no permanent aquatic flora present.<br><br>The advertised scheme amendment recommends ceding the creek to the Crown for the purpose of 'Parks and Recreation' reserve (Public Open Space).<br><br>There is however little public benefit in ceding and maintaining the area for 'Parks and Recreation' (Public Open Space). |
| 11. | Graham and Sheryl Moncur<br><br>Lot 331, 61 Davies Road. | What impact may occur to the watercourse running through the property? | | |
| 12. | Department of Agriculture and Food. | DAFWA recommends the allocation of a wider vegetation belt to buffer and protect the drainage line in the south west corner of Lot 1879. | Note comment from the Department of Agriculture and Food (WA) pertaining to a wider vegetation protection area associated with the creek.<br><br>**In accordance with the City's *Local Planning Scheme No.1 (cl.4.3.6)* and the *Government Sewerage Policy 2019*, it is recommended that a minimum 30m development setback and 100m effluent setback, from the known high-water mark of the minor watercourse is achieved.**<br><br>**It is recommended that this information is shown on the guide/concept plan and later transferred to an endorsed Local Structure Plan.** | N/A |
| 13. | Department of Agriculture and Food. | Any change in land use adjacent land zoned as rural needs to ensure that adequate setbacks and buffers are incorporated into the plan to reduce potential land-use conflict between adjacent uses.<br><br>The Environmental Protection Authority and Department of Heath guidelines set out generic buffers for changes in land use adjacent rural land. | Note comment from the Department of Agriculture and Food (WA) pertaining to incorporating suitable buffers to neighbouring lands.<br><br>No modifications recommended. | Land use surrounding includes rural lifestyle lots and a substantial area of remnant vegetation.<br><br>Buffers to neighbouring land is required to reduce risks associated with bushfire, to ensure revegetation of a creek and in-accordance with scheme setback requirements (15m). |

| | | | | |
|---|---|---|---|---|
| **BUSHFIRE** | | | | |
| 14. | City of Albany | Update the 'Fire Management Plan' to comply with the 'Guidelines for Planning in Bushfire Prone Areas'. | **It is recommended that the amendment document is modified by replacing the 'Fire Management Plan' with a 'Bushfire Management Plan' developed to comply with the Commissions 'Guidelines for Planning in Bushfire Prone Areas'.** | N/A |
| 15. | Graham and Sheryl Moncur<br><br>Lot 331, 61 Davies Road. | Will this amendment affect the easement associated with our property connecting it to Lot 1879? | Note comment from a neighbouring landholder pertaining to an existing easement for access.<br><br>**It is recommended that the driveway section of the easement may need reconstructing to enable access via fire trucks, in the instance of a bushfire.**<br><br>**It is recommended that the easement is reconstructed to achieve a 6m wide all weather gravel with fire gates.**<br><br>**Reconstruction can be done at the subdivision stage at the expense of the owner of Lot 1879.**<br><br>**It is recommended that this information is shown on the guide/concept plan and later transferred to an endorsed Local Structure Plan.** | An easement exists over the neighbouring Lot 331 Davies Road. The easement enables access to the subject Lot 1879, via the neighbouring Lot 331 Davies Road.<br><br>The easement is a full 20m wide and is therefore sufficient to accommodate a standard rural or urban road reserve or emergency access way. |
| 16. | Department of Fire and Emergency Services. | DFES has assessed the proposed scheme amendment and accompanying BMP and has identified several issues that need to be addressed prior to support of the proposal. | **It is recommended that additional info/explanation is provided to address issues raised by the DFES.** | The BMP does not adequately address the policy requirements of SPP 3.7 and the Guidelines. |
| **FENCING** | | | | |
| 17. | Graham and Sheryl Moncur<br><br>Lot 331, 61 Davies Road. | What fencing may be developed? | Note comment from a neighbouring landholder pertaining fencing.<br><br>Rural standard fencing is to be developed at the subdivision stage. | N/A |
| **GENERAL** | | | | |
| 18. | City of Albany | Land to the north and east of the subject lot is zoned Rural Residential Area No.9. Provisions have been endorsed for the Rural Residential Area No.9 to govern subdivision and development.<br><br>The Amendment No.12 proposes to utilise the provisions of the Rural Residential Area No.9 and to include the following new provisions:<br><br>*8. For Lots 75-86, building plans shall include an assessment of the foundation zone of the building area and include full details of proposed foundations to adequately accommodate foundation zone conditions.*<br><br>*9. For Lots 56-74, as shown on the Subdivision Guide Plan, all areas including pasture, parkland clearing, replanting and landscape areas shall be* | **It is recommended that the resolution within the initiated and advertised version of the Amendment No.12 is modified by deleting iii), iv), v) and vi) (the proposed provisions 8, 9 and 10 and the proposed 'Subdivision Guide Plan').**<br><br>**Instead of a 'Subdivision Guide Plan', it is recommended that a 'Concept Plan' is included within the amendment document to show:**<br><br>**(i) Opportunities and constraints and including buffers (100m effluent setback and 30m development setback) to the creek and revegetation of the creek (15m either side of the creek);**<br><br>**(ii) Fencing of the creek area (south western area);**<br><br>**(iii) Management of the creek via private ownership; and** | To comply with newly endorsed legislation (*Planning and Development (Local Planning Schemes) Regulations 2015).* |

| | | | | |
|---|---|---|---|---|
| | | *maintained as a Hazard Separation Area (refer to the Fire Management Plan).*<br><br>*10. All dwellings on Lots 56-86 shall be constructed to the specifications of Australian Standard 3959 – Building in Bushfire Prone Areas. In the instance of lots 75-86, construction shall be to the requirements of the relevant Bushfire Attack Level (BAL) per the Fire Management Plan (BAL 12.5 or BAL 19).*<br><br>The Amendment No.12 also proposes to make applicable a subdivision guide plan for the subject Lot 1879. | **(iv) The need for the reconstruction of the driveway section of an easement to enable access via fire trucks, in the instance of a bushfire. Reconstructing to achieve 6m wide all weather gravel with fire gates. Reconstruction can be done at the subdivision stage at the expense of the owner of Lot 1879.**<br><br>Prior to subdivision and development of the subject land, the *Planning and Development (Local Planning Schemes) Regulations 2015* requires (cl.16 (1)(c)(i)) the endorsement of a structure plan to identify appropriate lot layout and building envelopes considerate of foundation stability.<br><br>**It is recommended that the scheme resolution is amended to include the following:**<br><br>***Amending the provision 1. of the Rural Residential Area No.9 to read as follows:***<br><br>***Subdivision of RR9 shall generally be in accordance with ~~the Subdivision Guide Plan RR9 endorsed by the CEO, with any minor variations~~ a Local Structure Plan, approved by the Western Australian Planning Commission.***<br><br>**It is recommended that the scheme resolution is updated to align with the Commissions document format for 'Standard' amendments as follows:**<br><br>***The amendment is a Standard Amendment under the provisions of the Planning and Development (Local Planning Schemes) Regulations 2015 for the following reasons.***<br><br>• ***It is an amendment relating to a zone or reserve that is consistent with the objectives identified in the scheme for that zone or reserve;***<br>• ***It is an amendment that is consistent with a local planning strategy for the scheme that has been endorsed by the Commission;***<br>• ***It is an amendment that would have minimal impact on land in the scheme area that is not the subject of the amendment; and***<br>• ***It is an amendment that does not result in any significant environmental, social, economic or governance impacts on land in the scheme area.*** | |
| 19. | Robert Armstrong<br><br>PO Box 210<br>Boyup Brook<br>WA 6244 | The proposed rezoning of Lot 1879 Davies Road from 'General Agriculture' to 'Rural Residential' is supported. | Note comment from neighbouring landholder.<br><br>No modifications recommended. | N/A |

# Schedule of Modifications

## LOCAL PLANNING SCHEME AMENDMENT No.12 – Lot 1879 Davies Road, Kalgan.

a) **The amendment document is required to be modified to refer to the City's 2019 Local Planning Strategy.**

b) **That a guide/concept plan is included in the amendment document to show corrections and opportunities and constraints including bushfire hazards, scheme setback requirements, steep slopes, buffer to creek, revegetation, veg protection and suitable building envelope size and location.**

c) **That the low lying area located on the southern boundary of the subject lot is revegetated, fenced and managed in private ownership (15m either side of centreline of creek area). This information shall be shown on a guide/concept plan, as a component of the amendment document, and later transferred to an endorsed Local Structure Plan.**

d) **That the scheme resolution i) is amended as follows (so that the creek area is not reserved for parks and recreation):**

***Rezoning Location 1879 Davies Road, Lower Kalgan from the 'General Agriculture' zone to the 'Rural Residential' zone ~~and 'Parks & Recreation' Reserve~~.***

e) **In accordance with the City's *Local Planning Scheme No.1 (cl.4.3.6)* and the *Government Sewerage Policy 2019*, a minimum 30m development setback and 100m effluent setback, from the known high-water mark of the minor watercourse is required. This information shall be shown on the guide/concept plan and later transferred to an endorsed Local Structure Plan.**

f) **The amendment document shall be modified by replacing the 'Fire Management Plan' with a 'Bushfire Management Plan' developed to comply with the Commissions 'Guidelines for Planning in Bushfire Prone Areas'.**

g) **The driveway section of the easement may need reconstructing to enable access via fire trucks. It is recommended that the easement be reconstructed to achieve a 6m wide all weather gravel with fire gates. Reconstruction can be done at the subdivision stage at the expense of the owner of Lot 1879. This information shall be shown on the updated Local Structure Plan in effect for RR9.**

h) **Additional information/rationale is required to address issues raised by the DFES.**

**i) That the resolution within the initiated and advertised version of the Amendment No.12 is modified by deleting iii), iv), v) and vi) (the proposed provisions 8, 9 and 10 and the proposed 'Subdivision Guide Plan'). Instead of adopting a new Local Structure Plan (formally known as a 'Subdivision Guide Plan'), it is recommended that the existing Local Structure Plan in effect for RR9 under Schedule 14 be updated to incorporate the subject site. The Local Structure Plan and the amendment document shall be updated to include:**

- **(i) Opportunities and constraints and including buffers (100m effluent setback and 30m development setback) to the creek and revegetation of the creek (15m either side of the creek);**
- **(ii) Fencing of the creek area (south western area);**
- **(iii) Management of the creek via private ownership; and**
- **(iv) The need for the reconstruction of the driveway section of an easement to enable access via fire trucks, in the instance of a bushfire. Reconstructing to achieve 6m wide all weather gravel with fire gates. Reconstruction can be done at the subdivision stage at the expense of the owner of Lot 1879.**

| | | |
|---|---|---|
| RR9 | Nanarup Road, Kalgan Rural Residential zone | 1. Subdivision of RR9 shall generally be in accordance with the ~~Subdivision Guide Plan~~ Local Structure Plan *RR9* endorsed by the CEO, with any minor variations approved by the Western Australian Planning Commission.<br>2. The minimum lot size shall be one hectare.<br>3. The following land uses are 'P' permitted uses:<br>• Single House<br>4. The following land uses are 'D' discretionary uses:<br>• Ancillary Accommodation;<br>• Bed and Breakfast/Farmstay;<br>• Home Occupation;<br>• Industry – Cottage;<br>• Public Utility; and<br>• Rural Pursuit (which shall be limited to existing cleared and pastured land only).<br>5. All development (including dwelling and outbuildings) and any low fuel zones shall be located outside of any development exclusion area, revegetation area and/or creekline protection area as shown on the Local Structure Plan ~~Subdivision Guide Plan~~ and shall achieve the following minimum setbacks:<br>i. 15 metres from Gull Rock or Nanarup Roads;<br>ii. 15 metres from all other lot boundaries; and<br>iii. 25 metres from any lot boundary with Location 1462.<br>6. No new access/egress points onto Nanarup Road will be permitted.<br>7. Within Special Design Areas (Lots 15-22, 37-47 & 56-74 as shown on the Subdivision Guide Plan), applicants will be required to submit an overall design and landscape plan which addresses:<br>(a) setbacks from property boundaries and creeklines;<br>(b) existing and proposed vegetation/revegetation;<br>(c) low lying, flood prone and stormwater disposal areas;<br>(d) low fuel zones;<br>(e) that cut and fill of the site shall be kept to a minimum with preference given to split level development and the breaking up of building mass;<br>(f) that only one out building shall be permitted with a maximum size of 65m$^2$ and maximum size of 65m$^2$ and maximum height to the eaves of 3 metres;<br>(g) driveways shall be designed to minimise visual impact and erosion by being aligned with the contours of the site and planted with trees and |

| | | |
|---|---|---|
| | | shrubs. Stormwater runoff shall be attenuated to ensure erosion does not occur; and<br><br>(h) the landscape plan shall indicate the number, type and location of shrubs and trees to be planted and maintained as a condition of Development Approval to effectively minimise the visual impact of all development on the site. |