

27 October 2017

The Chief Executive Officer
Shire of Serpentine Jarrahdale
6 Paterson Street,
MUNDIJONG WA 6123

Attn: Mr Rob Casella

By email: rcasella@sjshire.wa.gov.au

Dear Sir

Re: Proposed Scheme Amendment, Lot 9 Hardey Rd, Serpentine

Further to the Scheme Amendment proposal submitted in August this year, please find enclosed our revised Scheme Amendment Report and supporting technical report.

Feedback on the documentation submitted in August has been incorporated in the revision, however the fundamental change from the initial proposal is a change in the proposed lot sizes and, therefore, the revised report and supporting technical reports are based upon a new Subdivision Guide Plan for lots having a minimum lot size of 1 hectare.

Please note that, as per our initial submission, we are proposing the subject land be rezoned to Rural Living A notwithstanding the advice received in the interim that the Western Australian Planning Commission (WAPC) has instructed the Shire to modify its Rural Strategy Review by removing the Rural Living A "classification" and instead depicting the subject land Rural Living B.

In seeking Council's initiation of a Scheme Amendment which is at odds with the WAPC's instruction in relation the Rural Strategy Review we offer the following rationale and justification:

1. The proposed Amendment to rezone the subject land from Rural to Rural Living A is consistent with the Shire's Draft Rural Strategy Review (2013) as endorsed by Council and, as such represents the Council's preferred outcome for the subject land notwithstanding the contrary view of the WAPC.
2. The Shire's professional view on the matter was reinforced in the Officer's Report to this year's March, April and May Council meetings, whereby the recommendation to Council (as one of a number of modifications to the Rural Strategy review requested by the WAPC in late 2016) was that the WAPC be asked to reconsider its request that Lot 9 be classified Rural Living B rather than Rural Living A.
3. It is contended that the WAPC's position on this matter is arbitrary and fails to take into account land capability of the subject land, evidenced by the Rural Strategy Review report of 2013 which recommended the Rural Living A classification for the subject land and by a Preliminary Land Capability Assessment by Emerge Associates which was submitted to the then Department of Planning (DoP, now the DoPLH) in early December 2016 prior to the WAPC's Statutory Procedures Committee (SPC) considering the Strategy later that month.

4. Furthermore, the WAPC's own South Metropolitan Peel Sub-Region Framework identifies the subject land as "Rural Residential" and purports to support "rural residential zones where they are planned for in a Local Planning Strategy and to effectively 'round off' existing rural residential areas." In its apparent acceptance of the subject land being depicted Rural Living B, the WAPC clearly agrees that the rezoning of the subject land constitutes a 'rounding off' of rural residential south of Serpentine townsite, and in terms of strategy we contend that Council's depiction of the subject land as Rural Living A in its detailed Rural Strategy Review is based on a degree of technical investigation, which is further evidenced by the site specific technical reports within our submission.
5. Furthermore, the proponent's decision to revise the proposal to facilitate a 1 hectare minimum lot size rather than the initial 0.4 hectares possible under Rural Living A brings the proposal into line with the definition of "Rural Residential" under State Planning Policy 2.5 (Rural Planning), which refers to a minimum lot size of 1 hectare.
6. Finally, it is understood that the DoPLH recommendation to the SPC to classify Lot 9 Hardey Road as Rural Living B may have been at least partly based on concerns that a Rural Living A classification could lead to 0.4 hectares lots which were at odds with the Framework and the Draft Government Sewer Policy, and that Rural Living B with its 2 hectare minimum lot size would be more appropriate. We contend that from a land capability perspective, the subject land is not conducive to the stock levels prevalent on lots upward of 2 hectares in area (described in the 2013 Rural Strategy as "hobby farms") and that, therefore, lots of about 1 hectare in area appear to be the optimal form of development, which only the Rural Living A zone can facilitate. The imposition of a 1 hectare minimum lot size is inherent in the requirement for a Structure Plan based on the Subdivision Guide Plan within the Scheme Amendment document to be approved by the WAPC prior to subdivision.

With respect to the process which has ensued since submitting our initial Scheme Amendment request in early August, we were advised that Council's resolution from its May meeting would be considered by the WAPC's Statutory Procedures Committee (SPC) on 22 August 2017.

Despite the fact that the Rural Strategy was listed as a confidential item on the agenda for that meeting, a deputation was made to the SPC that day, however the outcome conveyed to the Shire by letter dated 25 August 2017 (in the absence of minutes of the SPC meeting which were also confidential) and referred to ourselves by the Shire in early September caused the proponents to further consult officers of both the Shire and the DoPLH, leading us to conclude that a 1 hectare plan could potentially be seen as more compliant than the original 0.4 hectare plan.

While the original plan for 0.4 hectare lots was supported by a detailed Land Capability Assessment and the apparent logic of facilitating a development form similar to that to the immediate north (Serpentine Downs Estate) and to the near west, we trust that the decision to proceed with 1 hectare lots can gain Council's support for the reasons provided herein and which could in due course gain the support of the WAPC on a site specific basis based on the proposal's merit.

Yours faithfully,
Michael Glendinning



Principal

Michael Glendinning Property

SHIRE OF SERPENTINE JARRAHDALE
TOWN PLANNING SCHEME NO. 2
AMENDMENT NO. 203



**Michael
Glendinning**
Property

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October 2017

PLANNING AND DEVELOPMENT ACT 2005

RESOLUTION TO PREPARE AMENDMENT TO TOWN PLANNING SCHEME

SHIRE OF SERPENTINE JARRAHDAL

TOWN PLANNING SCHEME NO. 2

AMENDMENT NO. 203

Resolved that the local government, in pursuance of Section 75 of the Planning and Development Act, 2005 amend the above local planning scheme by:

1. Rezoning Lot 9 (No 147) Hardey Road, Serpentine from 'Rural' to 'Rural Living A' in accordance with the Scheme Amendment Map;
2. Amending the Scheme Map by delineating Lot 9 Hardey Road, Serpentine as 'RLA31';
3. Listing Lot 9 (No 147) Hardey Road, Serpentine as 'RLA31' in 'APPENDIX 4A – RURAL LIVING A ZONE' with landuse controls and special provisions.

The Amendment is complex under the provisions of the Planning and Development (Local Planning Schemes) Regulations 2015 for the following reason:

- the amendment is not consistent with a local planning strategy that has been endorsed by the Western Australian Planning Commission.

Dated this.....day of.....20....

..... CHIEF EXECUTIVE OFFICER

PROPOSAL TO AMEND A LOCAL PLANNING SCHEME

LOCAL GOVERNMENT	SHIRE OF SERPENTINE JARRAHDALÉ
DESCRIPTION OF LOCAL	TOWN PLANNING SCHEME NO. 2
TYPE OF SCHEME	LOCAL
SERIAL NO. OF AMENDMENT	203
PROPOSAL	<ol style="list-style-type: none"> 1. Rezone Lot 9 (No 147) Hardey Road, Serpentine from 'Rural' to 'Rural Living A' in accordance with the Scheme Amendment Map. 2. Amending the Scheme Map by delineating Lot 9 (No 147) Hardey Road, Serpentine as 'RLA31'. 3. Listing Lot 9 (No 147) Hardey Road, Serpentine as 'RLA31' in 'APPENDIX 4A – RURAL LIVING A ZONE' with landuse controls and special provisions.

SCHEME AMENDMENT REPORT

1.0 INTRODUCTION

Lot 9 is located less than two kilometres south of the Serpentine town site and immediately south of the established Serpentine Downs Rural Living A zone (RLAs 1, 27 and 29).

This Amendment proposes to rezone the subject land from Rural to Rural Living A consistent with the Shire's Draft Rural Strategy Review (2013) and the Draft South Metropolitan Sub-Regional Planning Framework, and based on the land's proximity to the Serpentine town site and its contiguous southward extension of the Rural Living A zone east of Hardey Road.

This report examines the existing and surrounding zoning, site characteristics and provides justification for the proposed Scheme Amendment. The report has been prepared following a Land Capability Assessment of the subject land, compilation of a District Water Management Strategy and a Bushfire Management Plan.

A Subdivision Guide Plan has been developed to support the Scheme Amendment having regard for the physical features of the land, surrounding road network, existing development and recommendations of the Land Capability Assessment.

In accordance with Clause 5.12.8 of the Scheme, the Subdivision Guide Plan forms part of this Scheme Amendment proposal.

2.0 LAND DESCRIPTION

2.1 Legal Description

The subject land comprises a total area of 22.749 hectares in one single lot described as Lot 9 on Plan No.13275 on Certificate of Title Volume 1577 Folio 160.

The registered proprietors of the subject land are Trevor Stanley Major and Virginia Kay Major. A copy of the Certificate of Title is included as **Attachment 1**.

2.2 Location Plan

Lot 9 has a 316m frontage to Hardey Road and a 147m to an un-named road reserve which intersects with Hardey Road at the property's southern boundary. As demonstrated by **Figure 1**, that road reserve and the southern boundary of the property align with Wattle Road and the southern boundary of existing Rural Living A development on the western side of the freight rail line.

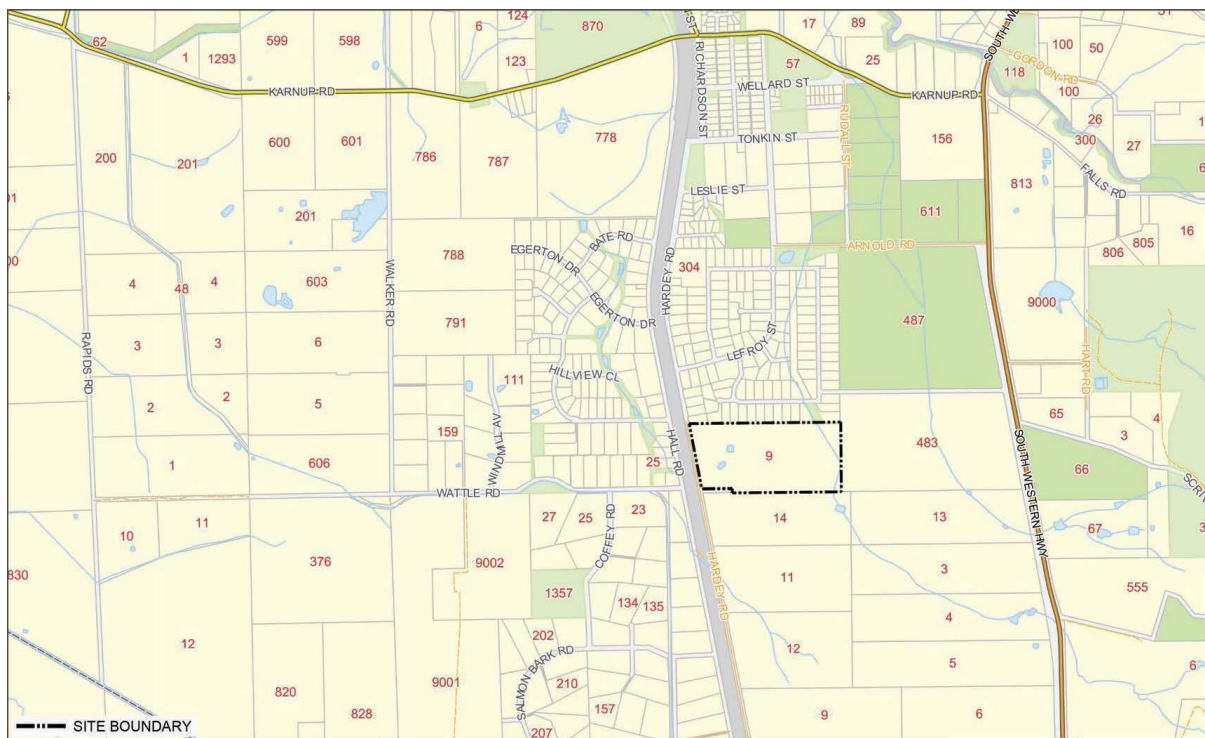


Figure 1: Location Plan

2.3 Existing Landuse and Development

Lot 9 is currently used for horse agistment. Situated on the property is a dwelling, two dams, stables, associated outbuildings and a trotting track. The existing dwelling is proposed to be retained on a lot within the proposed subdivision and ancillary buildings will be demolished.

3.0 PLANNING CONTEXT

3.1 Existing Zoning

Lot 9 Hardey Road is zoned Rural under the Metropolitan Region Scheme and the Shire of Serpentine Jarrahdale Town Planning Scheme No. 2, as illustrated in **Figure 2** below.

Land to the immediate north of the subject land is zoned Rural Living A (RLAs 1, 27 and 29) and has been developed as Serpentine Downs Estate, with a predominant lot size of just over 4000m².

Land to the west of the subject land (and west of the railway line) and north of Wattle Road is also zoned Rural Living A (RLA9), such that the rezoning of the subject land will logically align the southern boundary of the Rural Living A zone either side of the railway line.

Land to the south and east of the subject land is zoned Rural and used for broad scale rural purposes.

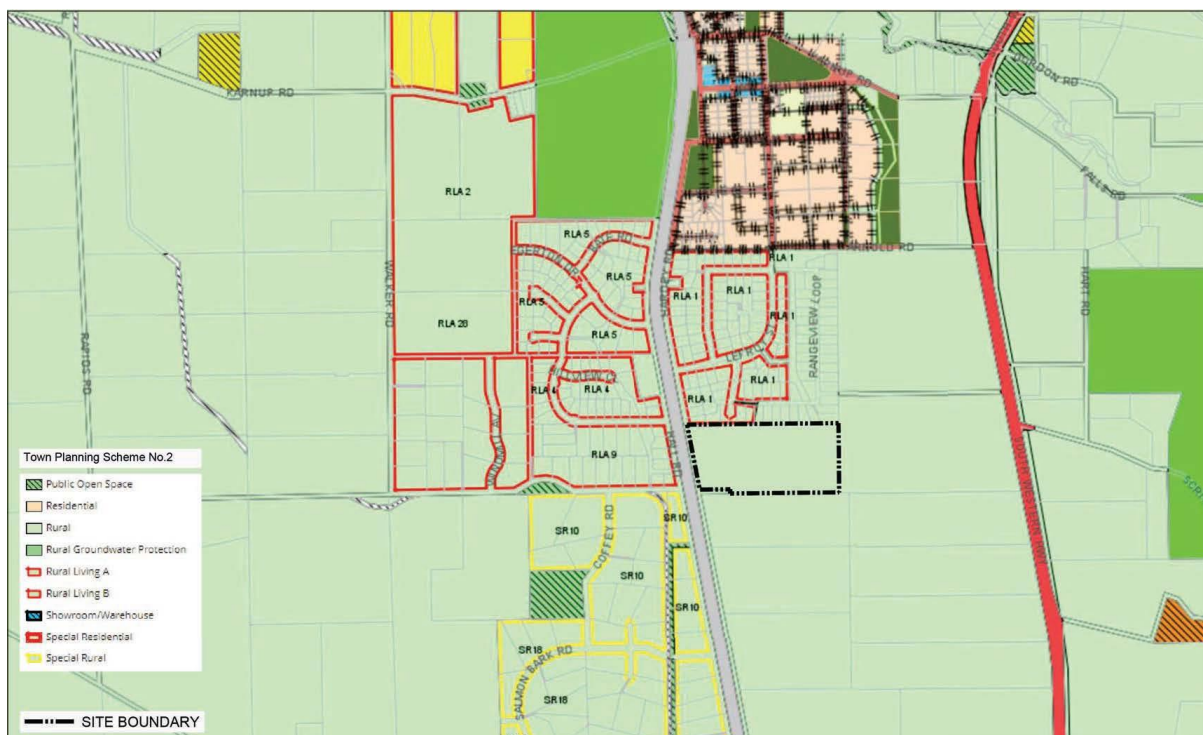


Figure 2 – Extract Town Planning Scheme No. 2

3.2 Relevant Scheme requirements

There are specific requirements applicable to the Rural Living A zone under Clause 5.12 of the Shire of Serpentine Jarrahdale Town Planning Scheme No 2 ('the Scheme').

Clause 5.12.2 of the Scheme states that 'The Rural Living A Zone is intended to cater for rural residential development on a range of lots between 4,000m² to one hectare in accordance with the objectives and guidelines of the Rural Strategy'.

All Rural Living A zones are listed in Appendix 4A of the Scheme along with special provisions applicable to each area.

3.3 Shire of Serpentine Jarrahdale Rural Strategy

The Shire of Serpentine Jarrahdale Rural Strategy was adopted in April 1994 and endorsed by the Western Australian Planning Commission (WAPC). Minor modifications were made to the Strategy in 2003 and again in 2006.

In 2012/13 a major review of the Strategy was undertaken and the Rural Strategy Review was adopted by Council in July 2014 and forwarded to the Department of Planning for the WAPC's endorsement. Under the Strategy the subject land was designated Rural Living A, as demonstrated by **Figure 3** below.

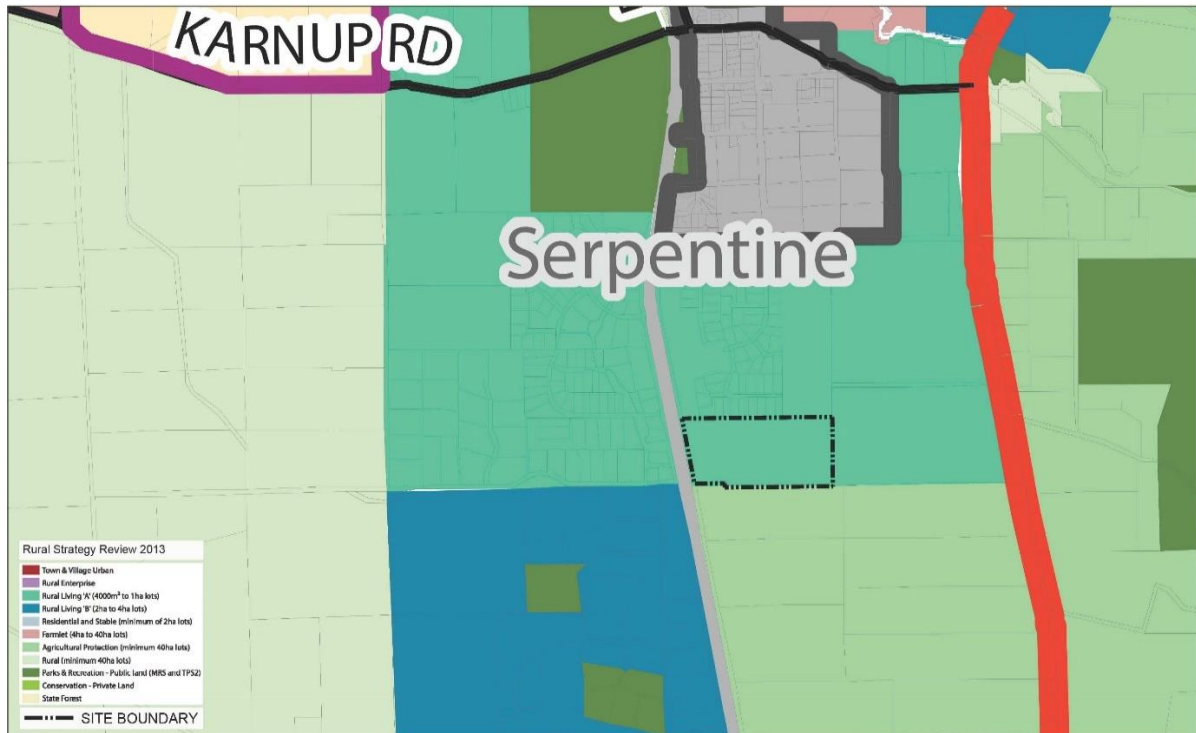


Figure 3 – Extract 2013 Rural Strategy

The Strategy Review was considered by the WAPC in December 2016, pursuant to which the WAPC requested a number of modifications to the Strategy, one of which was that the subject land be depicted Rural Living B rather than Rural Living A.

In March 2017, Council considered an Officer Recommendation to advise the WAPC of its position in respect of the requested modifications. The recommendation in respect of the subject land was to request the WAPC to reconsider its requested modification on the basis that “It will provide a logical southern boundary if the area is depicted as ‘Rural Living A’ with a 1ha minimum lot size designation.”

The item was, however, deferred at the March and April Council meetings and in May Council resolved to request that the WAPC “again consider the Council’s position in relation to its original adoption of the Strategy in 2013/14”.

This application is, therefore, founded on Council's preferred outcome for the subject land, notwithstanding that the WAPC has since required the Shire to depict the subject land as Rural Living B in the final document and provide that document to the Department.

3.4 Key State Government Strategies and Policies

3.4.1 Directions 2031 and Beyond

Directions 2031 and Beyond is currently the highest level strategic plan for the Perth and Peel Regions. It provides a framework to guide more detailed planning and delivery of housing, infrastructure, services and employment to achieve a connected city pattern of growth.

It recognises the benefits of a more consolidated city whilst working from historic patterns of urban growth. The framework sets achievable goals that will promote housing affordability over the longer term.

Six sub-regions are identified, with the Shire of Serpentine Jarrahdale being within the South East Sub-region, which is guided by the draft Outer Metropolitan Perth and Peel Sub-Regional Strategy. Under the connected city model, it is estimated that by 2031, the population of the south east sub-region will have grown by 34%.

3.4.2 Draft Perth and Peel @3.5million

To realise the vision encapsulated in Directions 2031 and Beyond and the State Planning Strategy 2050, the Western Australian Planning Commission has created a series of detailed draft planning frameworks with a unified, long-term growth strategy for landuse and infrastructure for the Perth and Peel regions.

The Perth and Peel @3.5million strategic suite of documents has been developed to engage the community in open discussion on expectations of what our city should look like in the future, on how our valued lifestyle can be maintained and how we can realistically accommodate a substantially increased population.

Together with the draft Perth and Peel @3.5million document, the strategic suite consists of four draft sub-regional planning frameworks for the Central, North-West, North-East and South Metropolitan Peel sub-regions. The Shire of Serpentine Jarrahdale falls within the South Metropolitan Peel Sub-region.

The draft frameworks provide guidance on where sustainable development should occur over the next 35 to 40 years to ensure the impact of urban growth on areas of environmental significance is minimised, to protect our heritage, and to maximise the benefits of available land and existing infrastructure.

The draft South Metropolitan Peel Sub-Region Framework recognises that Rural Residential areas provide alternative lifestyle and housing opportunities. However, the Framework also identifies that Rural Residential development places additional demand on community and service infrastructure.

For this reason, the draft South Metropolitan Peel Sub-Region Framework limits the areas identified for Rural Residential development to include existing Rural Residential zones, areas identified within endorsed or draft strategies, and some ‘rounding-off’ of existing areas.

As illustrated in **Figure 4** below, Lot 9 Hardey Rd, Serpentine is depicted as ‘Rural Residential’ under the draft South Metropolitan Peel Sub-Region Framework and this proposal to rezone the property to Rural Living A meets all of the above criteria for such zoning.

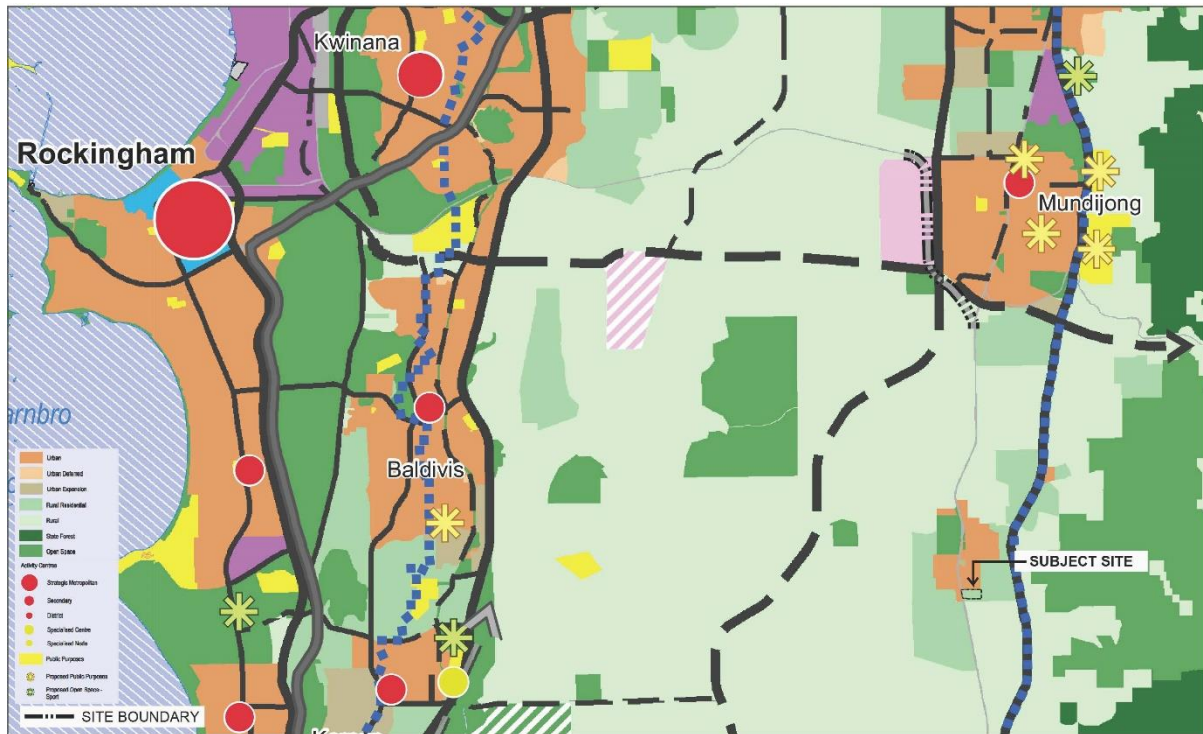


Figure 4 – The Planning Framework - South Metropolitan Peel Sub-region

As there are already Rural Living A subdivisions to the immediate north and near west of the subject land, it is considered that a Rural Living A zone on Lot 9 Hardey Road, Serpentine is essentially a rounding off of established zones in the immediate locality.

Notwithstanding that, as discussed in section 3.3, the WAPC has since required the Shire to depict the subject land as Rural Living B in the final version of its Rural Strategy Review, it is noted that at 1 hectare in area the lot sizes proposed by the Subdivision Guide Plan which forms part of this Amendment (Figure 9) accord with the range of lot sizes – one to four hectares - attributed to the definition of “Rural residential zone” under State Planning Policy 2.5 Rural Planning.

The proposal, therefore, is by definition in accordance with the WAPC’s published draft South Metropolitan Peel Sub-Region Framework.

3.4.3 Planning for Bushfire Protection Guidelines

The primary focus of the Western Australian Planning Commission’s Planning (WAPC) for Bushfire Protection Guidelines (Edition 2, 2010) was to ensure that bushfire hazards were

considered in planning decisions at all stages of the planning process, to avoid increased fire risk to life and property.

The 2010 Guidelines have been reviewed and new Planning for Bushfire Risk Management Guidelines and a new State Planning Policy 3.7: Planning in Bushfire Prone Areas ('SPP 3.7') became effective in December 2015.

SPP 3.7 encourages a conservative approach to strategic planning, subdivision, development and other planning decisions proposed in bushfire-prone areas. It specifically:

- addresses landuse planning elements of the Keelty report;
- elevates bushfire issues to be addressed by the highest level of planning policy available, giving it clear status and effect in the landuse planning policy framework;
- emphasises the need to consider bushfire management measures in strategic level policy documents, including regional and local planning schemes, subregional and local planning strategies and structure plans, as well as during statutory planning processes for subdivision and development applications; and
- seeks to achieve the consistent implementation of bushfire management measures across the community.

Bushfire Management Plans are required to be prepared to support scheme amendments and local structure plans in accordance with the WAPC Policy for Bushfire Protection.

3.4.4 Statement of Planning Policy 2.1: The Peel Harvey Coastal Plain Catchment

The Peel-Harvey coastal plain catchment policy ensures that landuse changes within the Peel-Harvey estuarine system likely to cause environmental damage to the estuary are brought under planning control and prevented.

The objectives of this policy include to:

- Improve the social, economic, ecological, aesthetic, and recreational potential of the Peel-Harvey coastal plain catchment.
- Ensure that changes to landuse within the catchment to the Peel-Harvey estuarine system are controlled so as to avoid and minimise environmental damage.
- Increase high water-using vegetation cover within the Peel-Harvey coastal plain catchment.
- Reflect the environmental objectives in the draft Environmental Protection Policy (Peel-Harvey Estuarine System) 1992.
- Prevent land uses likely to result in excessive nutrient export into the drainage system.

Lot 9 Hardey Road is situated within the catchment area. State Planning Policy 2.1 ('SPP 2.1') includes specific provisions for rural residential lots over 4000m² outlining requirements for effluent disposal.

Because of potential nitrate contamination of the groundwater, the Policy requires on-site effluent disposal to be limited to densities of no more than one effluent disposal system per 1 hectare unless specific investigation of the capacity of the local environment to absorb the effluent is undertaken and subject to alternative systems.

The policy recommends retention of existing vegetation except where there are defined building envelopes, for approved utility requirements and for firebreaks.

3.4.5 Draft Government Sewer Policy (2016)

The Draft Government Sewer Policy released in November 2016 by the Government of Western Australia for public consultation is understood to be the subject of many submissions and is as a result likely to undergo modifications prior to its finalisation, which is expected late 2017.

It is understood that, in the meantime, decisions of proposals affected by the draft GSP have focussed on the Objectives of the Policy, which in re draft are stated as:

- To protect public health and amenity;
- To protect the environment and the State's water and land resources;
- To promote the efficient use of infrastructure and urban land; and
- To minimise costs to the broader community by ensuring an appropriate level and form of sewerage servicing is provided.

It is also understood that many of the submissions on the draft policy have opposed the presumption against on-site wastewater disposal and the notion of a 1 hectare minimum lot size in rural residential/rural living zones, particularly in areas where land capability to sustain on-site disposal can be demonstrated.

While an initial Land Capability Assessment indicated that Lot 9 Hardy Road is capable of sustaining lots with a minimum lot size of 4000m², the proponent for the development of this land has opted for a 1 hectare minimum lot size so that the proposal conforms with:

- the Shire's Officer Recommendation to Council in response to the WAPC requested modifications to the Shire's Rural Strategy Review (refer section 3.3 of this report);
- the land being depicted as Rural Residential on Plan 1 "The Planning Framework" of the WAPC's draft South Metropolitan Peel Sub-Region Framework (refer section 3.4); and
- the default 1 hectare minimum lot size for unsewered lots within a sewage sensitive area under Section 2.4 of the WA Government's Draft Government Sewerage Policy (November 2016).

4.0 ENVIRONMENTAL ANALYSIS

4.1 Existing Environment – Land Capability Assessment

The site is not proposed to be connected to a reticulated sewer network, instead each lot will have an onsite effluent treatment and disposal system fully contained within the lot. A Land Capability Assessment has been undertaken by Emerge Associates and the findings are referred to in Emerge's Environmental Assessment and Justification Report (2017) – refer **Attachment 2**. This document demonstrates that this approach can satisfy the draft Country Sewerage Policy (DoH 2003) and can meet the intent of the draft Government Sewerage Policy (2016).

Regional landform and soil mapping for the site (discussed further below) indicates that there are no site characteristics of the site that would result in unmanageable issues due to the use of onsite effluent disposal systems. Potential aspects which may require some form of management/engineering response include seasonal flooding, a high-water table, low soil absorption and low microbial purification ability. Site specific investigations undertaken in November 2016 (as part of the Land Capability Assessment) have considered these factors, and it is concluded that these potential regional characteristics and associated limitations are unlikely to be encountered within the site, or can be readily managed through careful selection and design of future land application systems.

It is expected that any requirements for future investigations, associated system selection and design responses can be addressed through scheme provisions associated with the proposed town planning scheme amendment.

4.1.1 Topography

The site is generally gently sloping with a north-westerly aspect, with existing ground levels ranging from 43 metres Australian Height Datum (m AHD) in the south-eastern portion of the site, to 38m AHD in the north-western portion of the site (DoW 2008).

4.1.2 Geology and Geomorphology

Regional landform mapping identifies the site as being situated on three broadly defined soil-landform 'land units'. These land units include:

- **Pinjarra P1a Phase** which was broadly described as 'flat to very gently undulating plain. Imperfect to poorly drained and generally not susceptible to salinity'.
- **Pinjarra B1 Phase** which was broadly described as 'extremely low to very low relief dunes, undulating sandplain and discrete sand rises'.
- **Forrestfield F2b Phase** which was broadly described as 'well drained low slopes and foot slopes up to 5-10%'.

The Pinjarra P1a Phase land unit was identified as occurring across the majority of the site, with Pinjarra B1 Phase occurring in the western portion of the site, and the Forrestfield F2b Phase only marginally occurring in the north-eastern corner of the site.

4.1.3 Soils

Regional soil mapping indicates that three soil units occur within the site, as shown in **Figure 5**. These include:

- **Sandy Clay (Cs)** which is described as ‘white grey to brown, fine to coarse, sub-angular to rounded, clay of moderate plasticity; gravel and silt layers near scarp, of alluvial origin’.
- **Sand (S8)** which is described as ‘white to pale grey at surface, yellow at depth, fine to medium grained, moderately sorted sub-angular to sub-rounded, minor heavy minerals, or aeolian origin’.
- **Sand (S10)** which is described as ‘S8 over sandy clay to clayey sand of the Guildford formation’.

The Cs soil unit is identified as occurring across the majority of the site, with a lesser extent of the S8 soil unit, and a very small (almost negligible) extent of the S10 soil unit.

A limited number of soil samples were taken at the site, as outlined in the Land Capability Assessment, which indicate that soils within the site generally consist of Silty Sand to Clayey Silty Sand over Sandy Clay/Sandy Gravelly Clay.

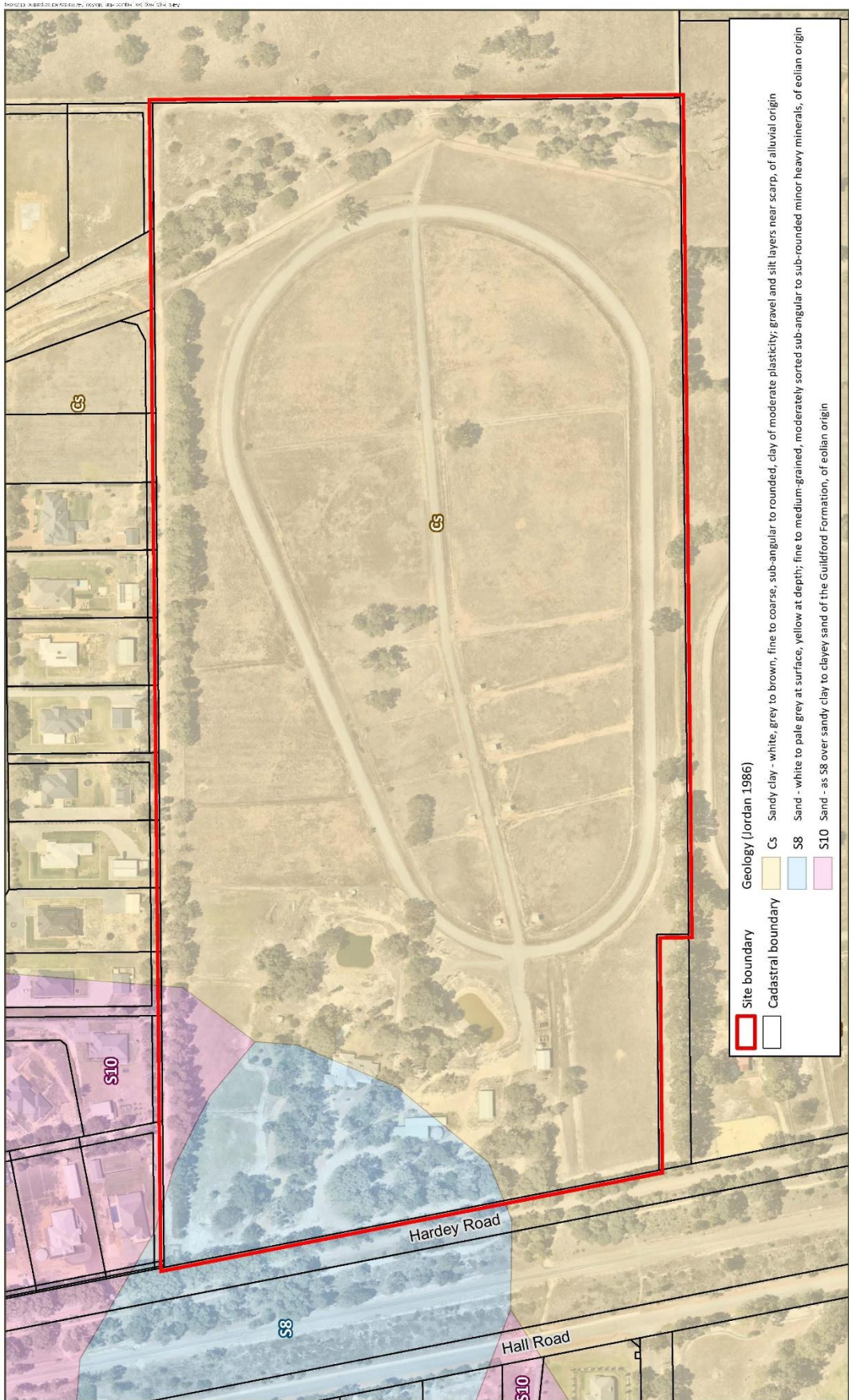
4.1.4 Vegetation

Regional vegetation complex mapping undertaken by Beard et al. (2013) indicates that one vegetation association would have historically occurred across the site. This vegetation association is Pinjarra 968 which is broadly described as ‘Jarrah, Marri and wandoo Eucalyptus marginata, Corrymbia calophylla, E. wandoo’. Given its current condition, vegetation within the site is unlikely to be representative of this association.

Based on a review of historic aerial photography, the site has been largely cleared of vegetation to support pastoral land uses, primarily horse agistment. A preliminary site inspection was undertaken by Emerge Associates in July 2017 which confirmed that the vegetation across the site is in a highly degraded condition and consists predominantly of Parkland Cleared areas with planted native and exotic species and sparse remnant native species dotted throughout. As shown in **Figure 6** three vegetation communities were identified in the site which includes three areas of Parkland Cleared, characterised by slightly varying species or structure.

The majority of vegetation occurs within the western portion of the site, surrounding the existing residence and farm sheds/outbuildings, and in the east of the site associated with the watercourse in this area (see **Figure 6**). Planted shelterbelt vegetation occurs in various locations around the perimeter of the site.

The proposed development of the site is unlikely to result in a significant impact on vegetation within the site as clearing is likely to be minimal with the promotion of vegetation retention within private lots, where possible. The consideration and management of vegetation as part of the proposed future development of the site is further considered in the Environmental Assessment and Justification Report (Emerge 2017b).



emerge ASSOCIATES

Michael Glendinning Property

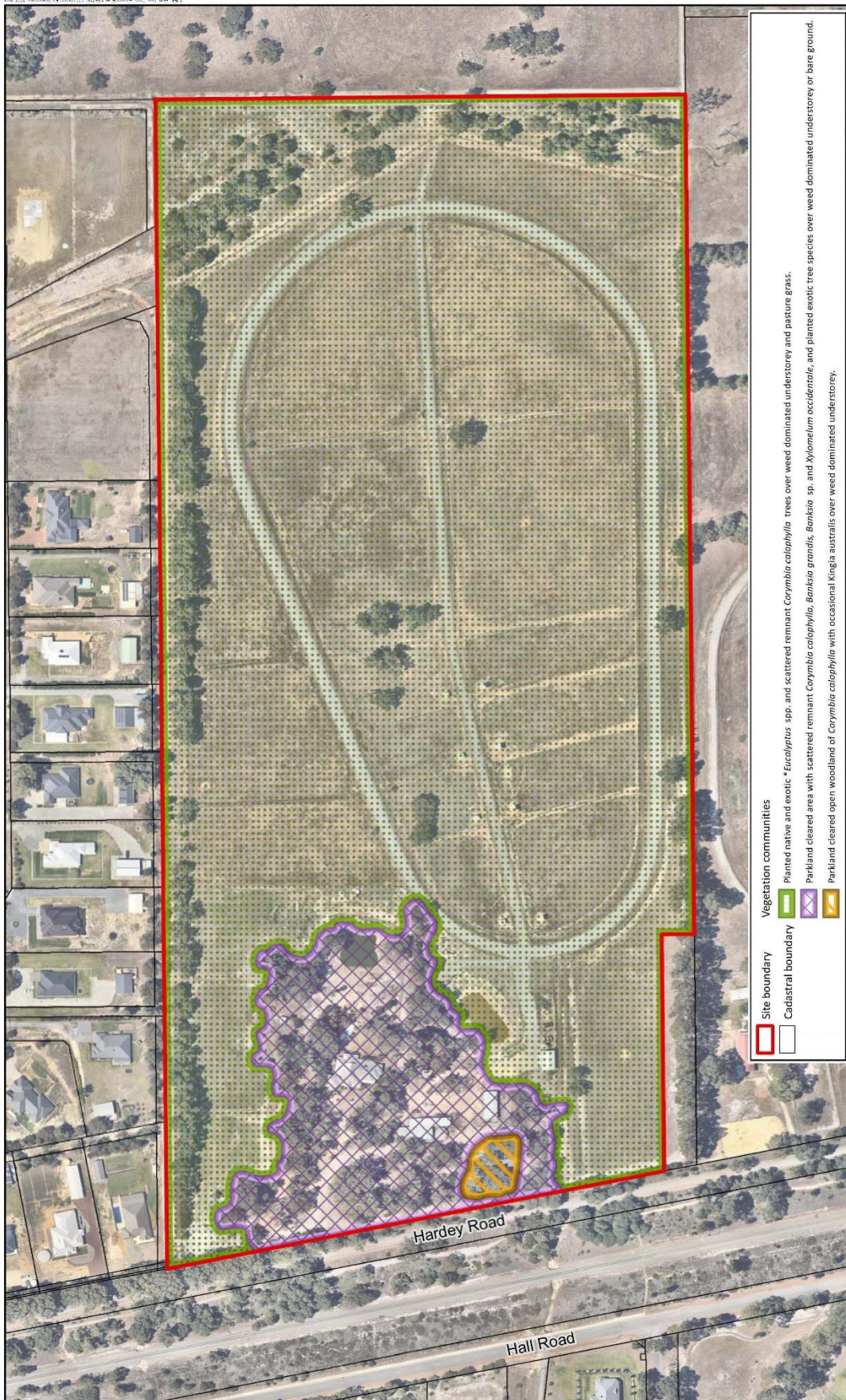
FIGURE 5 - Regional Soil Mapping
 147 Hardey Road, Serpentine, 6125

Scale 1:3000 @ A4 | Date July 2017

File Reference BP147HS_001.dwg | Project BP147HS

Source of Information:
 Soil boundaries:
 Projection: GDA94 MGA Zone 50 East

NOTE:
 All areas and dimensions are subject to survey. Detailed design may vary slightly without notice.



emerge ASSOCIATES

Michael Glendinning Property

FIGURE 6 - Vegetation Communities
 147 Hardey Road, Serpentine, 6125

Scale 1:3000 @ A4 | Date July 2017

File Reference BP4747HS_001.dwg | Project BP4747HS

Source of Information:
 Site boundaries: Lantana, Illawarra
 Projection: GDA94 MGA Zone 55 South

NOTE:
 Areas and descriptions are subject to error, engineering and detailed design and may change without notice.

4.1.5 Fauna

Due to the highly disturbed nature of the vegetation within the site, it is likely that only opportunistic fauna species would utilise the site. Vegetation at the site may provide limited habitat for a variety of fauna species, some of which may be significant such as the three species of Black Cockatoos.

The proposed development of the site is unlikely to result in a significant impact on fauna species as clearing is likely to be minimal with the promotion of vegetation (and associated fauna habitat) retention within private lots. Potential impacts on fauna species will be minimised through the location of the proposed development and management of fauna during implementation and construction of the project. The management of fauna and fauna habitat as part of the proposed future development of the site is further considered in the Environmental Assessment and Justification Report (Emerge 2017b).

4.1.6 Hydrology

The hydrological features of the site are summarised below, and are detailed further within the District Water Management Strategy prepared by Emerge Associates (2017c) and the Land Capability Assessment (Emerge 2017a).

- Soil Moisture

Based on the results of infiltration testing undertaken at the site (Emerge 2017a), the permeability of the soils was found to range from 'Moderate' to 'Very Rapid' based on the classifications provided in *Land Evaluation Standards for Land Resource Mapping* (Van Gool et al. 2005)

Observations made during site testing in November 2016 indicate that site conditions were generally dry, and there was no evidence of wet or waterlogged soil conditions. Pasture grasses had started to yellow off at the time, indicating the dry surface soils and the absence of moisture in the sub-soils. Based on further observations during an additional site inspection in July 2017, site conditions were generally moist, noting that the area had experienced recent high rainfall. The ground was damp, with some areas of shallow standing water, however not significantly soft or wet.

- Acid Sulfate Soils

Acid sulfate soil (ASS) risk mapping prepared by the Department of Environment Regulation (DER 2015) indicates the site has a 'moderate to low risk of ASS occurring within 3 m of the natural soil surface, but a high to moderate risk of ASS occurring beyond 3 m of the natural soil surface.

- Surface Water

The site is located approximately two kilometres south of the Serpentine River within the Serpentine sub-catchment of the broader Peel-Harvey Catchment.

Several surface water features occur within the site, including two farm dams in the west of the site and a minor water course situated just inside the site's eastern boundary. The minor water course flows from the south, through the site and then through the existing rural residential area to the north of the site, and ultimately discharges to the Serpentine River.

Potential impacts on the waterway will be minimised through the accommodation of an appropriate foreshore reserve and management of construction activity in proximity to the waterway. The management of the waterway values as part of the proposed future development of the site is considered further in the Environmental Assessment and Justification Report (Emerge 2017b).

The site is not located within the 100-year ARI floodway or flood fringe of the Serpentine River, or within the floodplain development control area as mapped by DoW.

The conveyance of surface water and stormwater can be managed through the typical water management process (applied through the development planning and approval process) in accordance with the endorsed Better Urban Water Management Framework. Generally, this includes the maintenance of the post-development environment in accordance with the pre-development environment, or as agreed with the local government. This is discussed further in the District Water Management Strategy (Emerge Associates 2017c).

- Public Drinking Water Source Areas

Publicly available Public Drinking Water Source Area (PDWSA) mapping (DoW 2016) indicates that the site is not located within or adjacent to any declared PDWSA.

- Wetlands

The majority of the site is mapped as a multiple use wetland (MUW), with a small area in the western portion of the site mapped as a resource enhancement wetland (REW) (DPaW 2016). Given the general absence of remnant vegetation within the site, and the regional landforms and soils mapping, the extent of this mapped REW is unlikely to be reflective of wetland conditions on the ground.

Multiple Use Wetlands do not require specific conservation or protection measures, and the hydrological characteristics of these wetlands (i.e. groundwater levels and surface water flows) can be suitably addressed through the standard urban water management process.

- Salinity

Regional soil mapping indicates that the soils within the site are generally not susceptible to salinity and no evidence of salinity was encountered during the preliminary site investigations in November 2016 (Emerge 2017a).

- Groundwater

There is currently no available regional groundwater contours covering the site; however, groundwater levels were observed during the site investigations, undertaken as part of the Land Capability Assessment (Emerge 2017a).

The depth to groundwater encountered at the sampling locations ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site. Given that the site investigation was undertaken in November 2016, when groundwater levels are typically at a seasonal high, these levels are expected to be generally representative of annual maximum groundwater levels within the area.

Groundwater can be managed through the typical water management process (applied through the development planning and approval process) in accordance with the endorsed Better Urban Water Management Framework. Generally, this includes the maintenance of the post-development environment in accordance with the pre-development environment. This is discussed further in the District Water Management Strategy (Emerge Associates 2017c).

4.1.7 Heritage

- Indigenous heritage

The Aboriginal Heritage Inquiry System (AHIS) is maintained pursuant to Section 38 of the Aboriginal Heritage Act 1972 by the Department Planning, Lands and Heritage (DoPLH), and contains information on Registered Aboriginal Heritages Sites and Other Heritage Places throughout Western Australia. A search of the AHIS online database (DoPLH 2017) indicates that no Registered Aboriginal Sites or Other Heritage Places occur within the site.

- Non-indigenous heritage

Based on a search of the Shire of Serpentine Jarrahdale Online Mapping Tool, the State Heritage Office online database (Heritage Council 2017) and the Australian Heritage Database (Department of Environment and Energy 2017), there are no registered heritage sites within the site.

4.1.8 Surrounding land uses

The site is generally surrounded by rural and rural residential properties, primarily associated with horse and livestock grazing. An existing freight railway line runs parallel to the western site boundary, approximately 48 m west of the site. This railway line is separated from the site by Hardey Road and vegetation within that road reserve.

In order to determine the acoustic implications of the railway line on the proposed development, a noise impact assessment has been undertaken and the results of this assessment are outlined further in the Environmental Assessment and Justification Report (Emerge 2017b). Noise can be suitably addressed through the provision of building setbacks and/or architectural treatments for future dwellings within impacted lots, where required.

5.0 JUSTIFICATION FOR PROPOSED RE-ZONING FROM RURAL TO RURAL LIVING A

This Amendment seeks to rezone Lots 9 Hardey Road, Serpentine from Rural to Rural Living A under the Shire of Serpentine Jarrahdale Town Planning Scheme No 2 ('the Scheme'). In support of the proposed rezoning the following planning justification is provided.

5.1 Strategic Planning

Whilst the draft South Metropolitan Peel Sub-Region Framework limits the areas identified for Rural Residential development, it supports rural residential zones where they are planned for in a Local Planning Strategy and to effectively 'round off' existing rural residential areas, as is the case for Lot 9 Hardey Road.

This amendment proposes the southward expansion of the Rural Living A zone (RLAs 1, 27 and 29) east of Hardey Road to align with the existing Rural Living A zone to the west of the rail line (RLA 9) consistent with the Shire's 2013 Rural Strategy Review.

While the WAPC has required that the Shire depict the subject land Rural Living A in the final version of its Rural Strategy Review, the proposal for 1 hectare lots is consistent with strategic planning being implemented at the local and state planning level (refer section 3 of this report).

5.2 Established Subdivision Patterns and Surrounding Zones

The Rural Living A zoned land to the north of Lot 9 has been subdivided into predominantly 4,000m² – 4,500m² lots. The estate is known as 'Serpentine Downs' and incorporates open space and drainage corridors on land with very similar characteristics to its neighbour, Lot 9 Hardey Road.

The Rural Living A zoned land to the west of Lot 9 has been subdivided into a mix of 4,000m² – 5,000m² lots adjacent to the railway line and 1 hectare lots to the west. While the land has similar characteristics to Lot 9 (as evidenced by the Land Capability Assessment conducted on the latter), the proposal to develop Lot 9 into 1 hectare lots is based on compliance with other and more recent planning strategies policies (see section 3.4.5 of this report).

As previously noted, the rezoning of Lot 9 to facilitate rural residential lots constitutes a logical rounding off of the surrounding zones. The area suits residents seeking room to move in a rural lifestyle environment, but who do not necessarily want a larger Special Rural style lot with all the associated land maintenance issues. As such the proposal for 1 hectare lots under the Rural Living A zone is considered a more responsible and sustainable proposition than lots of 2 hectares and upwards as would be facilitated by the alternatives of a Rural Living B zoning or the "no change" scenario of the land remaining a single large Rural lot.

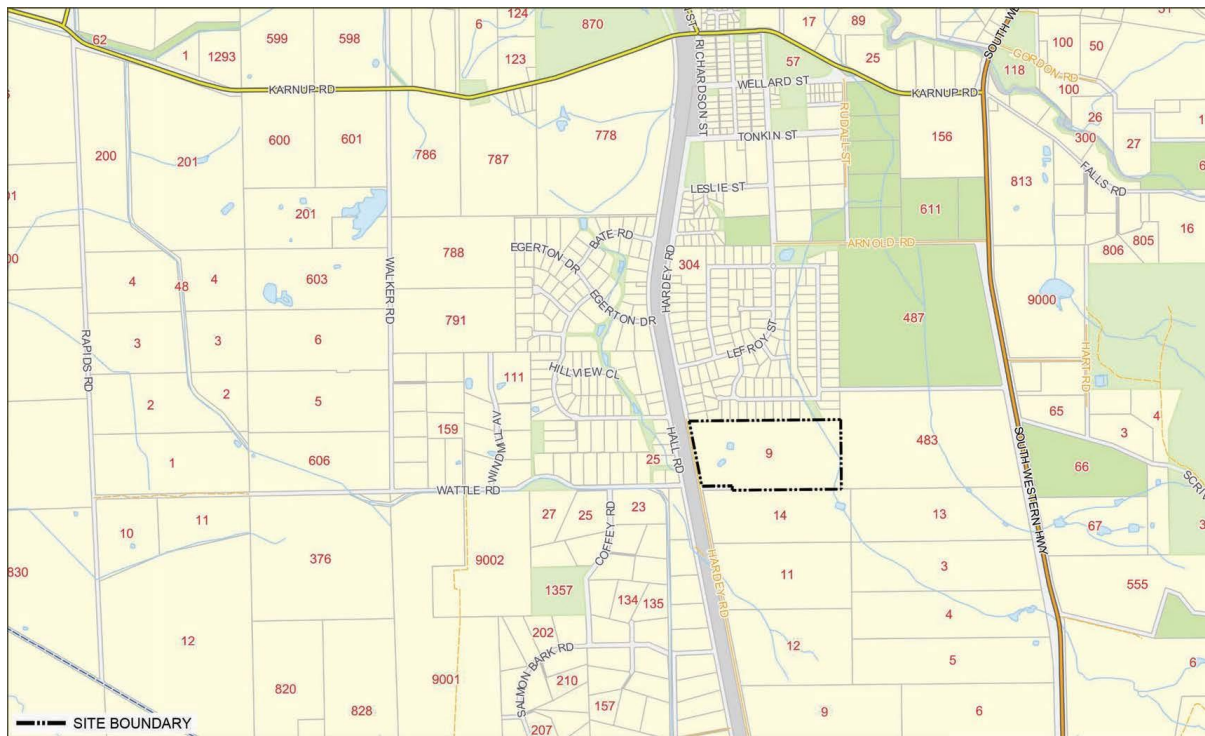


Figure 7 – Established subdivision pattern

5.3 Proximity to Serpentine Townsite and Associated Service Infrastructure

The subject land is located less than 2 kilometres from the Serpentine townsite.

The proximity to the Serpentine townsite with the availability of community facilities and service infrastructure is clearly a major factor in the identification of suitable areas for Rural Living within the Shire. It will maximise the provision, use and efficiency of infrastructure available in and around the Serpentine urban node.

The lots will be serviced with underground power and telecommunication infrastructure. Potable water will be provided through roof catchment and 20,000 litre rainwater tanks.

5.4 Land Capability

As outlined in Section 4.1, a detailed Land Capability Assessment has been conducted and from a geotechnical perspective Lot 9 is capable of supporting lot sizes from 4,000m², similar to the development to the immediate north, Serpentine Downs, however for other reasons as previously indicated the proponents wish to proceed with 1 hectare lots.

The land is highly capable of being developed and subdivided. The soils in this location are no different from the soils of adjacent land that has already been subdivided and developed.

6.0 SUBDIVISION GUIDE PLAN

6.1 Introduction

In accordance with Clause 5.12.8 of the Scheme, a Subdivision Guide Plan has been prepared to demonstrate how the land can be subdivided into lots of 1 hectare upwards.

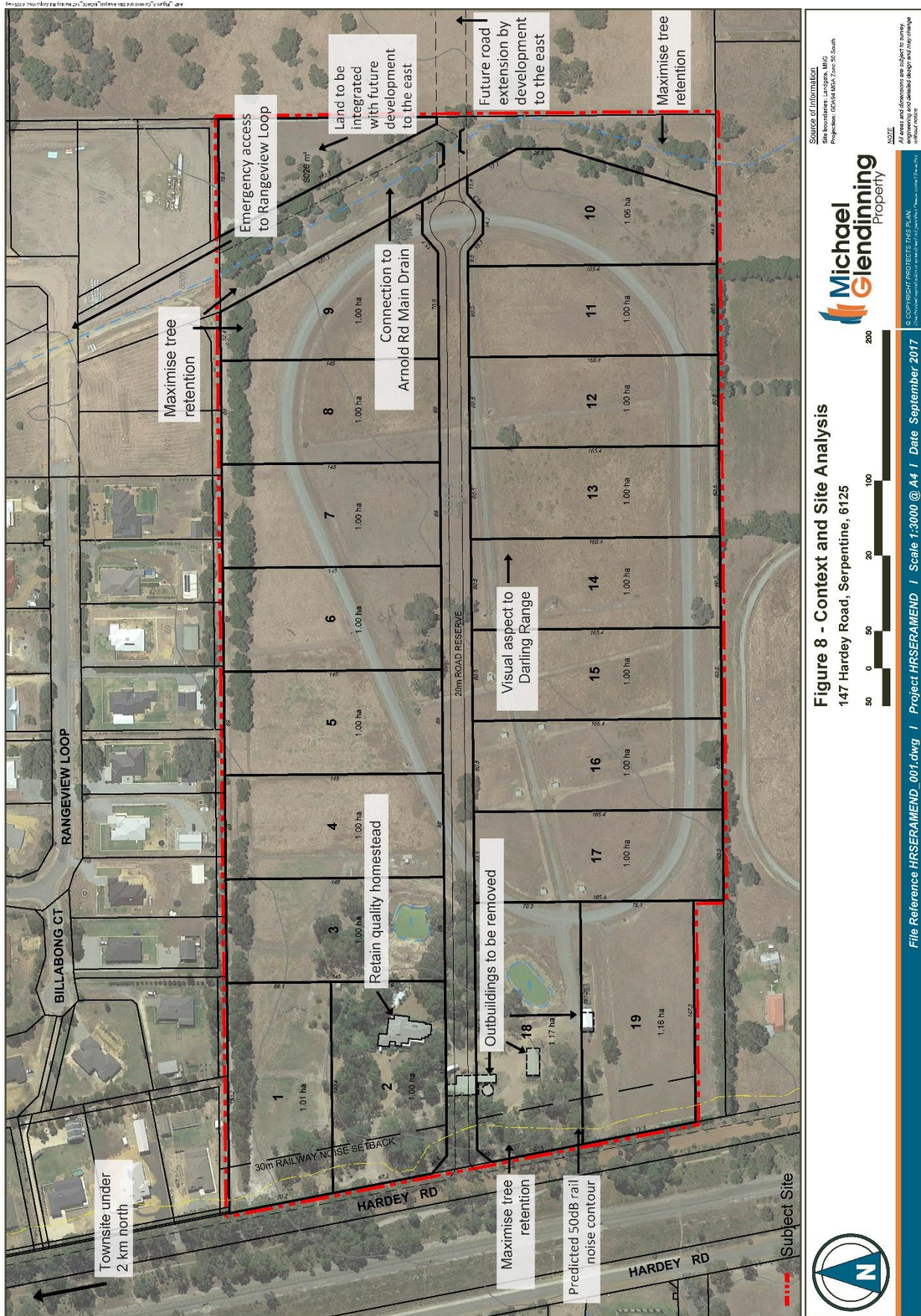
The Subdivision Guide Plan provides an indicative road layout and proposed lot yield which is intended to guide future subdivision and has been designed having regard for the topography, vegetation and drainage.

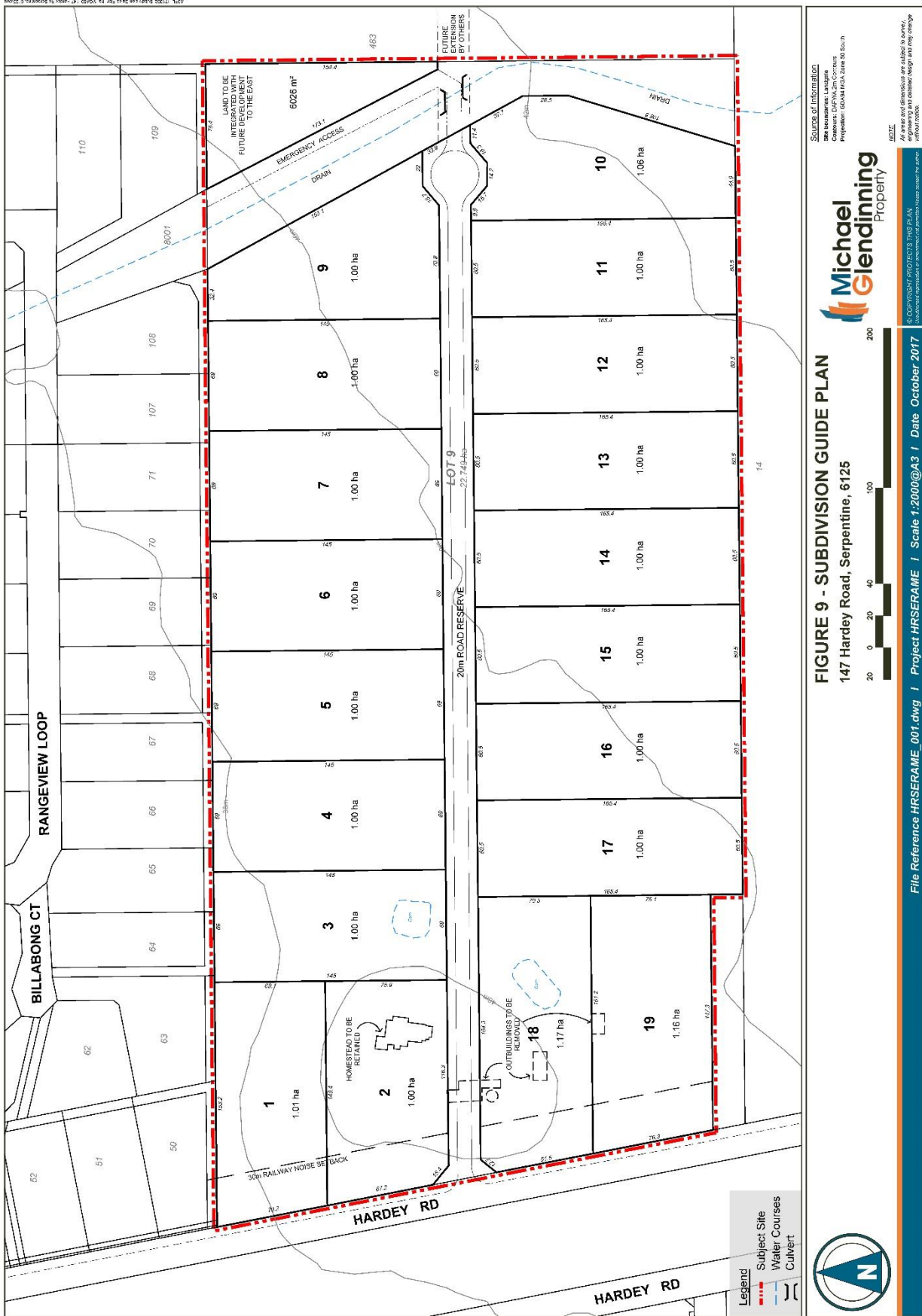
6.2 Context and Site Analysis

A Context and Site analysis is demonstrated on **Figure 8** as a number of elements associated with the proposed Subdivision Guide Plan design have been predetermined (such as the need to accommodate the same drainage line which traverses the eastern end of the land and connects to the Arnold Road Main Drain via the adjoining Serpentine Downs Estate). This approach is consistent with Appendix 1 of Liveable Neighbourhoods which states 'Context and site mapping may be undertaken together or separately'.

The proposed Subdivision Guide Plan, which is included as **Figure 9**, is informed by the Context and Site Analysis and is validated by the various technical appendices to this report. The Plan is designed to:

- Provide for a lot layout, density and form of development already established in Rural Living A estates to the immediate north and near west.
- Optimise lot orientation toward Hardey Road while accommodating the predicted 50dB rail noise contour within a 30m front setback on these lots.
- Retain the existing quality homestead and its vegetated and landscaped curtilage on a lot which respects its frontage and orientation towards Hardey Road.
- Maximises the opportunity for the retention and enjoyment of the limited remnant vegetation across the property, particularly adjacent Hardey Road and in the drainage reserve at the eastern end of the property.
- Provide a sealed and drained road connection to Hardey Road which can be extended to the east should the rural land immediately east be rezoned and developed, together with an emergency access within the proposal drainage reserve to ensure a second egress route is available in case of emergency.
- Optimises eastward views to the Darling Range for future residents.





6.3 Lot Size and Density

The proposed Subdivision Guide Plan will facilitate future subdivision to create 19 rural residential lifestyle lots of approximately 1 hectare in area. As required under the Special Provisions for RLA31 contained within this report, a Structure Plan will be prepared for approval by the Western Australian Planning Commission (WAPC), as will a plan of subdivision.

The position of the drain which traverses the eastern end of the site and the need for a drainage reserve to protect the drain and the adjacent vegetation results in a remnant portion of the parent lot to the north-east of the drain. As that parcel is less than 1 hectare in area it is intended that it remain as a balance title until such time as plans are developed for the land to the immediate east.

The density of 0.83 lots per hectare is typical of this form of development.

6.4 Road Network

Due to the size and desirable proportions of the proposed lots there is no opportunity to take advantage of the unnamed road reserve to the south west of the property and, therefore a single centrally located cul-de-sac (with provision for alternate fire escape along an emergency access within the proposed drainage reserve and possible eastward continuation of the road in time) has been planned.

The internal road reserve shall be a minimum of 20 metres wide to accommodate a standard rural road cross section comprising a 6.0-metre-wide unkerbed pavement with 1.2m shoulders draining into swales as do the roads within the Serpentine Downs RLA estate to the immediate north. A bridle path could also be incorporated into the verge of the 20-metre-wide roads.

Hardey Road adjacent to Lot 9 is currently unsealed. This section will be upgraded to a 7.0-metre-wide asphalted road to match the existing cross-section to the north.

Road and drainage works are required to meet the Shire's requirements. Detailed engineering drawings will require separate written by the Shire of Serpentine Jarrahdale as part of standard subdivision works.

6.5 Drainage and Water Management

As outlined in Section 4.1.6, a District Water Management Strategy (DWMS) has been prepared as supporting documentation to this scheme amendment (refer **Attachment 3**).

The DWMS for Lot 9 Hardey Road has been developed in accordance with Better Urban Water Management (WAPC 2008), State Planning Policy 2.9 Water Resources (WAPC 2006) and Planning Bulletin 92 Urban Water Management (WAPC 2008). Water will be managed using an integrated water cycle management approach, which has been developed using the philosophies and design approaches described in the Stormwater Management Manual for Western Australia (DoW 2007).

The key principles of integrated water cycle management that have guided the water management approach for Lot 9 Hardey Road include:

- Considering all water sources, including wastewater, stormwater and groundwater;
- Integrating water and landuse planning;
- Allocating and using water sustainably and equitably;
- Integrating water use with natural water processes; and
- Adopting a whole of catchment integration of natural resource use and management.

The overall objective for integrated water cycle management for residential developments is to maintain the existing hydrological regime and minimise pollution. The DWMS design objectives seek to deliver best practice outcomes using a Water Sensitive Urban Design (WSUD) approach, including management approaches for:

- Water conservation;
- Groundwater management;
- Flood mitigation; and
- Stormwater quality management.

The DWMS provides a summary of the existing environmental values of the site, which are based on site-specific studies undertaken and review of publicly available data. The characteristics and environmental values of the site and guidance provided by National and State policies and guidelines relevant to urban water management have guided the design criteria and propose a contemporary best practice approach to achieving the design objectives for water management.

The WSUD approach and measures that are proposed for the site include:

- Maintaining existing flow regimes consistent with the pre-development environment;
- Treatment of surface runoff prior to discharge from site;
- Locating properties outside of flood risk areas;
- Adopting appropriate non-structural best management practices;
- Adopting a fit-for-purpose water use approach; and
- Minimising use of both scheme and non-potable water.

The DWMS provides a water management framework on which the subsequent Local Water Management Strategy (LWMS) and/or Urban Water Management Plans (UWMP) will be based on, to support each relevant planning stage.

6.6 Water

The Water Corporation of Western Australia (Water Corporation) is the current water service provider for Serpentine.

An existing DN100 water main exists on the western side of Hardey Road and terminates at the boundary of Lot 9. Extension of this main and the internal reticulation of the development will need to be designed and approved by the Water Corporation.

6.7 Power

Existing Western Power owned and operated electricity distribution assets exist in the area of the proposed development. These assets are supplied from the Western Power Byford Zone Substation.

As the development can potentially be supplied from existing surrounding infrastructure, it is not foreseen that the supply of power is a major constraint. One 315kVA substation is proposed to service the development.

6.8 Telecommunications

The site is currently serviced by existing telecommunications infrastructure owned and operated by Telstra.

NBN advise planning for the Serpentine area is set to commence in late 2017. Due to the number of proposed lots the developer can apply for NBN connection however it may be cost prohibitive due to backhaul charges that may apply.

6.9 Gas

Serpentine town site is not currently serviced with gas. ATCO Gas advise there are no short to medium term plans to provide the area with gas. If gas is required, it will be bottled LPG supplied by the home owner.

6.10 Bushfire Management Plan

The site is identified as a 'Bushfire Prone Area' within the state *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM) (2017). As such, a Bushfire Management Plan (BMP) has been prepared by Emerge Associates and Bushfire Safety Consulting in accordance with the requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.1* (the Guidelines) (WAPC and DFES 2017) to support the proposed scheme amendment (Emerge Associates and Bushfire Safety Consulting 2017 – refer **Attachment 5**).

The BMP outlines the bushfire hazard level assessment that has been undertaken for the site in accordance with Appendix Two of the Guidelines, to identify the existing and likely long-term bushfire hazards within and surrounding the site through the identification of classified vegetation (within 150m). The BMP also provides commentary on how future development can address the bushfire performance criteria outlined in Appendix Four of the Guidelines.

Given the proposed future rural residential development within the site, the areas associated with future building envelopes and Asset Protection Zones (APZs) within lots will be maintained to achieve 'low threat vegetation' and will be excluded in accordance with Section 2.2.3.2 of AS 3959. Classified vegetation outside of APZs and identified outside the site boundary and east of the proposed drainage reserve (within the eastern portion of the site) is assumed to remain in its current state, and will therefore pose a long term bushfire hazard to the site.

While the site will be located within the vicinity of a long term bushfire hazard, the BMP (Emerge Associates and Bushfire Safety Consulting 2017) outlines how the bushfire protection criteria can be addressed as part of future development, and includes:

- The location, siting and design of the future development will be able to ensure that Bushfire Attack Level (BAL) 29 is not exceeded, with lots of an appropriate size to enable the provision of an APZ, and where required increased construction standards for future dwellings;
- An interconnected network of roads and access ways can be accommodated within the future development of the site to facilitate movement of people and emergency appliances to and from the site; and
- Water supply, through the provision of either a reticulated water system or dedicated water tanks strategically located throughout the development, can be provided to support onsite firefighting requirements.

As part of the future planning stages (i.e. subdivision), the BMP can be revised to address the specific proposed development and detail the responsibilities of the developer, future lot owners and local government to ensure SPP 3.7 and the Guidelines are addressed satisfactorily, and bushfire risk is minimised.

6.11 Staging

As there is a single road and only 19 lots to create, it is intended the lots under the Subdivision Guide Plan will be developed and released as one stage.

6.12 Planning Benefits

The Scheme Amendment and Subdivision Guide Plan will have a wide range of planning benefits including:

- Making available underutilised land that is not required for agricultural purposes;
- Catering for new rural lifestyle lots close to Serpentine townsite whilst still maintaining rural amenity;
- Catering for new housing stock in the short term and increasing lot supply adjacent to established rural lifestyle areas;
- Maximising use of existing services and infrastructure;
- Ensuring there are appropriate zoning and landuse controls to guide future subdivision and development;
- Maintaining lot sizes that respect the established rural residential character of the locality; and
- Rounding off existing Rural Living A zonings in the immediate locality.

7.0 SUMMARY AND CONCLUSION

Lot 9 Hardey Road, Serpentine is ideally located and suitable in terms of land capability, of being developed into Rural Living A “lifestyle lots” consistent with the Shire of Serpentine Jarrahdale Draft Local Planning Strategy (2013).

The subject land is situated less than 2 kilometres from the Serpentine townsite and is therefore close to all community facilities normally associated with an existing townsite.

Rural Living A lots cater for purchasers looking for rural lifestyle lots with privacy and space but without the maintenance and potential detriment to ground conditions of active rural living lots. Lot 9 will cater for lifestyle lots in a location close to Serpentine townsite with associated community facilities, infrastructure and services.

Future subdivision will be guided by a Subdivision Guide Plan, and the proposed rezoning will effectively be a rounding off of established Rural Living A subdivisions already developed to the immediate north and due west of Lot 9.

It is therefore requested that the local government and Western Australian Planning Commission support an amendment to Town Planning Scheme No. 2 to rezone the land from Rural to Rural Living A consistent with the Shire’s strategic intentions for the area.

PLANNING AND DEVELOPMENT ACT 2005
SHIRE OF SERPENTINE JARRAHDALE
TOWN PLANNING SCHEME NO. 2
AMENDMENT NO.203

The Serpentine Jarrahdale Shire Council under and by virtue of the power conferred upon it in that behalf by the Planning and Development Act, 2005, hereby amends the above local planning scheme by:

1. Rezoning Lot 9 Hardey Road, Serpentine from 'Rural' to 'Rural Living A' as depicted on the Scheme Amendment map;
2. Amending the Scheme Map by delineating Lot 9 Hardey Road, Serpentine as 'RLA31'.
3. Listing Lot 9 Hardey Road, Serpentine as 'RLA31' in 'APPENDIX 4A – RURAL LIVING A ZONE' with landuse controls and special provisions as follows:

NO.	SPECIFIED AREA OF LOCALITY (a)	SPECIAL PROVISIONS TO REFER TO (b)
RLA 31	Lot 9 Hardey Road, Serpentine	<ol style="list-style-type: none"> 1. Subdivision is to be generally in accordance with a structure plan approved by the Western Australian Planning Commission. 2. Within this Rural Living A zone, the following land uses are permitted, or may be permitted at the discretion of the Council: <ul style="list-style-type: none"> Use Classes permitted (P): * Residential - Single House * Public Recreation * Public Utility Discretionary Uses (AA): * Residential - Ancillary Accommodation * Home Occupation * Home Business <p>All other uses are prohibited.</p> 3. No dwelling shall be approved by the Council unless it is connected to an alternative effluent disposal system as

		<p>approved by the Department of Health with an adequate phosphorus retention capacity, as determined by the Department of Environment Regulation.</p> <ol style="list-style-type: none"> 4. At the time of the building application for each lot, a plan of the site shall be submitted by the applicant to the satisfaction and specification of the Council which shall show site contours, proposed pad levels, approved revegetation areas, existing trees and strands of vegetation, those trees and vegetation to be removed and retained and proposals for tree planting and maintenance. 5. The preparation of a structure plan for the subdivision of land into Rural Living A lot sizes, shall have regard to the objectives set out in this Scheme for the zone or zones affected by it and the requirements of clause 5.9.3. 6. The subdivider is to place a notification on the title of each lot advising potential purchasers that their property may be subject to periodic inundation in storm and flood events. In addition, purchasers are to be advised that direct stormwater connection into the Shire's roadside drainage system is not permitted. 7. The subdivider is to place a notification on the title of each lot advising potential purchasers that their property may be subject to periodic inundation in storm and flood events. 8. All buildings and structures shall be constructed at a minimum setback of 15 metres from the primary street and 7.5m from any other lot boundary.
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The Amendment is complex under the provisions of the Planning and Development (Local Planning Schemes) Regulations 2015 for the following reason:

- the amendment is not consistent with a local planning strategy that has been endorsed by the Western Australian Planning Commission.

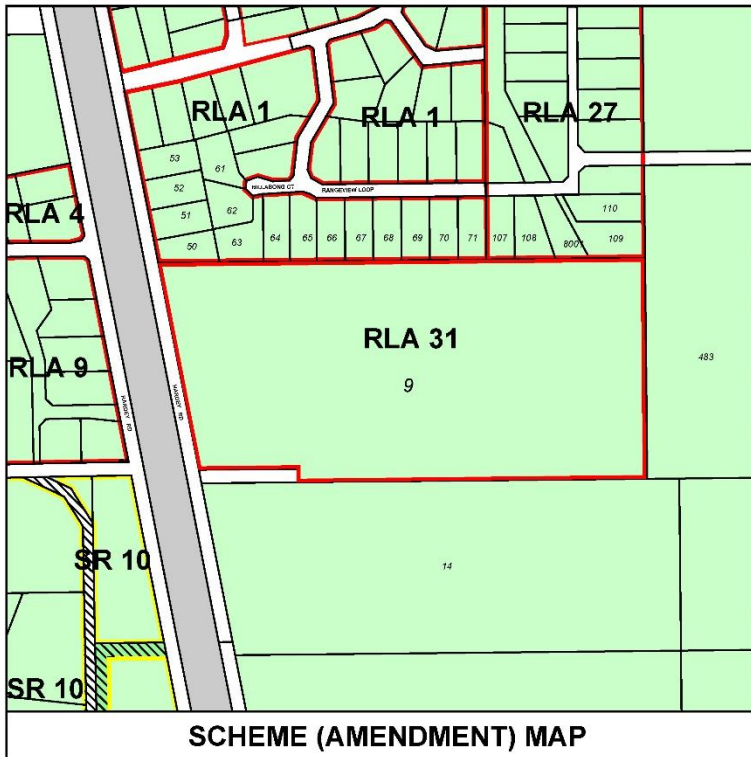
SHIRE OF SERPENTINE JARRAHDAL
TOWN PLANNING SCHEME No. 2

Planning and Development Act 2005



LEGEND

- REGION SCHEME RESERVES (MRS)**
 RAILWAYS
- LOCAL SCHEME RESERVES**
 (see scheme text for additional information)
- DRAINAGE PURPOSES
 LOCAL ROADS
 PUBLIC OPEN SPACE
- LOCAL SCHEME ZONES**
 (see scheme text for additional information)
- RURAL
 RURAL LIVING A
 SPECIAL RURAL



SCALE 1:10 000
DATE: 31.07.2017



ADOPTION

Adopted by resolution of the Council of the Shire of Serpentine Jarrahdale at the Ordinary Meeting held on the _____ day of _____ 20__.

.....

PRESIDENT

.....

CHIEF EXECUTIVE OFFICER

FINAL APPROVAL

Adopted by Resolution of the local government of the Shire of Serpentine Jarrahdale at the meeting held on the _____ day of _____ 20__, and pursuant to that Resolution the Seal of the Municipality was hereunto affixed in the presence of:

.....

PRESIDENT

.....

CHIEF EXECUTIVE OFFICER

RECOMMENDED/SUBMITTED FOR FINAL APPROVAL

.....

DELEGATED UNDER S.16 OF THE
PLANNING AND DEVELOPMENT ACT 2005

Date.....

FINAL APPROVAL GRANTED

.....

MINISTER FOR PLANNING

Date.....

SHIRE OF SERPENTINE JARRAHDALE

TOWN PLANNING SCHEME NO. 2

AMENDMENT NO. 203

Rezoning Lot 9 (No 147) Hardey Road, Serpentine from 'Rural' to 'Rural Living A'

ATTACHMENTS TO SCHEME AMENDMENT REPORT

Attachment 1 Certificate of Title

Attachment 2 Environmental Assessment & Justification Report

Emerge Associates

Attachment 3 District Water Management Strategy

Emerge Associates

Attachment 4 Engineering Services Report

JDSi Consulting Engineers

Attachment 5 Bushfire Management Plan

*Emerge Associates &
Bushfire Safety Consulting*

WESTERN



AUSTRALIA

REGISTER NUMBER 9/P13275	
DUPLICATE EDITION 1	DATE DUPLICATE ISSUED 30/7/2004

RECORD OF CERTIFICATE OF TITLE
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **1577** FOLIO **160**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES



LAND DESCRIPTION:

LOT 9 ON PLAN 13275

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

TREVOR STANLEY MAJOR
VIRGINIA KAY MAJOR
BOTH OF 147 HARDEY ROAD, SERPENTINE
AS JOINT TENANTS

(T I948655) REGISTERED 9 JULY 2004

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

- 1. *M839540 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA REGISTERED 27.11.2014.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 1577-160 (9/P13275).
PREVIOUS TITLE: 1577-156.
PROPERTY STREET ADDRESS: 147 HARDEY RD, SERPENTINE.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING M839540



ORIGINAL - NOT TO BE REMOVED FROM OFFICE OF T

CT 1577 0160 F



Application C09630
Volume 1577 Folio 156

WESTERN AUSTRALIA



1577 160

CERTIFICATE OF TITLE



UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 17th October, 1980

Lumbrough
REGISTRAR OF TITLES



ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of each of Serpentine Agricultural Area Lots 90 and 92 and being Lot 9 on Plan 13275, delineated and coloured green on the map in the Third Schedule hereto.

FIRST SCHEDULE (continued overleaf)

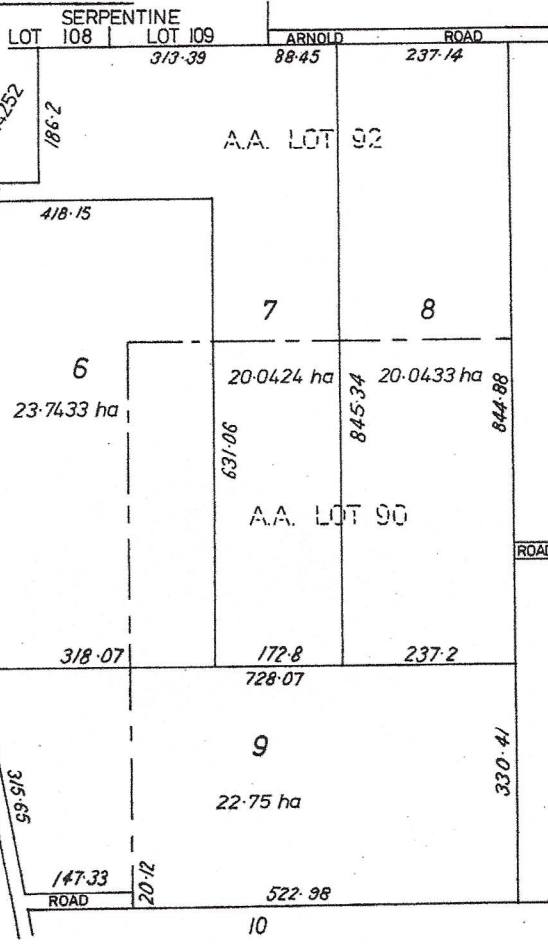
~~Strelley Hubert Peters Hardey of Serpentine, Farmer~~

SECOND SCHEDULE (continued overleaf)

NIL

Lumbrough
REGISTRAR OF TITLES

THIRD SCHEDULE



SCALE 1:7500

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

72009/12/77-45M-S/2860

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

Superseded - Copy for Sketch Only

Page 1 (of 2 pages) 1577 160
VOL. FOL.

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FIRST SCHEDULE (continued)

REGISTERED PROPRIETOR

Tranby Park Pty. Ltd. of "Tranby Park", Serpentine.
 Peter Kingsley Hardey of Serpentine.
 Flag Bay Holdings Pty Ltd of 33 Allday Street, St James.
 Christopher George McGuirk and Leanne Kim McGuirk both of 88 Mooramel Crescent, Dampier, as joint tenants.

INSTRUMENT		REGISTERED	TIME	SEAL	INITIALS
NATURE	NUMBER				
Transfer	C863259	24.9.84	11.36		
Transfer	E072892	12.4.89	10.48		
Transfer	E817431	26.2.92	10.06		
Transfer	G366806	7.1.97	8.51		

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SECOND SCHEDULE (continued)

PARTICULARS

to National Australia Bank Ltd.
 to National Australia Bank Ltd.
 to National Australia Bank Ltd.
 to Commonwealth Savings Bank of Australia.
 to Commonwealth Bank of Australia.

INSTRUMENT		REGISTERED	TIME	SEAL	INITIALS	REGISTERED OR LODGED	NUMBER	CANCELLATION	SEAL	INITIALS
NATURE	NUMBER									
Mortgage	D432234	10.3.87	9.11			REJECTED DEALING Discharged	D900733	Discharged		
Mortgage	D900734	12.10.88	9.41			REJECTED DEALING Discharged	E045924	Discharged		
Mortgage	E045926	12.4.89	10.48			REJECTED DEALING Discharged	E817430	Discharged		
Mortgage	E817432	26.2.92	10.06			REJECTED DEALING Discharged	G366805	Discharged		
Mortgage	G366807	7.1.97	8.51							

CERTIFICATE OF TITLE VOL. 1577 160

Environmental Assessment and Justification Report

Lot 9 Hardey Road, Serpentine

Project No: EP17-071(01)

**Prepared for Serene Environs
October 2017**

Environmental Assessment and Justification Report

Lot 9 Hardey Road, Serpentine



Document Control

Doc name:		Environmental Assessment and Justification Report Lot 9 Hardey Road, Serpentine			
Doc no.:		EP17-071(01)--004c			
Version	Date	Author	Reviewer		
1	August 2017	Vanessa Keating	VMK	Anna Welker	AW
	Issued to client				
A	September 2017	Vanessa Keating	VMK	Anna Welker	AW
	Updated following comment from client.				
B	October 2017	Jessica Lisle	JHL	Anna Welker	AW
	Update following revised plan				
C	October 2017	Jessica Lisle	JHL	Anna Welker	AW
	Updated following client feedback				

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Environmental Assessment and Justification Report

Lot 9 Hardey Road, Serpentine



Executive Summary

Serene Environs (the proponent) is seeking to amend the land use zoning over Lot 9 Hardey Road, Serpentine (herein referred to as 'the site'), to facilitate the future subdivision of the site into Rural Living lots. The site is approximately 22.8 hectares (ha) in size, situated approximately 50 km south-east of the Perth Central Business District (CBD) within the Shire of Serpentine Jarrahdale. It is currently zoned 'Rural' under both the Metropolitan Region Scheme (MRS) and the Shire of Serpentine Jarrahdale's Town Planning Scheme (TPS) No. 2. The proposed TPS amendment seeks to rezone the site from 'Rural' to 'Rural Living A,' consistent with the Shire's *Draft Rural Strategy Review* (2013).

Emerge Associates were engaged by Serene Environs to provide a suite of environmental consultancy services to inform and support the initiation of the proposed scheme amendment, by assessing the potential environmental impacts that could arise from future rural residential development. The findings of the environmental assessment can be summarised as follows:

- The site has been identified as an area suitable for 'Rural Living A' development under the Shire's Draft Rural Strategy Review (SSJ 2013) due to its proximity to the Serpentine town site and its contiguous southward extension of the 'Rural Living A' zone east of Hardey Road.
- The site has been classified as having a 'moderate to low' risk of ASS occurring within 3 m of the natural soil surface. ASS is only likely to require management where deep services extend below the permanent groundwater table and can be managed through the standard subdivision process (in accordance with the relevant DER guidelines).
- The site is not proposed to be connected to a reticulated sewer network; instead each lot will have an onsite effluent treatment and disposal system fully contained within the lot. A Land Capability Assessment has been undertaken by Emerge Associates (2017b) which confirms the suitability of the site for onsite effluent treatment and disposal.
- The site has largely been cleared of native vegetation and consists predominantly of Parkland Cleared areas with planted native and exotic species and sparse remnant native species dotted throughout. No vegetation within the site has been identified as significant (i.e. TEC or Threatened flora) or of regional or local significance. Existing vegetation within the site may provide amenity value for the future rural residential development. As part of the future local subdivision processes it is expected that existing vegetation will be retained wherever possible within private lots, public open space and road reserves.
- Due to the highly disturbed nature of the vegetation within the site, it is likely that only opportunistic fauna species would utilise the site. Vegetation at the site may provide limited habitat for a variety of fauna species, some of which may be significant such as the three species of Black Cockatoos. However, these are likely to be occasional visitors and not rely on the habitat for survival. Further investigation into fauna habitat values may be required to support the future subdivision of the site. This can be suitably addressed through the subdivision approval and clearance process. As part of the future local subdivision processes it is expected that existing vegetation will be retained wherever possible within private lots, public open space and road reserves.
- Based on the advice in the *Protocol for proposing modifications to the Geomorphic Wetlands Swan Coastal Plain dataset* (DEC 2007) and the lack of remnant vegetation, regional landform

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and soil mapping relating to the mapped REW within the site, it is considered that the area mapped as REW is not reflective of wetland conditions and a re-classification is appropriate (if required to facilitate development).

- The current hydrological functions of the site will be maintained through the application of the Better Urban Water Management Framework (implemented through the standard planning process).
- Based on a consideration of similar developments and road transport corridors, noise impacts from the freight railway line west of the site is expected to be suitably addressed through the provision of setbacks within lots or acoustic architectural treatments for future dwellings within impacted lots. This can be suitably addressed through the subdivision approval and clearance process.
- The site has been identified as a bushfire prone area under the Map of Bush Fire Prone Areas (OBRM 2017). A bushfire hazard level assessment has been undertaken as part of the BMP (Emerge Associates and Bushfire Safety Consulting 2017) and further detailed bushfire risk assessment will be required to support subdivision or development stages in order to address the performance criteria outlined in Appendix Four of the Guidelines (WAPC and DFES 2017).

Overall limited environmental values were identified within the site, and the proposed scheme amendment is considered unlikely to result in development that would significantly impact environmental attributes or values, or nearby land uses. Furthermore, the limited environmental attributes and values that were observed at the site can be appropriately accommodated through the future planning process, specifically through subdivision. As such, there are no significant environmental issues or constraints within the site to the extent that it would preclude the site from being rezoned to 'Rural Living A' under the Shire of Serpentine Jarrahdale TPS No. 2.

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Appendix A

Flora and Vegetation Database Search Results

Appendix B

Land Capability Assessment (Emerge Associates 2017b)

Appendix C

Transportation Noise Assessment
(Lloyd George Acoustics 2017)

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List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
ACM	Asbestos containing material
AHD	Australian Height Datum
APZ	Asset Protection Zone
AS	Australian Standard
BCA	Building Code of Australia
BMP	Bushfire Management Plan
ESA	Environmentally sensitive area
MUW	Multiple use wetland
PDWSA	Public Drinking Water Source Area
PEC	Priority ecological community
TEC	Threatened ecological community
UFI	Unique feature identifier

Table A2: Abbreviations – units of measurement

Units of measurement	
ha	Hectare
m	Metre
m ²	square metre
mAHD	Metres in relation to the Australian Height Datum

Table A3: Abbreviations – Organisations

Organisations	
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
DFES	Department of Fire and Emergency Services
DoP	Department of Planning (now DPLH)
DoW	Department of Water (now DWER)
DPaW	Department of Parks and Wildlife (now DBCA)
DoPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation

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Organisations

EPA	Environmental Protection Authority
OBRM	Office of Bushfire Risk Management
WALGA	Western Australia Local Government Association
WAPC	Western Australian Planning Commission

Table A4: Abbreviations – Legislation

Legislation

<i>BAM Act</i>	<i>Biosecurity and Agriculture Management Act 2007</i>
EP Act	Environmental Protection Act 1986
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
WC Act	Wildlife Conservation Act 1950

Table A5: Abbreviations – Planning terms

Planning terms

AS 3959	Australian Standard 3959-2009 Construction of buildings in bushfire prone areas
MRS	Metropolitan region scheme
POS	Public Open Space
TPS	Town planning scheme

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1 Introduction

1.1 Background

Serene Environs (the proponent) is seeking to amend the land use zoning over Lot 9 Hardey Road, Serpentine (herein referred to as 'the site'), to facilitate the future subdivision of the site into Rural Living lots. The location of the site is shown in **Figure 1**.

The site is approximately 22.8 hectares (ha) in size, situated approximately 50 km south-east of the Perth Central Business District (CBD) within the Shire of Serpentine Jarrahdale. It is currently zoned 'Rural' under both the Metropolitan Region Scheme (MRS) and the Shire of Serpentine Jarrahdale's Town Planning Scheme (TPS) No. 2. The proposed TPS amendment seeks to rezone the site from 'Rural' to 'Rural Living A,' consistent with the Shire's *Draft Rural Strategy Review (2013)*.

1.2 Scope of work

Emerge Associates were engaged by Serene Environs to provide a suite of environmental consultancy services to support the initiation of the proposed scheme amendment. This included site specific investigations and the preparation of the following documents:

- Environmental Assessment and Justification Report (this report)
- District Water Management Strategy (Emerge Associates 2017a)
- Land Capability Assessment (Emerge Associates 2017b)
- Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2017)
- Transportation Noise Assessment (Lloyd George Acoustics 2017)

In order to inform the preparation of this Environmental Assessment Justification Report (EAJR), Emerge Associates conducted a number of site inspections as well as a comprehensive desktop review of all available information relating to environmental features both within and adjacent to the site, including:

- Landforms, topography and soils.
- Flora and vegetation.
- Fauna.
- Groundwater, wetlands and waterways.
- Historical and existing land uses.
- Indigenous and non-indigenous heritage.
- Bushfire hazards.

1.3 Purpose of this report

This report provides a synthesis of information regarding the environmental values and attributes of the site, obtained from a range of sources including local and regional reports, databases, mapping and site specific investigations undertaken by Emerge Associates and a broader multidisciplinary project team.

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The information presented in this report is intended to inform and support the initiation of the proposed scheme amendment, by assessing the potential environmental impacts that could arise from the proposed rural residential development. It includes consideration of the relevant state and local legislation and policy, as well as the environmental factors and objectives outlined by the Environmental Protection Authority (EPA) in their suite of Environmental Factor Guidelines (EPA 2016).

This report also outlines the future environmental management requirements that can be addressed as part of future stages of planning in order to avoid and manage anticipated environmental impacts.

2 Description of Existing Environment

2.1 Local context

The site is currently used for horse agistment purposes and contains a residential dwelling and associated outbuildings. The site is largely composed of cleared paddocks with a number of mature trees around the dwelling and lot boundary. The site is bound by surrounding rural and rural residential land uses to the north, east and south and by Hardey Road and a freight railway line to the west, as shown in **Figure 1**.

2.2 Climate

The climate of the site (which applies to the wider Perth metropolitan region) is described as Mediterranean, with hot, dry summers and moderately wet, mild winters. The majority of rainfall occurs between May and October each year, and on average is between 600 to 1000 millimetres annually. However, in the last 40 years there has been a marked decrease in rainfall, with a noticeable shift to a drier climate across the south-west of Western Australia (CSIRO 2009).

The closest weather station to the site which records rainfall and temperature data is located in Karnet (Bureau of Meteorology (BoM) station number 9111), situated approximately 11 km east of the site. Based on weather data collected from 1963 to 2017 at this weather station, the local area experiences an average of 1159.3 mm of annual rainfall, a mean annual maximum temperature of 22.5°C and a mean annual minimum temperature of 10.6°C (BoM 2017).

2.3 Topography, landform and soils

2.3.1 Topography

The site is generally gently sloping with a north-westerly aspect, with existing ground levels ranging from 43 meters Australian Height Datum (m AHD) in the south-eastern portion of the site, to 38 m AHD in the north-western portion of the site (DoW 2008). Topographic contours over the site are shown in **Figure 1**.

2.3.2 Landforms and soils

Regional landform mapping identifies the site as being situated on three broadly defined soil-landform 'land units'. These land units include:

- **Pinjarra P1a Phase** which was broadly described as 'flat to very gently undulating plain. Imperfect to poorly drained and generally not susceptible to salinity'.
- **Pinjarra B1 Phase** which was broadly described as 'extremely low to very low relief dunes, undulating sandplain and discrete sand rises'.
- **Forrestfield F2b Phase** which was broadly described as 'well drained low slopes and foot slopes up to 5-10%'.

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The Pinjarra P1a Phase land unit occurs across the majority of the site, with Pinjarra B1 Phase occurring in the western portion of the site, and the Forrestfield F2b Phase only occurring in the north-eastern corner of the site.

2.3.3 Surface soils and geology

Regional soil mapping indicates that three soil units occur within the site, as shown in **Figure 2**. These include:

- **Sandy Clay (Cs)** which is described as 'white grey to brown, fine to course, sub-angular to rounded, clay of moderate plasticity; gravel and silt layers near scarp, of alluvial origin'.
- **Sand (S8)** which is described as 'white to pale grey at surface, yellow at depth, fine to medium grained, moderately sorted sub-angular to sub-rounded, minor heavy minerals, or eolian origin'.
- **Sand (S10)** which is described as 'S8 over sandy clay to clayey sand of the Guildford formation'.

The Cs soil unit is identified as occurring across the majority of the site, with a lesser extent of the S8 soil unit, and a very small (almost negligible) extent of the S10 soil unit.

A number of soil samples were taken at the site as part of the Land Capability Assessment (Emerge Associates 2017b) which indicate that soils within the site generally consist of Silty Sand to Clayey Silty Sand over Sandy Clay/Sandy Gravelly Clay. This is outlined further in the Land Capability Assessment.

2.3.4 Land capability

The site is not proposed to be connected to a reticulated sewer network; instead each lot will have an onsite effluent treatment and disposal system fully contained within the lot. A Land Capability Assessment was undertaken by Emerge Associates (2017b) (**Appendix B**) based on the original concept design of the site (i.e. including rural residential lots of approximately 4,000m²).

The LCA was prepared to outline how, based on the specific environmental characteristics of the site and detailed calculations of nutrient loading and discharge areas, the smaller lots could adequately support the use of onsite effluent disposal systems without negatively impacting on the environment. The LCA demonstrated that for 4,000 m² lots this approach could satisfy the draft Country Sewerage Policy (DoH 2003) and can meet the intent of the draft Government Sewerage Policy (Department of Planning 2016).

Since the preparation of the LCA, the proposed development concept for the site has been revised to increase the size of the rural-residential lots to a minimum of 1 ha, while still proposing an onsite effluent treatment and disposal system. While the justification for small lots within the LCA is no longer relevant, the assessment of the environmental characteristics of the site and their ability to support the use of onsite effluent treatment and disposal systems is still considered relevant for the revised concept.

The LCA demonstrates that the site has the capacity for onsite effluent treatment and disposal, and in addition, the revised concept now also meets the minimum 1 ha lots size mandated under the draft Government Sewerage Policy.

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2.3.5 Acid sulfate soils

Acid sulfate soil (ASS) risk mapping prepared by the Department of Water and Environment Regulation (2017) indicates that within the site there is a 'moderate to low risk of ASS occurring within 3 m of the natural soil surface, but a high to moderate risk of ASS occurring beyond 3 m of the natural soil surface. The management of ASS as part of the future development within the site is discussed further in **Section 5**.

2.4 Biodiversity and natural assets

2.4.1 Flora and vegetation

Based on a review of historic aerial photography, the site has been largely cleared of vegetation to support pastoral land uses, primarily horse agistment. A preliminary site inspection was undertaken by Emerge Associates in July 2017 which confirmed that the vegetation across the site is in a highly degraded condition and consists predominantly of Parkland Cleared areas with planted native and exotic species and sparse remnant native species dotted throughout.

Regional vegetation complex mapping undertaken by Beard et al. (2013) indicates that one vegetation association would have historically occurred across the site. This vegetation association is Pinjarra 968 which is broadly described as 'Jarrah, Marri and wandoo *Eucalyptus marginata*, *Corymbia calophylla*, *E. wandoo*'. Given the current condition of the site, vegetation within the site is unlikely to be representative of this association.

Based on a preliminary site inspection by Emerge Associates, three vegetation communities were identified in the site, as shown in **Figure 3**, which includes three areas of Parkland Cleared, characterised by slightly varying species or structure, including:

- Parkland cleared open woodland of *Corymbia calophylla* with occasional *Kingia australis* over weed dominated understorey. This very small patch (<0.1ha) of vegetation was observed to be in completely degraded condition and is likely to be a remnant of what would have originally represented *Floristic Community Type 3a - Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain*, a listed Threatened Ecological Community (TEC) pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This patch is now considered highly disturbed, and lacks the natural attributes and vegetation structure that would constitute this community, as shown in **Plate 1**.
- Parkland cleared area with scattered remnant *Corymbia calophylla*, *Banksia grandis*, *Banksia* sp. and *Xylomelum occidentale*, and planted exotic tree species over weed dominated understorey or bare ground, as shown in **Plate 2**.
- Planted native and exotic *Eucalyptus* spp. and scattered remnant *Corymbia calophylla* trees over weed dominated understorey and pasture grass, as shown in **Plate 3** and **Plate 4**.

As shown in **Figure 3**, the majority of vegetation occurs within the western portion of the site, surrounding the existing residence and farm sheds/outbuildings, and in the east of the site associated with the watercourse in this area. Planted shelterbelt vegetation also occurs in various locations around the perimeter of the site.

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Plate 1: Small patch of Parkland Cleared vegetation in the west of the site, consisting of *Corymbia calophylla* with occasional *Kingia australis* over weed dominated understorey



Plate 2: Parkland Cleared vegetation in the west of the site, consisting of scattered remnant *Corymbia calophylla*, *Banksia grandis*, *Banksia* sp. and *Xylomelum occidentale*, and planted exotic tree species over weed dominated understorey or bare ground

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Plate 3: Parkland Cleared vegetation across the majority of the site consists of planted native and exotic *Eucalyptus spp.* and scattered remnant *Corymbia calophylla* trees over weed dominated understorey and pasture grass



Plate 4: Planted rows of *Eucalyptus spp.* within the eastern portion of the site, adjacent to the Arnold Road Main Drain.

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2.4.1.1 Significant flora

Specific species of flora can acquire 'Threatened' or 'Priority' conservation status where populations are restricted geographically or threatened by local processes. On a state level, the Department of Biodiversity, Conservation and Attractions (DBCA) (previously the Department of Parks and Wildlife) recognises these threats and subsequently enforces regulations under the *Wildlife Conservation Act 1950* (WC Act) to conserve Threatened flora species and protect significant populations.

At a federal level, the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) promotes the conservation of biodiversity by providing statutory protection for Matters of National Environmental Significance (MNES) including flora at a species level. Section 178 and 179 of the EPBC Act provides for the lists and categories of Threatened species under the Act.

A search was conducted of DBCA's NatureMap database of Threatened and Priority flora species and MNES Search Tool to identify if any flora species of conservation significance are known to occur in the wider local area (within 5km of the site). The results of the search have been provided in **Appendix A**.

Given the heavily degraded nature of the site, it is considered highly unlikely that any flora species of conservation significance would be found within the site. In addition, no flora species of conservation significance were observed during the site visit in July 2017.

2.4.1.2 Threatened and Priority Ecological Communities

In Western Australia, Threatened Ecological Communities (TECs) are defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. TECs are recognised as specific ecological communities that are rare or under threat. TECs are not afforded direct statutory protection at a State level but their significance is acknowledged through other state environmental approval processes (i.e. environmental impact assessment pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act)). Under the state process DBCA has been identifying and listing TECs since 1994, using a range of definitions to indicate the level of threat to the TEC in question. In addition to listing as a TEC, a community may be listed as a 'Priority Ecological Community' (PEC). This is an ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined.

In addition to the state approval process, a number of TECs are also protected under the EPBC Act. Based on a search of the Protected Matters Search Tool database (see **Appendix A**), four TECs are known to occur within 5 km of the site, including:

- Banksia Woodlands of the Swan Coastal Plain ecological community.
- Clay Pans of the Swan Coastal Plain.
- *Corymbia calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain.
- *Corymbia calophylla* – *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain.

As outlined previously, the site largely comprised Parkland Cleared areas with planted native and exotic species and sparse remnant native species dotted throughout, and therefore no TECs or PECs are likely to occur within the site.

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A very small patch of vegetation (<0.1ha), which is in completely degraded condition, would have originally represented *Floristic Community Type 3a - Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain*, a listed TEC pursuant to the EPBC Act (as outlined above). However, this patch is highly disturbed, and now lacks the natural attributes and vegetation structure that would constitute this community.

2.4.2 Bush Forever and conservation reserves

The Government of Western Australia's *Bush Forever Policy* is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of Bush Forever is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10% of each vegetation complex for protection (Government of WA 2000a). Bush Forever sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

There are no Bush Forever sites or other conservation reserves within or in close proximity to the site.

2.4.3 Ecological linkages

Ecological linkages allow the movement of fauna, flora and genetic material between areas of fragmented remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners, food sources, refuge from disturbances (i.e. fire) and assists in maintaining the genetic diversity of plant communities and populations. Ecological linkages are often continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

Ecological linkages have been identified by the state government in Bush Forever (Government of WA 2000b), Perth's Greenways (1998) and the System 6 study. These identified linkages reflect the on-ground linkages throughout the Perth Metropolitan area and are published by the Perth Biodiversity Project.

Mapping by the Perth Biodiversity Project identifies a Regional Ecological Linkage (Link ID #90) within the western portion of the site, generally associated with remnant vegetation within the railway reserve outside of the site and scattered vegetation within rural lots in the local area. Vegetation in this portion of the site is in a highly degraded condition, and consists of Parkland Cleared areas with planted native and exotic species and sparse remnant native species dotted throughout.

The connectivity of this linkage will be maintained through the long term retention of vegetation within the Hardey Road and railway reserves west of the site, and where retention is possible within private lots within the site. The integrity of the connection is not dependent on the limited vegetation within the site and no further consideration is required.

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2.4.4 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Within an ESA, exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply and the presence of an ESA would indicate that the site is likely to support significant environmental values. Exemptions under Schedule 6 of the EP Act still apply in ESAs, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption).

No ESAs are declared within the site. A declared ESA occurs approximately 100 m west of the site, generally associated with wetland values in this area.

2.4.5 Terrestrial fauna

The conservation status of fauna species in Western Australia is assessed under the state administered *Wildlife Conservation Act 1950* (WC Act). The WC Act utilises a set of schedules and DBCA also produces a list of priority fauna species which while not considered threatened under the WC Act, there is some concern over their long-term survival. As well as those species protected under the WC Act, the Federal government also maintains a list of protected species under the EPBC Act.

Fauna habitat values at the site have been severely compromised by the clearing of native vegetation within the site and ongoing livestock grazing. Vegetation within the site lacks any natural attributes or structure and is likely only utilised fauna species with non-specific requirements which would allow them to persist in highly disturbed habitats.

Opportunistic fauna species, such as the three species of Black Cockatoos may utilise the site; however, these are only likely to be occasional visitors and are unlikely to rely on the habitat for survival.

The future management of fauna and fauna habitat is discussed further in **Section 5**.

2.5 Hydrology

2.5.1 Groundwater

The site is within the Serpentine Groundwater Area and the Serpentine 3 Groundwater Sub-area. Information on the regional groundwater resources obtained from the Department of Water (DoW) Water Register (DoW 2017) indicates that the site is underlain by a multi-layered aquifer system comprised of the following resources:

- Perth - Superficial Swan (unconfined).
- Perth – Cattamarra Coal Measures (confined).
- Perth - Leederville (confined).

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There are currently no available regional groundwater contours covering the site; however, groundwater levels were observed during the site investigations, undertaken as part of the Land Capability Assessment (Emerge Associates 2017b). The depth to groundwater encountered at the sampling locations ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site. Given that the site investigation was undertaken in November 2016, when groundwater levels are typically at a seasonal high, these levels are expected to be generally representative of annual maximum groundwater levels within the area.

2.5.2 Surface water

The site is located approximately two kilometres south of the Serpentine River within the Serpentine sub-catchment of the broader Peel-Harvey Catchment. Several surface water features occur within the site, including two farm dams in the west of the site and the artificial Arnold Road Main Drain situated just inside the site's eastern boundary.

2.5.2.1 Arnold Road Main Drain

The artificial drain flows from the south, through the site and then through the existing rural residential area to the north of the site, and ultimately discharges to the Serpentine River. Based on a review of historic aerial imagery, the majority of vegetation in proximity to the drain line was removed prior to 1965, with vegetation generally consisting of mature trees over pasture grass (see **Plate 5** and **Plate 6**). Evidence of planting appears in aerial photography from 2003, as shown in **Plate 7** and **Plate 8**. Vegetation remaining today consists of predominantly planted native and exotic **Eucalyptus* spp. and scattered remnant *Corymbia calophylla* trees over weed dominated understorey and pasture grass, as discussed in **Section 2.4.1**.

Based on regional wetland mapping (DBCA 2017), there are no wetland values associated with the drain, which forms part of a network of agricultural drains in the area, discharging to the Serpentine River approximately 2 km north of the site. Regional soil mapping outlined in **Section 2.3** also indicated no change in soils in proximity to the drain line, with no change in topography other than a single, narrow incised channel. The channel appears to naturally meander in the southern portion of the site, before curving north-west and running in a straight line through the remainder of the site.

The future management of the foreshore area associated with the drain is discussed further in **Section 5**.

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Plate 5: Aerial imagery from 1965, shows limited remnant vegetation in the east of the site (site boundary shown in red)



Plate 6: Aerial imagery from 1995, shows limited remnant vegetation in the east of the site (site boundary shown in red)

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Plate 7: Aerial imagery from 2003, shows evidence of planting in the vicinity of the drain, in the east of the site (site boundary shown in red)



Plate 8: Aerial imagery from 2006, shows established planting in the vicinity of the drain, in the east of the site (site boundary shown in red)

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2.5.3 Wetlands

The majority of the site is mapped as a multiple use wetland (MUW) (UFI 16021), with a small area in the western portion of the site mapped as a resource enhancement wetland (REW) (UFI 15364) (DBCA 2017) (**Figure 4**). Based on the findings of this report including the general absence of remnant vegetation within the REW, and the regional landforms and soils mapping, and the advice in the *Protocol for proposing modifications to the Geomorphic Wetlands Swan Coastal Plain dataset* (DEC 2007), the extent of this mapped REW is not reflective of wetland conditions on the ground. This is discussed further in **Section 5**.

Multiple Use Wetlands do not require specific conservation or protection measures, and the hydrological characteristics of these wetlands (i.e. groundwater levels and surface water flows) can be suitably addressed through the standard urban water management process.

2.5.4 Public Drinking Water Source Areas

Publicly available Public Drinking Water Source Area (PDWSA) mapping (DoW 2017) indicates that the site is not located within or adjacent to any declared PDWSA.

2.6 Heritage

2.6.1 Indigenous heritage

The Aboriginal Heritage Inquiry System (AHIS) is maintained pursuant to Section 38 of the Aboriginal Heritage Act 1972 by the Department Planning, Lands and Heritage (DoPLH), and contains information on Registered Aboriginal Heritages Sites and Other Heritage Places throughout Western Australia. A search of the AHIS online database (DoPLH 2017) indicates that no Registered Aboriginal Sites or Other Heritage Places occur within the site.

2.6.2 Non-Indigenous heritage

Based on a search of the Shire of Serpentine Jarrahdale Online Mapping Tool, the State Heritage Office online database (Heritage Council 2017) and the Australian Heritage Database (Department of Environment and Energy 2017), there are no registered heritage sites within the site.

2.7 Land use considerations

2.7.1 Historic and existing land uses, and potential contamination

The majority of the site has been historically cleared of native vegetation to support pastoral and rural-residential land uses. Currently the site supports a single dwelling with miscellaneous sheds/outbuildings, and extensive horse paddocks and exercise areas.

Based on available information, it is unlikely that historic uses within the site would have resulted in potential contamination. Any potential contamination within the site is likely to be minor in nature and associated with sheds/structures with potential asbestos containing materials (ACM), or by unauthorised dumping of waste within the site. No ACM was observed in the site during the site visit undertaken by Emerge Associates personnel in July 2017.

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2.7.2 Surrounding land uses

The site is generally surrounded by rural and rural residential properties, primarily associated with horse and livestock grazing. An existing freight railway line runs parallel to the western site boundary, approximately 50 m west of the site. This railway line is separated from the site by Hardey Road and vegetation within that road reserve.

A noise impact assessment has been undertaken to determine the acoustic implications of the railway on the proposed development (Lloyd George Acoustics 2017) (**Appendix C**). The acoustic assessment confirmed that, given the nature of the development (i.e. 1ha rural residential lots), noise is expected to be suitably addressed where required through the provision of lot setbacks for built form within impacted lots.

2.8 Bushfire hazards

The site has been identified as a bushfire prone area under the *Map of Bush Fire Prone Areas* (OBRM 2017), as shown in **Plate 9**. The identification of bushfire prone areas within any portion of the site requires further assessment of the bushfire hazard implications on development in accordance with the *Guidelines for Planning in Bushfire Prone Areas Version 1.2* (the Guidelines) (WAPC and DFES 2017). This has been addressed through the preparation of a *Bushfire Management Plan* (Emerge Associates and Bushfire Safety Consulting 2017), in accordance with the requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015b) and Appendix Two of the Guidelines, as they relate to proposed scheme amendments in bushfire prone areas.

All areas within the site and surrounding 100 m have been assessed for the presence of bushfire prone vegetation and have been classified as per Table 2.4.3 of *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009) to determine the associated bushfire hazard rating levels.

Given the proposed future rural residential development within the site in the assumed post development scenario, the areas associated with future building envelopes and Asset Protection Zones (APZs) within lots will be maintained to achieve 'low threat vegetation' and will be excluded in accordance with Section 2.2.3.2 of AS 3959. Classified vegetation (including Grassland (Class G) and Woodland (Class B)) outside of APZs and identified outside the site boundary and east of the proposed drainage reserve (within the eastern portion of the site) is assumed to remain in its current state, and will therefore pose a long term bushfire hazard to the site. These classified vegetation types are identified as 'moderate' and 'extreme' bushfire hazards respectively.

The long term bushfire hazard features impacting on the site are associated with existing rural landholdings surrounding the site and the proposed rural residential land use. The bushfire hazard assessment is outlined in detail within the Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2017). While the site will be located within the vicinity of 'moderate' and 'extreme' bushfire hazards, the BMP outlines how the bushfire protection criteria can be addressed as part of future development.

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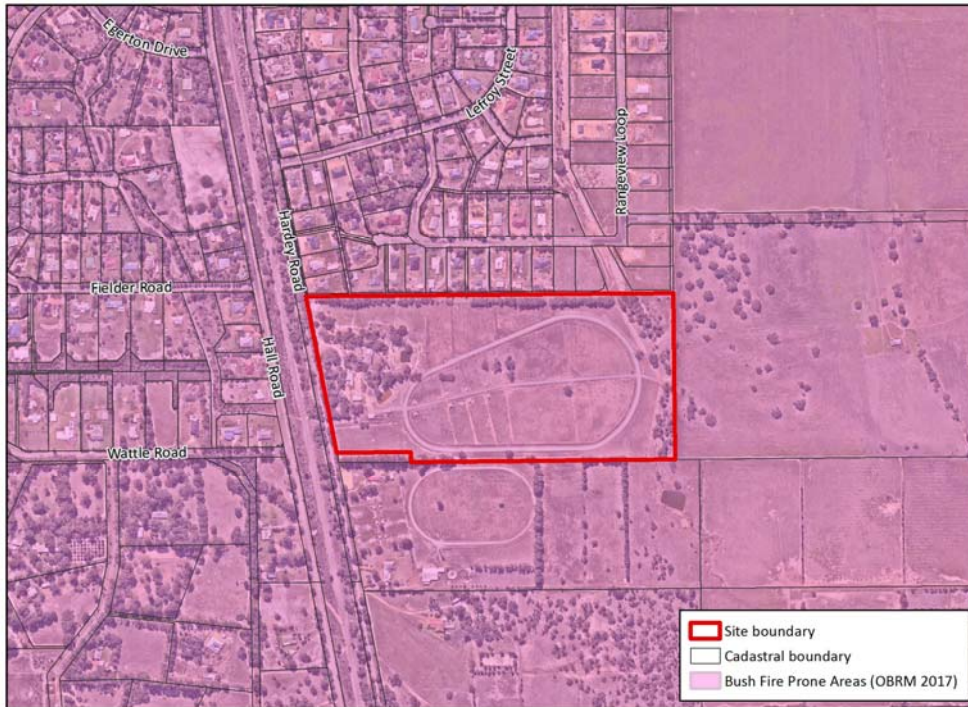


Plate 9: Areas within and surrounding the site identified as “Bushfire Prone Areas” under the state-wide Map of Bush Fire Prone Areas (OBRM 2017).

3 The Proposed Land Use and the Planning and Approval Framework

3.1 Proposed scheme amendment

The site is comprised of a single lot, zoned 'Rural' under both the Metropolitan Region Scheme and the Shire of Serpentine Jarrahdale TPS No. 2. The Shire of Serpentine will need to initiate a scheme amendment to rezone the site to 'Rural Living A' under TPS No. 2, consistent with the Shire's Draft Rural Strategy Review (2013) and the Draft South Metropolitan Sub-Regional Planning Framework (WAPC 2015a). This amendment will enable the future development of the site into rural residential lots of 1ha or more, similar to existing development in the local area.

The site has been identified as an area suitable for 'Rural Living A' development under the Shire's Draft Rural Strategy Review (SSJ 2013) based on its proximity to the Serpentine town site and its contiguous southward extension of the 'Rural Living A' zone east of Hardey Road.

3.2 Shire of Serpentine Jarrahdale Rural Strategy

The Shire of Serpentine Jarrahdale Rural Strategy was adopted in April 1994 and endorsed by the WAPC. Minor modifications were made to the Strategy in 2003 and again in 2006.

In 2012/2013 a major review of the Strategy was undertaken and was adopted by Council in July 2014 and forwarded to the Department of Planning for the WAPC's endorsement. Under the Strategy, the Shire has designated the site 'Rural Living A' which under TPS No. 2 permits lot sizes from 0.4ha (4,000m²).

Due to the need for the Strategy to be assessed with reference to the Sub-Regional Planning Frameworks being progressed by the WAPC, the Strategy was only recently considered by the WAPC in December 2016, pursuant to which the WAPC requested a number of modifications to the Strategy, one of which was that the site be depicted 'Rural Living B' rather than 'Rural Living A'.

In May 2017, the Council resolved to request that the WAPC reconsider the Strategy as adopted by Council in 2014. The WAPC has since instructed Council to adopt each of its requested modifications in finalising the draft strategy, however this Scheme Amendment proposes to demonstrate the site's capability to sustain subdivision into lots having a minimum lot size of 1ha and therefore proposes Rural Living A in accordance with Council's preference when adopting its 2013 Draft Rural Strategy Review in 2014.

3.3 Future planning approvals process

Subject to the initiation and finalisation of the scheme amendment, the next stage of the planning process will likely be the subdivision and development within site. Detailed design associated with the subdivision approval and clearances will enable the coordination and provision of utility networks, transport networks, public open space, water management, development standards and other infrastructure development.

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It is usual for the subdivision process to involve the imposition of subdivision conditions, in accordance with the WAPC's *Model Subdivision Conditions Schedule 2016*. Generally, these conditions relate to the specific details of the development design, including considerations such as lot design, reserves, school sites, electricity and gas pipelines, fire and emergency, drainage, buildings and use, amenity and heritage, etc.

4 Environment Factors Considered by the EPA

The Environmental Protection Authority (EPA) is an independent body, made up of a five-member board, not subject to the direction of the Minister for Environment. The roles and responsibilities of the EPA relate to statutory obligations under the EP Act, including:

- Conducting environmental impact assessments.
- Initiating measures to protect the environment from harm and pollution.
- Providing advice to the Minister for Environment on environmental matters.

The EPA identifies environmental factors and associated management objectives to assist in assessing whether the environmental impact of a proposal is acceptable.

Once the TPS amendment has been received by the responsible authority, the amendment will be referred to the EPA under *Section 48A of the Environmental Protection Act 1986* prior to being initiated. The EPA will then make a decision on whether the proposed scheme amendment requires formal assessment. The EPA may also provide informal advice on the proposed scheme amendment without formally assessing the scheme, or determine that the proposed amendment is not capable of being environmentally acceptable.

The environmental factors and objectives considered by the EPA, as outlined within their suite of Environmental Factor Guidelines (EPA 2016), have been summarised in **Table 1**, which includes consideration of whether the objective for each factor is likely to be met as a result of the proposed scheme amendment (and subsequent development) of the site.

Overall the consideration of the EPA factors and objectives indicates that the proposed scheme amendment is unlikely to result in development that would significantly impact environmental attributes or values, or nearby land uses and the proposed development can be suitably managed through the standard urban development process.

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Table 1: Summary of environmental factors and applicability to the proposed future land use

Factor not applicable to proposed development

Factor applicable to proposed development

Environmental factor	EPA objective	Can the proposed future development meet the EPA objective?
Sea		
Benthic communities and habitat	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.	Not applicable. The site is not located adjacent to or in the vicinity of the coast and does not propose any works that would affect related values.
Coastal processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	Not applicable. The site is not located adjacent to or in the vicinity of the coast and does not propose any works that would affect related values.
Marine environmental quality	To maintain the quality of water, sediment and biota so that the environmental values are protected.	Not applicable. The site is not located adjacent to or in the vicinity of the coast and does not propose any works that would affect related values.
Marine fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	Not applicable. The site is not located adjacent to or in the vicinity of the coast and does not propose any works that would affect related values.
Land		
Flora and vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	This objective can be met as no significant flora and vegetation values have been identified within the site that would require specific retention or protection as part of future development. The majority of vegetation has been historically cleared from the site to support pastoral land uses, and now consists of parkland cleared areas of mostly planted native and introduced trees, with some remnant native trees, over weedy pasture grass, and is in a highly degraded condition.
Landforms	To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected.	No significant landforms have been identified within the site. This objective can be met and the function of soils will be maintained as part of proposed future development of the site through the standard planning and development process.
Subterranean fauna	To protect subterranean fauna so that biological diversity and ecological integrity are maintained.	Not applicable. The proposed future development is not expected to have any interaction with subterranean fauna.

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Table 1: Summary of environmental factors and applicability to the proposed future land use (continued)

Factor not applicable to proposed development

Factor applicable to proposed development

Environmental factor	EPA objective	Can the proposed future development meet the EPA objective?
Terrestrial environmental quality	To maintain the quality of land and soils so that the environment values are protected.	This objective can be met and any proposed future development of the site will be undertaken in accordance with the requirements of the WAPC, Department of Water and Shire of Serpentine Jarrahdale. The future development of the site will result in the removal of horses/livestock from the site, and is unlikely to negatively impact on the quality of the land and soils within the site based on the similarity to the existing rural land uses. The site will not be connected to reticulated sewer and all lots will be serviced by onsite effluent disposal and secondary treatment units (e.g. ATUs). The suitability of the site to support onsite effluent disposal has been assessed and confirmed as part of a Land Capability Assessment (Emerge Associates 2017b) (Appendix B). The ongoing maintenance of the systems will be monitored by the provider and by the Shire of Serpentine Jarrahdale to ensure no impacts to the quality of land and soils. The site is classified as having a 'moderate to low' risk of ASS occurring 3 m of the natural soil surface. This is not considered to be a significant constraint on the proposed development, and any future ASS considerations can be identified and suitably managed during the subdivision process to ensure the quality of land and soils within the site are not impacted.
Terrestrial fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	No significant fauna or fauna habitat values have been identified within the site that would require specific retention or protection as part of any future development. Due to the highly disturbed nature of the vegetation within the site, it is likely that only opportunistic fauna species would utilise the site. Vegetation at the site may provide limited habitat for a variety of fauna species, some of which may be significant such as the three species of Black Cockatoos. However, these species are likely to be occasional visitors and are unlikely to rely on the habitat for survival. Vegetation will be retained within private lots where possible, and within public open space and reserves. Therefore, this objective can be met through the standard planning and subdivision processes for any future development.

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Table 1: Summary of environmental factors and applicability to the proposed future land use (continued)

Factor not applicable to proposed development

Factor applicable to proposed development

Environmental factor	EPA objective	Can the proposed future development meet the EPA objective?
Water		
Hydrological processes.	To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.	<p>Overall this objective can be met. Surface water and groundwater will be managed in accordance with the endorsed <i>Better Urban Water Management Framework</i>, which includes maintenance of the post-development environment in accordance with the pre-development environment.</p> <p>The majority of the site is mapped as a multiple use wetland (MUW) (UFI 16021), with a small area in the western portion of the site mapped as a resource enhancement wetland (REW) (UFI 15364) (DBCA 2017). Given the general absence of remnant vegetation within the site, and the regional landforms and soils mapping, the extent of this mapped REW is unlikely to be reflective of wetland conditions on the ground. During a site visit with the Shire of Serpentine – Jarrahdale, the Shire indicated that a formal re-classification process for the REW may be required to enable development. As mentioned previously the site conditions are not reflective of wetland conditions and therefore would be conducive to this re-classification. The hydrological characteristics of the site can also be managed through the standard urban water management process (applied through the planning process).</p> <p>Several surface water features occur within the site, including two farm dams in the west of the site and the artificial Arnold Road Main Drain, which is situated just inside the site's eastern boundary. An emergency access track for bushfire is also proposed to be located adjacent to the drain. Potential impacts on the drain will be minimised through the accommodation of an appropriate foreshore area, retention of remnant vegetation where possible, and management of construction activity in proximity to the drain.</p>
Inland waters environmental quality	To maintain the quality of groundwater and surface water so that environmental values are protected.	<p>Several surface water features occur within the site, including two farm dams in the west of the site and the Arnold Road Main Drain is situated just inside the site's eastern boundary. Potential impacts on the drain will be minimised through the accommodation of an appropriate foreshore area, retention of remnant vegetation where possible, and management of construction activity in proximity to the drain.</p> <p>Overall, this objective can be met through the management of surface water and groundwater quality in accordance with the <i>Better Urban Water Management Framework</i>, including Water Sensitive Urban Design and through consideration of the broader existing drainage infrastructure of the area.</p>

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Table 1: Summary of environmental factors and applicability to the proposed future land use (continued)

Factor not applicable to proposed development

Factor applicable to proposed development

Environmental factor	EPA objective	Can the proposed future development meet the EPA objective?
Air		
Air quality	To maintain air quality and minimise emissions so that environmental values are protected.	The proposed future development of the site is unlikely to introduce land uses that would detrimentally impact air quality, and dust impacts would be short term in duration, associated with earthworks and/or construction and can be managed in line with standard development processes.
People		
Human health	To protect human health from significant harm.	Given the size of the proposed lots and restrictions associated with the land use zoning, any future development within the site is unlikely to adversely affect human health. A Transportation Noise Assessment (Lloyd George Acoustics 2017) has been undertaken to determine the impact of the adjacent freight railway line on proposed lots (Appendix C). Based on the assessment and the nature of the development (1ha rural residential lots) it is expected that the noise implications of the railway line can be suitably managed through lot setbacks where required, ensuring no impact to human health.
Social surroundings	To protect social surroundings from significant harm.	No aboriginal heritage values have been identified within the site, and are therefore unlikely to be impacted. The proposed future development of the site is unlikely to detrimentally impact the aesthetic, cultural, economic or social surroundings of the area given the proposed land use is consistent with the existing uses across the local area.

5 Environmental Assessment and Future Environmental Management Framework

Table 2 below summarises the environmental values that have been considered for the site, and outlines those values that will require further specific consideration as part of the future development within the site. Where applicable, an outline on the future management considerations has been provided.

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Table 2: Summary of environmental value, consideration of potential impacts and future management requirements

Environmental Value	Relevant Consideration and potential for impact	Applicable Legislation/ policy and/or guidelines	Management considerations/requirements for future planning stages
Climate	No issues are posed and therefore no further consideration of this factor is required.	Not applicable.	Not applicable.
Topography	No issues are posed and therefore no further consideration of this factor is required.	Not applicable.	Not applicable.
Geology	No issues are posed and therefore no further consideration of this factor is required.	Not applicable.	Not applicable.
Landforms and soils	A limited number of soil samples were taken at the site, as outlined in the Land Capability Assessment, which indicate that soils within the site generally consist of Silty Sand to Clayey Silty Sand over Sandy Clay/Sandy Gravelly Clay.	Not applicable	Not applicable.
Land capability	The site is not proposed to be connected to a reticulated sewer network; instead each lot will have an onsite effluent treatment and disposal system fully contained within the lot. A Land Capability Assessment has been undertaken by Emerge Associates (2017b) which confirms the suitability of the site for onsite effluent treatment.	<ul style="list-style-type: none"> • draft Country Sewerage Policy (DoH 2002) • draft Government Sewerage Policy (DoP 2016) 	Any requirements for future investigations, and associated onsite effluent disposal system selection and design responses, can be addressed through scheme provisions associated with the proposed town planning scheme amendment and implemented as part of the future subdivision. This is outlined further in the Land Capability Assessment (Emerge Associates 2017b) (Appendix B).
Acid Sulfate Soils	The site is classified as having a 'moderate to low' risk of ASS occurring 3 m of the natural soil surface. Therefore, disturbance of soil below the seasonal low groundwater table has the potential to mobilise ASS however is only likely to be a relevant consideration for activities that involve excavation below the permanent groundwater table (i.e. excavation for any deep services such as sewer).	<ul style="list-style-type: none"> • <i>Environmental Protection Act 1986</i> • <i>Acid Sulfate Soils Planning Guidelines</i> (WAPC 2008a) • <i>Identification and investigations of acid sulfate soils and acidic landscapes</i> (DEC 2013) 	The extent of ASS which is encountered and potentially disturbed, and any management requirements, will be largely dependent upon the extent of excavation below the natural soil surface and any potential dewatering activities associated with development of the site. Generally, the extent of excavation is not known until detailed design is completed following subdivision; however, any future ASS considerations can be identified and suitably managed during the subdivision process, when detailed design is progressed.

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Table 2: Summary of environmental value, consideration of potential impacts and future management requirements (continued)

Environmental Value	Relevant Consideration and potential for impact	Applicable Legislation/ policy and/or guidelines	Management considerations/requirements for future planning stages
Flora and vegetation	The site has largely been cleared of native vegetation and consists predominantly of Parkland Cleared areas with planted native and exotic species and sparse remnant native species dotted throughout. No vegetation within the site has been identified as significant (i.e. TEC or Threatened flora) or of regional or local significance. Existing vegetation within the site may provide amenity value for the future rural residential development.	<ul style="list-style-type: none"> • <i>Environmental Protection and Biodiversity Conservation Act 1999</i> • <i>Environmental Protection Act 1986</i> • <i>Wildlife Conservation Act 1950</i> • <i>EPA Guidance Statement No. 33 Environmental Guidance for Planning and Development</i> (EPA 2008) • <i>Local Biodiversity Strategy</i> (SSJ 2008) • <i>Local Planning Policy No. 67: Landscape and Vegetation</i> (SSJ 2016) 	<p>As part of the future subdivision process it is recommended that where possible, existing native vegetation and trees be retained within private lots, road reserves and or public open space/reserves.</p> <p>The extent of vegetation retained will be largely dependent upon the location of building envelopes, the requirement for fill (to provide separation from groundwater in support of onsite effluent disposal systems), and the extent of earthworks within the site.</p>
Bush Forever	No Bush Forever sites are located within or in close proximity to the site.	<ul style="list-style-type: none"> • <i>State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region</i> (WAPC 2010) • <i>Bush Forever Volume 1, Volume 2 and Volume 3</i> (Government of WA 2000a) 	Not applicable.
Ecological Linkages	An ecological linkage has been identified within the western portion of the site, generally associated with remnant vegetation within the railway reserve west of Hardey Road and scattered vegetation within rural lots in the local area. The connectivity of this linkage will be maintained through the long term retention of vegetation within the Hardey Road and railway reserves west of the site, and where retention is possible within private lots. The integrity of the connection is not dependent on the limited vegetation within the site and no further consideration is required.	<ul style="list-style-type: none"> • <i>Local Biodiversity Strategy</i> (SSJ 2008) 	Not applicable.
Environmentally Sensitive Areas	No ESA's have been identified within the site.	<ul style="list-style-type: none"> • <i>Environmental Protection Act 1986</i> • <i>Environmental Protection (Clearing of Native Vegetation) Regulations 2004</i> 	Not applicable

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Table 2: Summary of environmental value, consideration of potential impacts and future management requirements (continued)

Environmental Value	Relevant Consideration and potential for impact	Applicable Legislation/ policy and/or guidelines	Management considerations/requirements for future planning stages
Local Natural Areas (LNA)	No LNA's or locally significant vegetation values have been identified within the site.	<ul style="list-style-type: none"> • <i>Local Biodiversity Strategy (SSJ 2008)</i> 	Not applicable.
Terrestrial Fauna	Due to the highly disturbed nature of the vegetation within the site, it is likely that only opportunistic fauna species would utilise the site. Vegetation at the site may provide limited habitat for a variety of fauna species, some of which may be significant such as the three species of Black Cockatoos. However, these species are only likely to be occasional visitors and would not rely on the habitat for survival.	<ul style="list-style-type: none"> • <i>Environmental Protection and Biodiversity Conservation Act 1999</i> • <i>Environmental Protection Act 1986</i> • <i>Wildlife Conservation Act 1950</i> • <i>EPA Guidance Statement No. 33 Environmental Guidance for Planning and Development (EPA 2008)</i> • <i>Local Biodiversity Strategy (SSJ 2008)</i> 	<p>As part of the future subdivision process it is recommended that where possible, existing native vegetation and trees be retained within private lots, road reserves and or public open space/reserves.</p> <p>The extent of vegetation retained will be largely dependent upon the location of building envelopes, the requirement for fill (to provide separation from groundwater in support of onsite effluent disposal systems), and the extent of earthworks within the site.</p> <p>Further investigation into fauna habitat values may be required to support the future subdivision of the site. This can be suitably addressed through the subdivision approval and clearance process.</p>
Groundwater	The depth to groundwater encountered at the sampling locations ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site. Appropriate separation to groundwater and management of groundwater levels as part of development will be a relevant consideration, particularly given the proposed use of onsite effluent disposal systems.	<ul style="list-style-type: none"> • <i>Planning and Development Act 2005</i> • <i>State Water Strategy (Government of WA 2003)</i> • <i>State Planning Policy 2.9 Water Resources (WAPC 2006)</i> • <i>Better Urban Water Management Framework (WAPC 2008b)</i> • <i>Stormwater Management Manual</i> • <i>Local Planning Policy No. 06: Water Sensitive Design (SSJ 2001)</i> 	<p>Groundwater can be managed through the typical water management process (applied through the development planning and approval process) in accordance with the endorsed Better Urban Water Management Framework. Generally, this includes the maintenance of the post-development environment in accordance with the pre-development environment.</p> <p>This is outlined further within the District Water Management Strategy (Emerge Associates 2017a).</p>

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Table 2: Summary of environmental value, consideration of potential impacts and future management requirements (continued)

Environmental Value	Relevant Consideration and potential for impact	Applicable Legislation/ policy and/or guidelines	Management considerations/requirements for future planning stages
Surface water	<p>Several surface water features occur within the site, including two farm dams in the west of the site, and the Arnold Road Main Drain just inside the site's eastern boundary. This drain flows from the south, through the site and then through the existing rural residential area to the north of the site, and ultimately discharges to the Serpentine River. Potential impacts on the drain will be minimised through the accommodation of an appropriate foreshore area and management of construction activity in proximity to the drain. In addition, the management of the quality and quantity of surface water runoff within the site in accordance with the urban water management framework will be a relevant consideration.</p>	<ul style="list-style-type: none"> • Planning and Development Act 2005 • State Water Strategy (Government of Western Australia 2003) • State Planning Policy 2.9 Water Resources (WAPC 2006) • Better Urban Water Management Framework (WAPC 2008) • Stormwater Management Manual • Local Planning Policy No. 06: Water Sensitive Design (Shire of Serpentine Jarrahdale 2016). 	<p>The reserve depicted on the proposed subdivision layout is considered appropriate to accommodate the ecological attributes of the drain given the artificial nature of the drain, the limited riparian vegetation, the topography and the soil type of the foreshore area as described in Section 2.5.2.1. The proposed reserve will tie in with the existing drainage reserve to the north, which was informed by detailed hydrological modelling (Cardno 2013), and will enable the mature trees in this area to be retained east of the drain line where possible.</p> <p>Further hydrological modelling of the flows through the site will be undertaken as part of future water management design and documentation, which will inform the ultimate width of the foreshore area. The ultimate design of this corridor and foreshore area will be finalised as part of future detailed design stages and will be informed by further hydrological modelling.</p> <p>The conveyance of surface water and stormwater can be managed through the typical water management process (applied through the development planning and approval process) in accordance with the endorsed Better Urban Water Management Framework. Generally, this includes the maintenance of the post-development environment in accordance with the pre-development environment, or as agreed with the local government. This is discussed further in the District Water Management Strategy (Emerge Associates 2017a).</p>

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Table 2: Summary of environmental value, consideration of potential impacts and future management requirements (continued)

Environmental Value	Relevant Consideration and potential for impact	Applicable Legislation/ policy and/or guidelines	Management considerations/requirements for future planning stages
Wetlands	The majority of the site is mapped as a multiple use wetland (MUW) (UFI 16021), with a small area in the western portion of the site mapped as a resource enhancement wetland (REW) (UFI 15364) (DBCA 2017). Based on the outcomes of this assessment, the area mapped as REW does not reflect the wetland conditions on the ground. This is based on the general absence of remnant vegetation within the site, the historic disturbance from residential and rural land uses, and the regional landforms and soils mapping. This assessment is in accordance with the advice in the <i>Protocol for proposing modifications to the Geomorphic Wetlands Swan Coastal Plain dataset</i> (DEC 2007).	<ul style="list-style-type: none"> • <i>Wetlands Conservation Policy for Western Australia</i> (Government of WA 1997) • <i>Environmental Protection Authority Guidance Statement No. 33 Environmental Guidance for Planning and Development</i> (EPA 2008) • Better Urban Water Management Framework • Stormwater Management Manual • Local Planning Policy No. 06: Water Sensitive Design (Shire of Serpentine Jarrahdale 2016). • Protocol for proposing modifications to the Geomorphic Wetlands Swan Coastal Plain dataset (DEC 2007) 	<p>Multiple Use Wetlands do not require specific conservation or protection measures, and through the standard urban water management process (applied through the planning process) the hydrological characteristics of these types of wetlands can be maintained. This will be addressed through the preparation of an Urban Water Management Plan to support subdivision. This is discussed further in the District Water Management Strategy (Emerge Associates 2017a).</p> <p>Based on the advice in the <i>Protocol for proposing modifications to the Geomorphic Wetlands Swan Coastal Plain dataset</i> (DEC 2007) and the findings of this EAJR relating to the mapped REW within the site, it is considered that the area mapped as REW is not reflective of wetland conditions and a re-classification is appropriate (if required).</p>
Public Drinking Water Source Areas	The site is not located within or adjacent to any declared PDWSA	<ul style="list-style-type: none"> • <i>Metropolitan Water Supply, Sewerage and Drainage Act 1909</i> • <i>Water Quality Protection Note 108</i> (DoW 2010) • <i>State Planning Policy 2.7: Public Drinking Water Source Policy</i> 	Not applicable.
Indigenous Heritage	No Registered Aboriginal Heritage Sites or Other Heritage Places have been identified within the site based on a review of the AHIS.	<ul style="list-style-type: none"> • <i>Aboriginal Heritage Act 1972</i> 	Under the <i>Aboriginal Heritage Act 1972</i> , all Aboriginal sites are protected whether they are known or not. As part of ground disturbing activities, if Aboriginal artefacts or sites (not previously identified) are uncovered, works will need to cease and a suitably qualified expert brought in to survey the potential site. If required based on the outcome of the survey, additional consent pursuant to the <i>Aboriginal Heritage Act 1972</i> may be required to manage and disturb the site.
Non-Indigenous Heritage	No non-Indigenous heritage values have been identified within the site.	<ul style="list-style-type: none"> • <i>Heritage of Western Australia Act 1990</i> • <i>State Cultural Heritage Policy</i> 	Not applicable.

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Table 2: Summary of environmental value, consideration of potential impacts and future management requirements (continued)

Environmental Value	Relevant Consideration and potential for impact	Applicable Legislation/ policy and/or guidelines	Management considerations/requirements for future planning stages
Historic and Existing Land Uses	The majority of the site has been historically cleared of native vegetation to support pastoral and rural-residential land uses. Currently the site supports a single dwelling with miscellaneous sheds/outbuildings, and extensive horse paddocks and exercise areas.	Not applicable.	Not applicable.
Potential Contamination	Based on a review of historical aerial photography, known historical land uses and a site visit undertaken by Emerge Associates, historic land uses are unlikely to result in contamination that would require specific management or that would preclude future development of the site (or a portion of the site).	<ul style="list-style-type: none"> • <i>Contaminated Sites Act 2003</i> 	Not applicable.
Surrounding Land Uses	There is potential for noise impacts from surrounding land uses, specifically the existing freight railway line west of the site (west of Hardey Road).	<ul style="list-style-type: none"> • <i>State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning</i> 	Based on a consideration of similar developments and road transport corridors, noise is expected to be suitably addressed through the provision (where required) of lot setbacks for future dwellings within impacted lots. This can be managed through the typical planning and development process as discussed in the Transportation Noise Assessment (Lloyd George Acoustics 2017) provided in Appendix C .
Bushfire Hazard	Portions of the site have been identified as bushfire prone areas under the <i>Map of Bushfire Prone Areas</i> (OBRM 2017).	<ul style="list-style-type: none"> • <i>Fire and Emergency Services Act 1998</i> • <i>Planning and Development (Local Planning Scheme) Amendment Regulations 2015</i> • <i>State Planning Policy 3.7 Planning in Bushfire Prone Areas</i> (WAPC 2015) • <i>Guidelines for Planning in Bushfire Prone Areas Version 1.1</i> (WAPC and DFES 2017) • <i>AS3959-2009 Construction of buildings in bushfire prone areas</i> (Standards Australia 2009) 	<p>The BMP (Emerge Associates and Bushfire Safety Consulting 2017) prepared for the site includes a bushfire hazard level assessment and provides commentary on how future development can address the performance principles outlined in Appendix Four of the Guidelines (WAPC and DFES 2017).</p> <p>Further detailed bushfire risk assessment will be required as part of future subdivision stage in order to outline how a specific development design will address Appendix Four of the Guidelines in response to the bushfire hazards remaining at that time. This is outlined further in the BMP (Emerge Associates and Bushfire Safety Consulting 2017).</p>

Environmental Assessment and Justification Report

Lot 9 Hardey Road, Serpentine



6 Summary and Conclusions

Serene Environs is seeking to amend the land use zoning over the site to facilitate the future subdivision of the site into Rural Living lots. The proposed TPS amendment seeks to rezone the site from 'Rural' to 'Rural Living A,' consistent with the Shire's *Draft Rural Strategy Review (2013)*.

Due to the historic disturbance of the site, limited environmental values have been identified within the site. Overall, the proposed scheme amendment is unlikely to result in development that would significantly impact environmental attributes or values, or nearby land uses as the proposed Rural Living development is consistent with the local area and can be suitably managed through the standard planning process. In particular:

- The site has been identified as an area suitable for 'Rural Living A' development under the Shire's Draft Rural Strategy Review (SSJ 2013)
- The site has been classified as having a 'moderate to low' risk of ASS occurring within 3 m of the natural soil surface. ASS is only likely to require management where deep services extend below the permanent groundwater table and can be managed through the standard subdivision process (in accordance with the relevant DER guidelines).
- The site is not proposed to be connected to a reticulated sewer network; instead each lot will have an onsite effluent treatment and disposal system fully contained within the lot. A Land Capability Assessment has been undertaken by Emerge Associates (2017b) which demonstrates the suitability of the site and the proposed rural residential lots for onsite effluent disposal systems.
- The site has largely been cleared of native vegetation and consists predominantly of Parkland Cleared areas with planted native and exotic species and sparse remnant native species dotted throughout. No vegetation within the site has been identified as significant (i.e. TEC or Threatened flora) or of regional or local significance. Existing vegetation within the site may provide amenity value for the future rural residential development. As part of the future local subdivision processes it is expected that existing vegetation will be retained wherever possible within private lots, public open space and road reserves.
- Due to the highly disturbed nature of the vegetation within the site, it is likely that only opportunistic fauna species would utilise the site. Vegetation at the site may provide limited habitat for a variety of fauna species, some of which may be significant such as the three species of Black Cockatoos. Further investigation into fauna habitat values may be required to support the future subdivision of the site. This can be suitably addressed through the subdivision approval and clearance process.
- The current hydrological functions of the site will be maintained through the application of the Better Urban Water Management Framework (implemented through the standard planning process).
- Based on the advice in the *Protocol for proposing modifications to the Geomorphic Wetlands Swan Coastal Plain dataset* (DEC 2007) and the lack of remnant vegetation, regional landform and soil mapping relating to the mapped REW within the site, it is considered that the area mapped as REW is not reflective of wetland conditions and a re-classification is appropriate (if required to enable development).

Environmental Assessment and Justification Report

Lot 9 Hardey Road, Serpentine



- A preliminary assessment of the biophysical attributes of the drain within the eastern portion of the site has been undertaken in order to determine an appropriate foreshore area. This assessment determined that the reserve depicted within the proposed subdivision layout is able to accommodate the known hydrological and ecological attributes of the drain. Further site specific hydrological modelling will inform the ultimate foreshore area, as part of detailed development design stages.
- Based on the acoustic assessment (Lloyd George Acoustics 2017), noise impacts from the freight railway line west of the site is expected to be suitably addressed through the provision of setbacks for future dwellings within impacted lots. This will be considered in further detail as part of the subdivision approvals.
- The site has been identified as a bushfire prone area under the Map of Bush Fire Prone Areas (OBRM 2017). A bushfire hazard level assessment has been undertaken as part of the BMP (Emerge Associates and Bushfire Safety Consulting 2017) and further detailed bushfire risk assessment will be required to support subdivision or development stages in order to address the performance criteria outlined in Appendix Four of the Guidelines (WAPC and DFES 2017).

The environmental attributes and values of the site can be appropriately accommodated through the planning process and the preparation of a local structure plan and/or subdivision. There are no significant environmental issues or constraints within the site to the extent that it would preclude the site from being rezoned to 'Rural Living A' under the Shire of Serpentine Jarrahdale TPS No. 2.

Environmental Assessment and Justification Report

Lot 9 Hardey Road, Serpentine



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Figures



Figure 1: Site Plan and Topographic Contours

Figure 2: Regional Soil Mapping

Figure 3: Vegetation Communities

Figure 4: Geomorphic Wetlands and Waterways

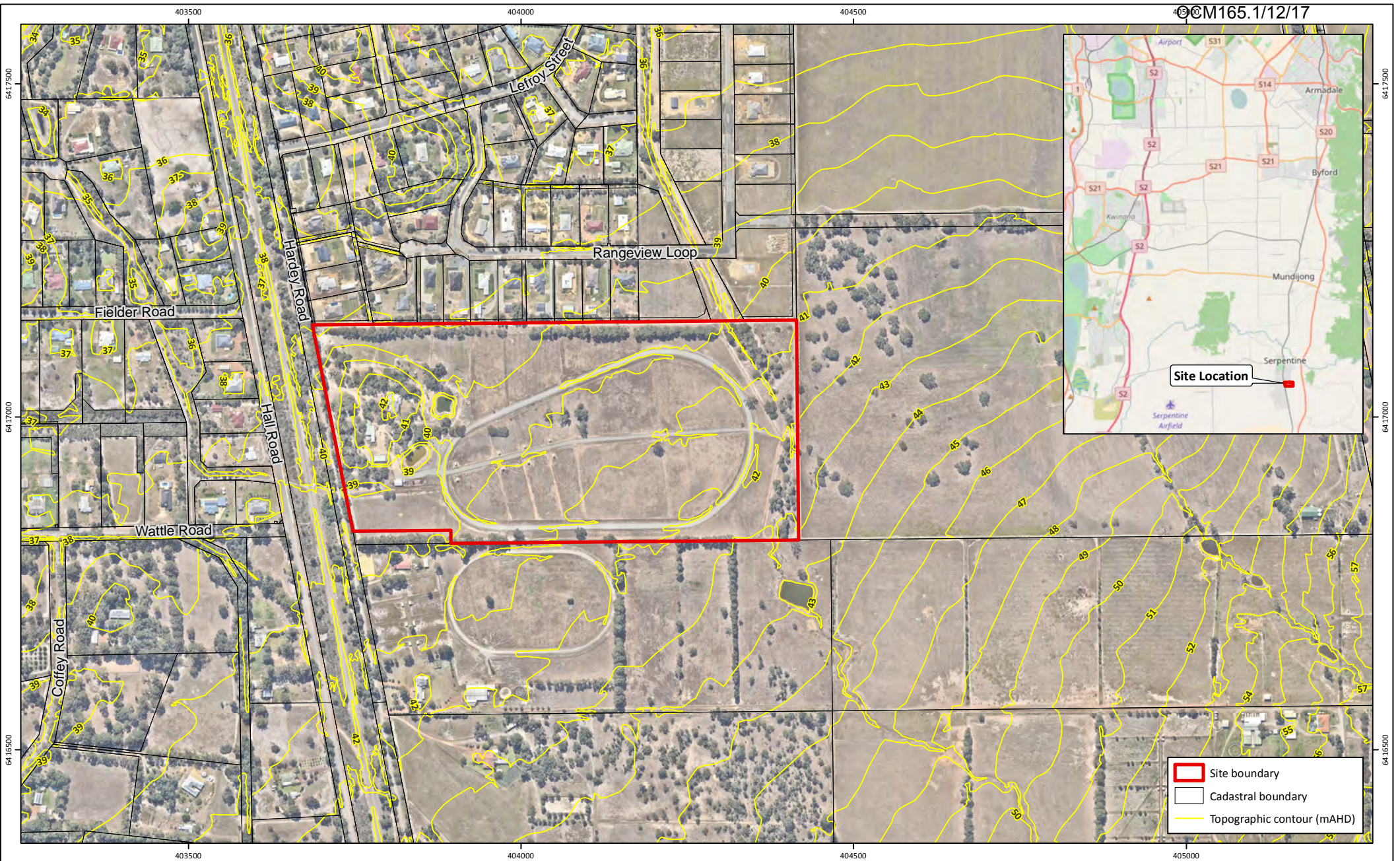


Figure 1: Site Plan and Topographic Contours

Project: Environmental Assessment and Justification Report
 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
 EP17-071(01)--F09

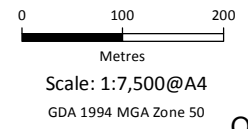
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Date: 02/08/2017

Checked: VMK

Approved: ACW

Date: 04/08/2017



- Site boundary
- Cadastral boundary
- Topographic contour (mAHd)



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

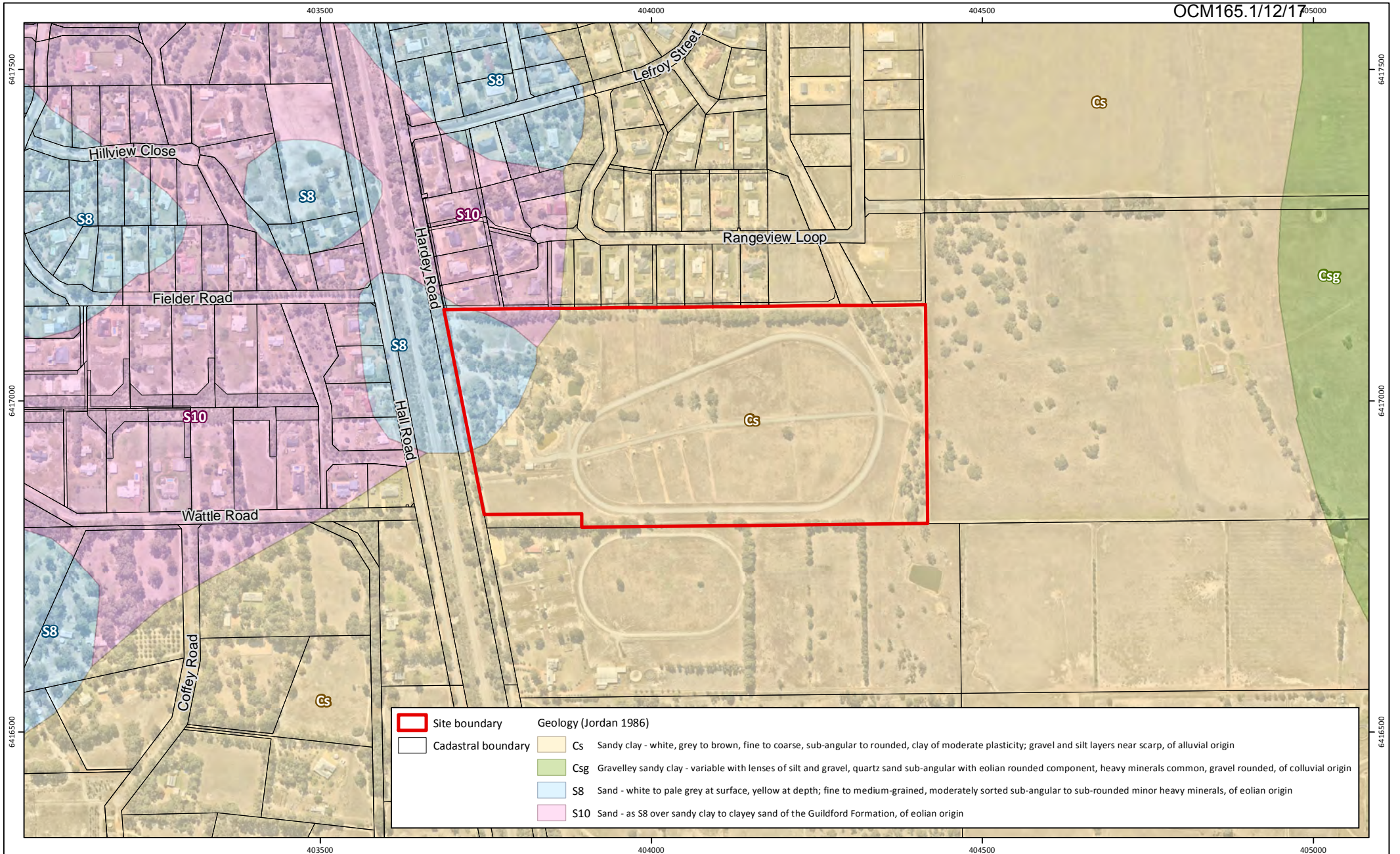
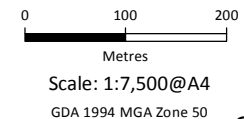


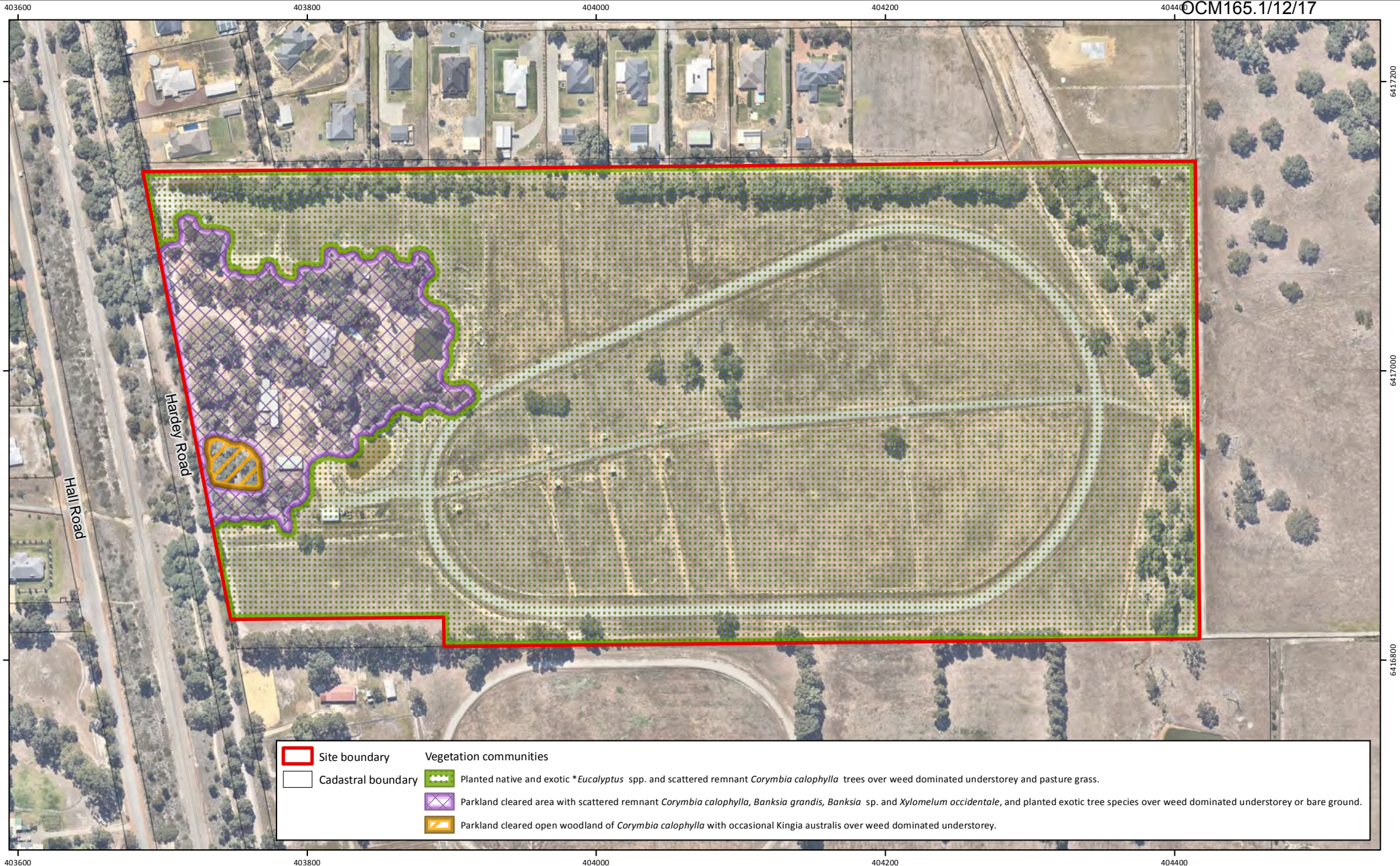
Figure 2: Regional Soil Mapping

Project: Environmental Assessment and Justification Report
 Lot 9 Hardey Road, Serpentine
Client: Serene Environs

Plan Number:
 EP17-071(01)--F03a
Drawn: KNM
Date: 02/08/2017
Checked: VMK
Approved: ACW
Date: 04/08/2017



OCM 18 December 2017

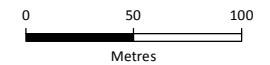


Site boundary	Vegetation communities
Cadastral boundary	Planted native and exotic * <i>Eucalyptus</i> spp. and scattered remnant <i>Corymbia calophylla</i> trees over weed dominated understorey and pasture grass.
	Parkland cleared area with scattered remnant <i>Corymbia calophylla</i> , <i>Banksia grandis</i> , <i>Banksia</i> sp. and <i>Xylomelum occidentale</i> , and planted exotic tree species over weed dominated understorey or bare ground.
	Parkland cleared open woodland of <i>Corymbia calophylla</i> with occasional <i>Kingia australis</i> over weed dominated understorey.

Figure 3: Vegetation Communities

Project: Environmental Assessment and Justification Report
 Lot 9 Hardey Road, Serpentine
Client: Serene Environs

Plan Number:
 EP17-071(01)--F02a
Drawn: KNM
Date: 02/08/2017
Checked: VMK
Approved: ACW
Date: 04/08/2017



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



OCM 18 December 2017

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

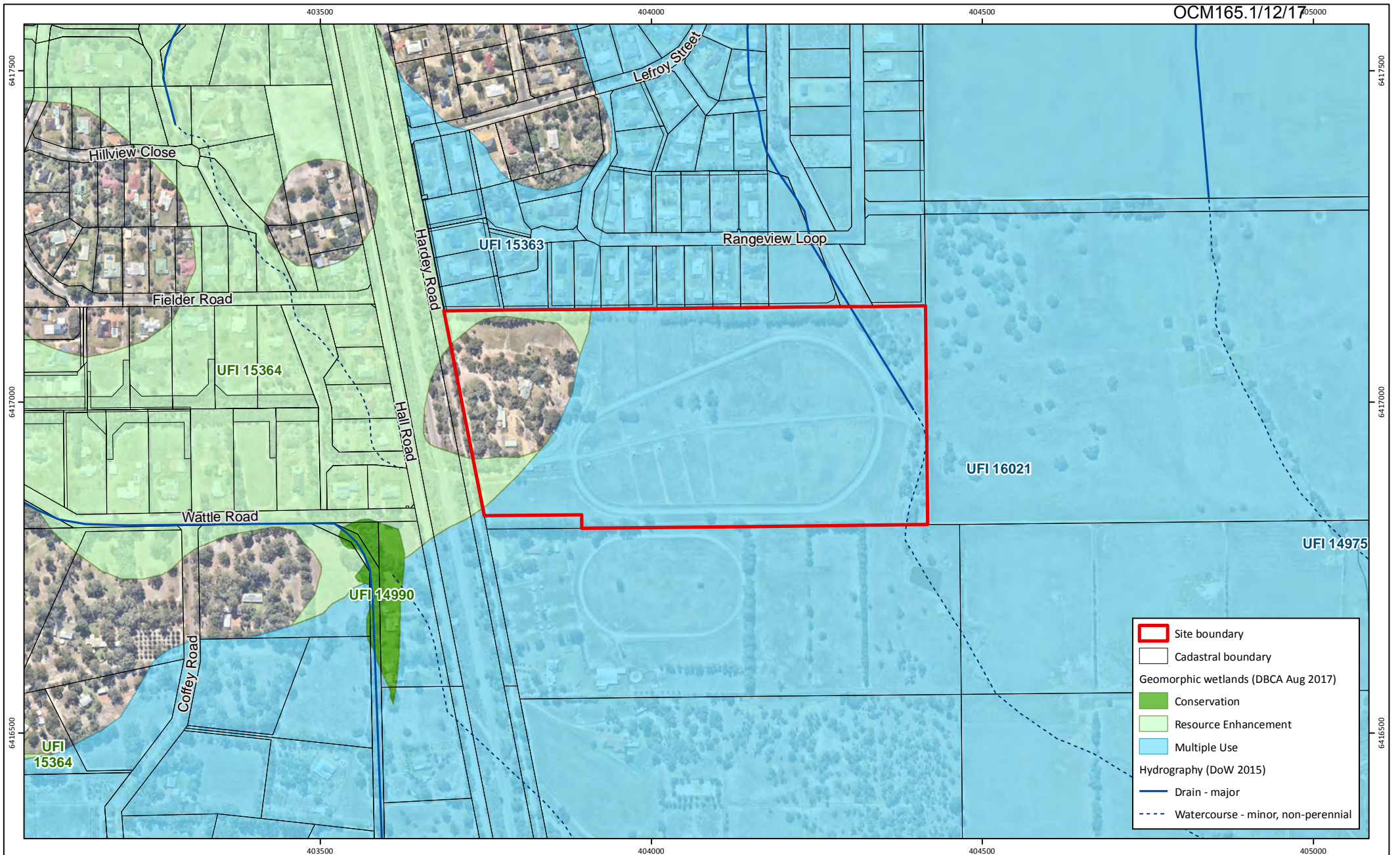


Figure 4: Geomorphic Wetlands and Waterways

Project: Environmental Assessment and Justification Report
 Lot 9 Hardey Road, Serpentine
Client: Serene Environs

Plan Number:
 EP17-071(01)--F10
Drawn: KNM
Date: 02/08/2017
Checked: VMK
Approved: ACW
Date: 04/08/2017



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 Metres
 Scale: 1:7,500@A4
 GDA 1994 MGA Zone 50



OCM 18 December 2017

Appendix A

Flora and Vegetation Database Search Results





EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/08/17 18:40:36

[Summary](#)

[Details](#)

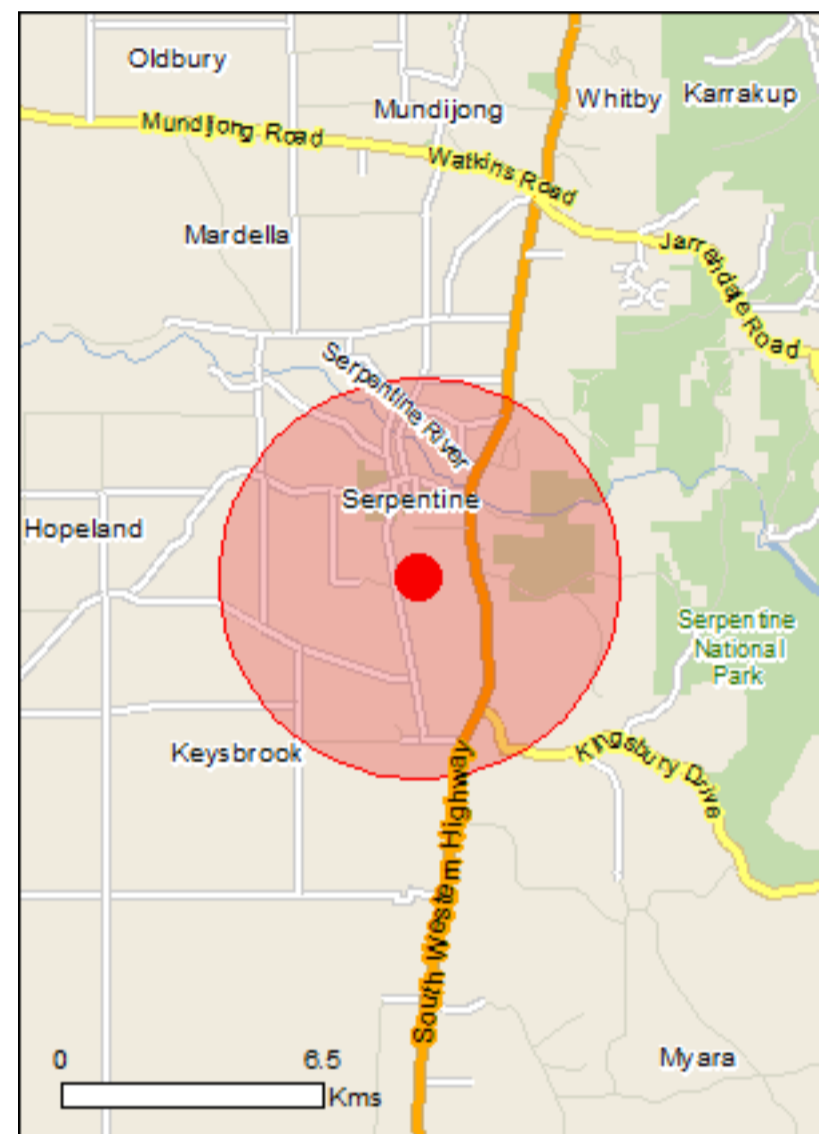
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

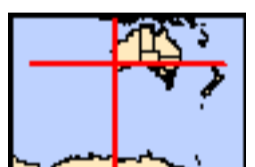
[Acknowledgements](#)



This map may contain data which are
©Commonwealth of Australia
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[Coordinates](#)

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	24
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	6
Regional Forest Agreements:	1
Invasive Species:	38
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [\[Resource Information \]](#)

Name	Proximity
Peel-yalgorup system	20 - 30km upstream

Listed Threatened Ecological Communities [\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat likely to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat likely to occur within area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat may occur within area

Listed Migratory Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within

Name	Threatened	Type of Presence OCM165.1/12/17 area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Karnet	WA
Lambkin	WA
NTWA Bushland covenant (0076)	WA
Serpentine	WA
Unnamed WA46587	WA
Unnamed WA50643	WA

Regional Forest Agreements	[Resource Information]
----------------------------	--------------------------

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species	[Resource Information]
------------------	--------------------------

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area

Name	Status	Type of Presence OCM165.1/12/17
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Reptiles

Name	Status	Type of Presence
Hemidactylus frenatus		OCM165.1/12/17
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.37998 115.98017

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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NatureMap Species Report

Created By Guest user on 02/08/2017

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 58' 34" E, 32° 22' 47" S
Buffer 5km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	? ?			
2.	15429 <i>Acacia alata</i> var. <i>alata</i>			
3.	15469 <i>Acacia barbinervis</i> subsp. <i>barbinervis</i>			
4.	3254 <i>Acacia celastrifolia</i> (<i>Glowing Wattle</i>)			
5.	3294 <i>Acacia dentifera</i>			
6.	11192 <i>Acacia drummondii</i> subsp. <i>elegans</i>			
7.	3331 <i>Acacia extensa</i> (<i>Wiry Wattle</i>)			
8.	3373 <i>Acacia horridula</i>		P3	
9.	3382 <i>Acacia incrassata</i>			
10.	3383 <i>Acacia incurva</i>			
11.	3410 <i>Acacia lateriticola</i>			
12.	3454 <i>Acacia nervosa</i> (<i>Rib Wattle</i>)			
13.	3464 <i>Acacia obovata</i>			
14.	14129 <i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>		P3	
15.	3502 <i>Acacia pulchella</i> (<i>Prickly Moses</i>)			
16.	15483 <i>Acacia pulchella</i> var. <i>pulchella</i>			
17.	3527 <i>Acacia saligna</i> (<i>Orange Wattle, Kudjong</i>)			
18.	30032 <i>Acacia saligna</i> subsp. <i>saligna</i>			
19.	3541 <i>Acacia sessilis</i>			
20.	3557 <i>Acacia stenoptera</i> (<i>Narrow Winged Wattle</i>)			
21.	3574 <i>Acacia teretifolia</i>			
22.	3581 <i>Acacia trigonophylla</i>			
23.	3591 <i>Acacia urophylla</i>			
24.	3602 <i>Acacia willdenowiana</i> (<i>Grass Wattle</i>)			
25.	24260 <i>Acanthiza apicalis</i> (<i>Broad-tailed Thornbill, Inland Thornbill</i>)			
26.	24261 <i>Acanthiza chrysorrhoa</i> (<i>Yellow-rumped Thornbill</i>)			
27.	24262 <i>Acanthiza inornata</i> (<i>Western Thornbill</i>)			
28.	1205 <i>Acanthocarpus canaliculatus</i>			
29.	1208 <i>Acanthocarpus preissii</i>			
30.	24560 <i>Acanthorhynchus superciliosus</i> (<i>Western Spinebill</i>)			
31.	25535 <i>Accipiter cirrocephalus</i> (<i>Collared Sparrowhawk</i>)			
32.	25536 <i>Accipiter fasciatus</i> (<i>Brown Goshawk</i>)			
33.	<i>Acritoptila margaretae</i>			
34.	<i>Acritoptila</i> sp.			
35.	6205 <i>Actinotus leucocephalus</i> (<i>Flannel Flower</i>)			
36.	14970 <i>Adenanthos barbiger</i>			
37.	1790 <i>Adenanthos meisneri</i>			
38.	<i>Adversaeschna brevistyla</i>			
39.	23474 <i>Agrostocrinum hirsutum</i>			
40.	1261 <i>Agrostocrinum scabrum</i> (<i>Blue Grass Lily</i>)			
41.	184 <i>Aira caryophyllea</i> (<i>Silvery Hairgrass</i>)	Y		
42.	1731 <i>Allocasuarina huegeliana</i> (<i>Rock Sheoak, Kwowl</i>)			
43.	1732 <i>Allocasuarina humilis</i> (<i>Dwarf Sheoak</i>)			
44.	<i>Allothereua maculata</i>			
45.	197 <i>Amphipogon debilis</i>			
46.	20184 <i>Amphipogon laguroides</i> subsp. <i>laguroides</i>			
47.	199 <i>Amphipogon strictus</i> (<i>Greybeard Grass</i>)			
48.	200 <i>Amphipogon turbinatus</i>			
49.	<i>Aname mainae</i>			
50.	24312 <i>Anas gracilis</i> (<i>Grey Teal</i>)			
51.	24316 <i>Anas superciliosa</i> (<i>Pacific Black Duck</i>)			
52.	6300 <i>Andersonia aristata</i> (<i>Rice Flower</i>)			
53.	6314 <i>Andersonia lehmanniana</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
54.	7833 <i>Angianthus preissianus</i>			
55.	1411 <i>Anigozanthos manglesii</i> (Mangles Kangaroo Paw, Kurulbrang)			
56.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
57.	1416 <i>Anigozanthos viridis</i> (Green Kangaroo Paw, Kurulbardang)			
58.	11566 <i>Anigozanthos viridis</i> subsp. <i>viridis</i>			
59.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
60.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
61.	12724 <i>Anthotium junciforme</i>			
62.	25670 <i>Anthus australis</i> (Australian Pipit)			
63.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
64.	<i>Arachnura higginsi</i>			
65.	<i>Araneus senicaudatus</i>			
66.	7838 <i>Arctotheca calendula</i> (Cape Weed, African Marigold)	Y		
67.	24340 <i>Ardea novaehollandiae</i> (White-faced Heron)			
68.	24341 <i>Ardea pacifica</i> (White-necked Heron)			
69.	222 <i>Aristida ramosa</i> (Purple Wiregrass)	Y		
70.	<i>Arrenuridae</i> sp.			
71.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
72.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
73.	20350 <i>Astartea affinis</i> (West-coast Astartea)			
74.	20249 <i>Astartea leptophylla</i> (River-bank Astartea)			
75.	6323 <i>Astroloma ciliatum</i> (Candle Cranberry)			
76.	6328 <i>Astroloma glaucescens</i>			
77.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
78.	<i>Aturidae</i> sp.			
79.	<i>Australotiphys barmutai</i>			
80.	<i>Austrogomphus collaris</i>			
81.	17233 <i>Austrostipa campylachne</i>			
82.	17234 <i>Austrostipa compressa</i>			
83.	233 <i>Avena barbata</i> (Bearded Oat)	Y		
84.	36441 <i>Babingtonia camphorosmae</i> (Camphor Myrtle)			
85.	1800 <i>Banksia attenuata</i> (Slender Banksia, Piara)			
86.	32576 <i>Banksia dallanneyi</i> (Couch Honeypot)			
87.	32080 <i>Banksia sessilis</i> var. <i>sessilis</i>			
88.	1852 <i>Banksia telmatiaea</i> (Swamp Fox Banksia)			
89.	32053 <i>Banksia undata</i> (Urchin Dryandra)			
90.	32054 <i>Banksia undata</i> var. <i>undata</i>			
91.	32315 <i>Barbula calycina</i>			
92.	<i>Barnardius zonarius</i>			
93.	32321 <i>Bartramia breutelii</i>			
94.	32323 <i>Bartramia pseudostricta</i>			
95.	15037 <i>Bartsia trixago</i>	Y		
96.	743 <i>Baumea juncea</i> (Bare Twigrush)			
97.	745 <i>Baumea preissii</i>			
98.	748 <i>Baumea vaginalis</i> (Sheath Twigrush)			
99.	<i>Berosus approximans</i>			
100.	4598 <i>Beyeria lechenaultii</i> (Pale Turpentine Bush)			
101.	25788 <i>Billardiera fraseri</i> (Elegant Pronaya)			
102.	3165 <i>Billardiera variifolia</i>			
103.	1417 <i>Blancoa canescens</i> (Winter Bell)			
104.	11503 <i>Boronia crenulata</i> var. <i>crenulata</i>			
105.	4429 <i>Boronia molloyae</i> (Tall Boronia)			
106.	4438 <i>Boronia ramosa</i>			
107.	11564 <i>Boronia ramosa</i> subsp. <i>ramosa</i>			
108.	1273 <i>Borya sphaerocephala</i> (Pincushions)			
109.	3704 <i>Bossiaea aquifolium</i> (Water Bush, Nedik)			
110.	14396 <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i>			
111.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
112.	3714 <i>Bossiaea ornata</i> (Broad Leaved Brown Pea)			
113.	3718 <i>Bossiaea rufa</i>			
114.	18497 <i>Bossiaea</i> sp. <i>Waroona</i> (B.J. Keighery & N. Gibson 229)			
115.	<i>Bostockia porosa</i>			
116.	8661 <i>Brachypodium distachyon</i> (False Brome)	Y		
117.	7871 <i>Brachyscome ciliaris</i>			
118.	32327 <i>Breutelia affinis</i>			
119.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
120.	245 <i>Briza minor</i> (Shivery Grass)	Y		
121.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
122.	12770 <i>Burchardia congesta</i>			
123.	1385 <i>Burchardia multiflora</i> (Dwarf Burchardia)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
124.	25715 <i>Cacatua roseicapilla</i> (Galah)			
125.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
126.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
127.	42307 <i>Cacomantis pallidus</i> (Pallid Cuckoo)			
128.	1276 <i>Caesia micrantha</i> (Pale Grass Lily)			
129.	1277 <i>Caesia occidentalis</i>			
130.	1590 <i>Caladenia ferruginea</i> (Rusty Spider Orchid)			
131.	1592 <i>Caladenia flava</i> (Cowslip Orchid)			
132.	1596 <i>Caladenia huegelii</i> (Grand Spider Orchid)		T	
133.	1599 <i>Caladenia latifolia</i> (Pink Fairy Orchid)			
134.	1605 <i>Caladenia marginata</i> (White Fairy Orchid)			
135.	15377 <i>Caladenia reptans</i> subsp. <i>reptans</i>			
136.	16365 <i>Calandrinia</i> sp. Kenwick (G.J. Keighery 10905)			
137.	1214 <i>Calectasia grandiflora</i> (Blue Tinsel Lily)			
138.	4717 <i>Callitriche stagnalis</i> (Common Starwort)	Y		
139.	36600 <i>Callitriche pyramidalis</i> (Swamp Cypress)			
140.	35758 <i>Calothamnus quadrifidus</i> subsp. <i>homalophyllus</i> (Murchison Clawflower)			
141.	35816 <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>			
142.	5428 <i>Calothamnus rupestris</i> (Mouse Ears)			
143.	5429 <i>Calothamnus sanguineus</i> (Silky-leaved Blood flower, Pindak)			
144.	5431 <i>Calothamnus torulosus</i>			
145.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
146.	24731 <i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black-Cockatoo)		T	
147.	24733 <i>Calyptorhynchus baudinii</i> (Baudin's Cockatoo (long-billed black-cockatoo), Baudin's Cockatoo)		T	
148.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)		T	
149.	5437 <i>Calytrix acutifolia</i>			
150.	5485 <i>Calytrix variabilis</i>			
151.	2952 <i>Cassytha glabella</i> (Tangled Dodder Laurel)			
152.	2956 <i>Cassytha pomiformis</i> (Dodder Laurel)			
153.	2957 <i>Cassytha racemosa</i> (Dodder Laurel)			
154.	<i>Ceinidae</i> sp.			
155.	6539 <i>Centaurium erythraea</i> (Common Centaury)	Y		
156.	1121 <i>Centrolepis aristata</i> (Pointed Centrolepis)			
157.	1125 <i>Centrolepis drummondiana</i>			
158.	1134 <i>Centrolepis polygyna</i> (Wiry Centrolepis)			
159.	<i>Ceratopogonidae</i> sp.			
160.	<i>Cercophonius sulcatus</i>			
161.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
162.	31 <i>Cheilanthes austrotenuifolia</i>			
163.	34 <i>Cheilanthes distans</i> (Bristly Cloak Fern)			
164.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
165.	33939 <i>Cherax cainii</i> (Marron)			
166.	<i>Cherax quinquecarinatus</i>			
167.	<i>Cheumatopsyche</i> sp. AV2 (SAP)			
168.	<i>Chironomus</i> aff. <i>alternans</i> (V24) (CB)			
169.	<i>Chironomus tepperi</i>			
170.	8971 <i>Chorizema cordatum</i>			
171.	3753 <i>Chorizema dicksonii</i> (Yellow-eyed Flame Pea)			
172.	25601 <i>Chrysococcyx lucidus</i> (Shining Bronze Cuckoo)			
173.	<i>Cladocera</i> (unident.)			
174.	<i>Cladopelma curtivalva</i>			
175.	<i>Cladotanytarsus</i> sp. A (SAP)			
176.	<i>Cloeon</i> sp.			
177.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
178.	24399 <i>Columba livia</i> (Domestic Pigeon)	Y		
179.	4550 <i>Comesperma calymega</i> (Blue-spike Milkwort)			
180.	4551 <i>Comesperma ciliatum</i>			
181.	4564 <i>Comesperma virgatum</i> (Milkwort)			
182.	<i>Condocerus aptus</i>			
183.	1875 <i>Conospermum huegelii</i> (Slender Smokebush)			
184.	1882 <i>Conospermum stoechadis</i> (Common Smokebush)			
185.	15611 <i>Conospermum stoechadis</i> subsp. <i>stoechadis</i> (Common Smokebush)			
186.	1418 <i>Conostylis aculeata</i> (Prickly Conostylis)			
187.	12109 <i>Conostylis aculeata</i> subsp. <i>preissii</i>			
188.	1420 <i>Conostylis androstemma</i> (Trumpets)			
189.	1453 <i>Conostylis serrulata</i>			
190.	1454 <i>Conostylis setigera</i> (Bristly Cottonhead)			
191.	1455 <i>Conostylis setosa</i> (White Cottonhead)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
192.	<i>Copepoda</i> sp.			
193.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
194.	<i>Cormocephalus aurantiipes</i>			
195.	<i>Cormocephalus turneri</i>			
196.	38874 <i>Cortinarius globuliformis</i>			
197.	25592 <i>Corvus coronoides</i> (Australian Raven)			
198.	17104 <i>Corymbia calophylla</i> (Marri)			
199.	17105 <i>Corymbia haematoxylon</i> (Mountain Marri)			
200.	7947 <i>Cotula turbinata</i> (Funnel Weed)	Y		
201.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
202.	24422 <i>Cracticus tibicen</i> subsp. <i>dorsalis</i> (White-backed Magpie)			
203.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
204.	13354 <i>Craspedia variabilis</i>			
205.	29054 <i>Crepis foetida</i> subsp. <i>foetida</i> (Stinking Hawksbeard)	Y		
206.	<i>Cricotopus 'brevicornis'</i>			
207.	<i>Cricotopus 'parbicinctus'</i>			
208.	25398 <i>Crinia georgiana</i> (Quacking Frog)			
209.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
210.	25401 <i>Crinia pseudinsignifera</i> (Bleating Froglet)			
211.	35838 <i>Cristonia biloba</i> subsp. <i>biloba</i>			
212.	4804 <i>Cryptandra nutans</i>			
213.	30893 <i>Cryptoblepharus buchananii</i>			
214.	<i>Cryptochironomus griseidorsum</i>			
215.	24883 <i>Ctenophorus ornatus</i> (Ornate Crevice-Dragon)			
216.	25049 <i>Ctenotus labillardieri</i>			
217.	<i>Culicidae</i> sp.			
218.	6663 <i>Cuscuta epithymum</i> (Lesser Dodder, Greater Dodder)	Y		
219.	15404 <i>Cyanicula sericea</i>			
220.	768 <i>Cyathochaeta avenacea</i>			
221.	<i>Cyclopoida</i> sp.			
222.	815 <i>Cyperus tenellus</i> (Tiny Flatsedge)	Y		
223.	17692 <i>Cytogonidium leptocarpoides</i>			
224.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)	Y		
225.	7420 <i>Dampiera alata</i> (Winged-stem Dampiera)			
226.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
227.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
228.	5508 <i>Darwinia citriodora</i> (Lemon-scented Darwinia)			
229.	5531 <i>Darwinia thymoides</i>			
230.	1218 <i>Dasyogon bromeliifolius</i> (Pineapple Bush)			
231.	24092 <i>Dasyurus geoffroi</i> (Chuditch, Western Quoll)		T	
232.	6960 <i>Datura ferox</i> (Fierce Thornapple)	Y		
233.	6218 <i>Daucus glochidiatus</i> (Australian Carrot)			
234.	15656 <i>Daviesia brachyphylla</i>			
235.	3799 <i>Daviesia cordata</i> (Bookleaf)			
236.	16579 <i>Daviesia decipiens</i>			
237.	3805 <i>Daviesia decurrens</i> (Prickly Bitter-pea)			
238.	19747 <i>Daviesia decurrens</i> subsp. <i>decurrens</i>			
239.	3815 <i>Daviesia horrida</i> (Prickly Bitter-pea)			
240.	3835 <i>Daviesia preissii</i>			
241.	17663 <i>Desmocladius asper</i>			
242.	15831 <i>Desmocladius castaneus</i>			
243.	17691 <i>Desmocladius fasciculatus</i>			
244.	1259 <i>Dianella revoluta</i> (Blueberry Lily)			
245.	11636 <i>Dianella revoluta</i> var. <i>divaricata</i>			
246.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
247.	306 <i>Dichelachne crinita</i> (Longhair Plumegrass)			
248.	1287 <i>Dichopogon capillipes</i>			
249.	<i>Dicrotendipes</i> sp.			
250.	17838 <i>Dielsia stenostachya</i>			
251.	<i>Dinocambala ingens</i>			
252.	1509 <i>Dioscorea hastifolia</i> (Warrine, Warram)			
253.	<i>Diplacodes bipunctata</i>			
254.	24939 <i>Diplodactylus polyophthalmus</i>			
255.	18541 <i>Diplopeltis huegelii</i> subsp. <i>huegelii</i>			
256.	18589 <i>Diplopeltis huegelii</i> subsp. <i>lehmannii</i>			
257.	12943 <i>Diuris brumalis</i>			
258.	4757 <i>Dodonaea ceratocarpa</i>			
259.	<i>Dolichopodidae</i> sp.			
260.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
261.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			

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262.	3098 <i>Drosera glanduligera</i> (Pimpernel Sundew)			
263.	13197 <i>Drosera hyperostigma</i>			
264.	3106 <i>Drosera macrantha</i> (Bridal Rainbow)			
265.	14298 <i>Drosera macrantha</i> subsp. <i>macrantha</i>			
266.	12243 <i>Drosera mannii</i>			
267.	13209 <i>Drosera marchantii</i> subsp. <i>marchantii</i>			
268.	3109 <i>Drosera menziesii</i> (Pink Rainbow)			
269.	11853 <i>Drosera menziesii</i> subsp. <i>menziesii</i>			
270.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
271.	13191 <i>Drosera occidentalis</i> subsp. <i>occidentalis</i>		P4	
272.	3118 <i>Drosera pallida</i> (Pale Rainbow)			
273.	8911 <i>Drosera rosulata</i>			
274.	3131 <i>Drosera stolonifera</i> (Leafy Sundew)			
275.	<i>Egretta novaehollandiae</i>			
276.	349 <i>Ehrharta longiflora</i> (Annual Veldt Grass)	Y		
277.	<i>Elanus axillaris</i>			
278.	25250 <i>Elapognathus coronatus</i> (Crowned Snake)			
279.	47937 <i>Elseya melanops</i> (Black-fronted Dotterel)			
280.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
281.	1644 <i>Elythranthera emarginata</i> (Pink Enamel Orchid)			
282.	<i>Empididae</i> sp.			
283.	<i>Enchytraeidae</i> sp.			
284.	<i>Eolophus roseicapillus</i>			
285.	24652 <i>Eopsaltria georgiana</i> (White-breasted Robin)			
286.	379 <i>Eragrostis elongata</i> (Clustered Lovegrass)			
287.	15412 <i>Eriochilus dilatatus</i> subsp. <i>multiflorus</i>			
288.	6219 <i>Eryngium pinnatifidum</i> (Blue Devils)			
289.	41801 <i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)		P3	
290.	15446 <i>Eryngium pinnatifidum</i> subsp. <i>pinnatifidum</i>			
291.	5616 <i>Eucalyptus decurva</i> (Slender Mallee)			
292.	5688 <i>Eucalyptus laeliae</i> (Darling Range Ghost Gum)			
293.	5690 <i>Eucalyptus lane-poolei</i> (Salmon White Gum)			
294.	5708 <i>Eucalyptus marginata</i> (Jarrah, Djara)			
295.	13547 <i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah)			
296.	5763 <i>Eucalyptus rudis</i> (Flooded Gum, Kulurda)			
297.	13511 <i>Eucalyptus rudis</i> subsp. <i>rudis</i>			
298.	5797 <i>Eucalyptus wandoo</i> (Wandoo, Wondoo)			
299.	12906 <i>Eucalyptus wandoo</i> subsp. <i>wandoo</i>			
300.	3872 <i>Euchilopsis linearis</i> (Swamp Pea)			
301.	<i>Eucyrtops latior</i>			
302.	<i>Euoplos inornatus</i>			
303.	4627 <i>Euphorbia helioscopia</i> (Sun Spurge)	Y		
304.	4648 <i>Euphorbia terracina</i> (Geraldton Carnation Weed)	Y		
305.	3880 <i>Eutaxia virgata</i>			
306.	25621 <i>Falco berigora</i> (Brown Falcon)			
307.	25622 <i>Falco cenchroides</i> (Australian Kestrel, Nankeen Kestrel)			
308.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
309.	1747 <i>Ficus carica</i> (Common Fig)	Y		
310.	32365 <i>Fissidens leptocladus</i>			
311.	32367 <i>Fissidens megalotis</i>			
312.	32469 <i>Fissidens taylorii</i> var. <i>taylorii</i>			
313.	25727 <i>Fulica atra</i> (Eurasian Coot)			
314.	2969 <i>Fumaria capreolata</i> (Whiteflower Fumitory)	Y		
315.	34028 <i>Galaxias occidentalis</i> (Western Minnow)			
316.	7321 <i>Galium divaricatum</i>	Y		
317.	7323 <i>Galium murale</i> (Small Goosegrass)	Y		
318.	20513 <i>Gastrolobium dilatatum</i>			
319.	20473 <i>Gastrolobium ebracteolatum</i>			
320.	3923 <i>Gastrolobium spathulatum</i> (Poison Bush)			
321.	3924 <i>Gastrolobium spinosum</i> (Prickly Poison)			
322.	42314 <i>Gavicalis virescens</i> (Singing Honeyeater)			
323.	32383 <i>Gemmabryum sullivanii</i>			
324.	25404 <i>Geocrinia leai</i> (Ticking Frog)			
325.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
326.	1524 <i>Gladiolus undulatus</i> (Wild Gladiolus)	Y		
327.	6143 <i>Glischrocaryon aureum</i> (Common Popflower)			
328.	3945 <i>Gompholobium aristatum</i>			
329.	10909 <i>Gompholobium confertum</i>			
330.	3950 <i>Gompholobium knightianum</i>			
331.	3951 <i>Gompholobium marginatum</i>			

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332.	3954 <i>Gompholobium polymorphum</i>			
333.	6149 <i>Gonocarpus cordiger</i>			
334.	29362 <i>Goodenia coerulea</i>			
335.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
336.	1964 <i>Grevillea bipinnatifida</i> (Fuchsia Grevillea)			
337.	19628 <i>Grevillea bipinnatifida</i> subsp. <i>bipinnatifida</i>			
338.	13429 <i>Grevillea diversifolia</i> subsp. <i>diversifolia</i>			
339.	1997 <i>Grevillea endlicheriana</i> (Spindly Grevillea)			
340.	13450 <i>Grevillea manglesii</i> subsp. <i>manglesii</i>			
341.	2066 <i>Grevillea pilulifera</i> (Woolly-flowered Grevillea)			
342.	2122 <i>Grevillea wilsonii</i> (Native Fuchsia)			
343.	32473 <i>Grimmia pulvinata</i> var. <i>africana</i>			
344.	<i>Gripopterygidae</i> sp.			
345.	<i>Gyrinidae</i> sp.			
346.	1465 <i>Haemodorum discolor</i>			
347.	1468 <i>Haemodorum laxum</i>			
348.	1472 <i>Haemodorum simplex</i>			
349.	1474 <i>Haemodorum sparsiflorum</i>			
350.	2128 <i>Hakea amplexicaulis</i> (Prickly Hakea)			
351.	2137 <i>Hakea ceratophylla</i> (Horned Leaf Hakea)			
352.	2152 <i>Hakea cyclocarpa</i> (Ramshorn)			
353.	2166 <i>Hakea incrassata</i> (Marble Hakea)			
354.	2175 <i>Hakea lissocarpha</i> (Honey Bush)			
355.	2203 <i>Hakea ruscifolia</i> (Candle Hakea)			
356.	2206 <i>Hakea stenocarpa</i> (Narrow-fruited Hakea)			
357.	2212 <i>Hakea sulcata</i> (Furrowed Hakea)			
358.	2214 <i>Hakea trifurcata</i> (Two-leaf Hakea)			
359.	2215 <i>Hakea undulata</i> (Wavy-leaved Hakea)			
360.	6686 <i>Halgania corymbosa</i>		P3	
361.	<i>Halipilus fuscatus</i>			
362.	<i>Halipilus</i> sp.			
363.	<i>Harrisius</i> sp. A (SAP)			
364.	32392 <i>Hedwigidium integrifolium</i>			
365.	<i>Hellyethira litua</i>			
366.	<i>Helochares tenuistriatus</i>			
367.	439 <i>Hemarthria uncinata</i> (Matgrass)			
368.	<i>Hemicordulia tau</i>			
369.	25115 <i>Hemiergis initialis</i> subsp. <i>initialis</i>			
370.	6855 <i>Hemigenia humilis</i>			
371.	6856 <i>Hemigenia incana</i> (Silky Hemigenia)			
372.	<i>Henicops dentatus</i>			
373.	1293 <i>Hensmania turbinata</i>			
374.	5108 <i>Hibbertia acerosa</i> (Needle Leaved Guinea Flower)			
375.	5112 <i>Hibbertia aurea</i>			
376.	5114 <i>Hibbertia commutata</i>			
377.	20051 <i>Hibbertia diamesogenos</i>			
378.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
379.	45534 <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>			
380.	5148 <i>Hibbertia mylnei</i>			
381.	5150 <i>Hibbertia nymphaea</i>			
382.	5155 <i>Hibbertia pilosa</i> (Hairy Guinea Flower)			
383.	5169 <i>Hibbertia serrata</i> (Serrate Leaved Guinea Flower)			
384.	11481 <i>Hibbertia spicata</i> subsp. <i>spicata</i>			
385.	5173 <i>Hibbertia subvaginata</i>			
386.	47965 <i>Hieraaetus morphnoides</i> (Little Eagle)			
387.	<i>Hirudinea</i> sp.			
388.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
389.	6222 <i>Homalosciadium homalocarpum</i>			
390.	3964 <i>Hovea chorizemifolia</i> (Holly-leaved Hovea)			
391.	3966 <i>Hovea pungens</i> (Devil's Pins, Puyenak)			
392.	3968 <i>Hovea trisperma</i> (Common Hovea)			
393.	12741 <i>Hyalosperma cotula</i>			
394.	12007 <i>Hybanthus floribundus</i> subsp. <i>floribundus</i>			
395.	6226 <i>Hydrocotyle callicarpa</i> (Small Pennywort)			
396.	<i>Hydrodromidae</i> sp.			
397.	24215 <i>Hydromys chrysogaster</i> (Water-rat, Rakali)		P4	
398.	<i>Hyphydrus elegans</i>			
399.	5817 <i>Hypocalymma angustifolium</i> (White Myrtle, Kudjid)			
400.	5825 <i>Hypocalymma robustum</i> (Swan River Myrtle)			
401.	8086 <i>Hypochaeris glabra</i> (Smooth Catsear)	Y		

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402.	9352 <i>Hypochaeris radicata</i> (Flat Weed, Cats-ear)	Y		
403.	1070 <i>Hypolaena exsulca</i>			
404.	<i>Idiomnata blackwallii</i>			
405.	20200 <i>Isolepis cernua</i> var. <i>setiformis</i>			
406.	917 <i>Isolepis marginata</i> (Coarse Club-rush)			
407.	919 <i>Isolepis oldfieldiana</i>			
408.	<i>Isometroides vesicus</i>			
409.	25478 <i>Isoodon obesulus</i> (Southern Brown Bandicoot)		P4	
410.	24153 <i>Isoodon obesulus</i> subsp. <i>fusciventer</i> (Quenda, Southern Brown Bandicoot)		P4	
411.	<i>Isopeda leishmanni</i>			
412.	2221 <i>Isopogon asper</i>			
413.	29775 <i>Isopogon drummondii</i>		P3	
414.	2237 <i>Isopogon sphaerocephalus</i> (Drumstick Isopogon)			
415.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
416.	3997 <i>Jacksonia alata</i>			
417.	4018 <i>Jacksonia lehmannii</i>			
418.	4025 <i>Jacksonia restioides</i>			
419.	19272 <i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>		P2	
420.	1180 <i>Juncus capitatus</i> (Capitate Rush)	Y		
421.	11922 <i>Juncus kraussii</i> subsp. <i>australiensis</i>			
422.	1196 <i>Juncus usitatus</i> (Common Rush)	Y		
423.	<i>Karaops ellenae</i>			
424.	4037 <i>Kennedia coccinea</i> (Coral Vine)			
425.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
426.	4045 <i>Kennedia stirlingii</i> (Bushy Kennedia)			
427.	1221 <i>Kingia australis</i> (Kingia, Pulonok)			
428.	5835 <i>Kunzea micrantha</i>			
429.	17461 <i>Kunzea micrantha</i> subsp. <i>micrantha</i>			
430.	5841 <i>Kunzea recurva</i>			
431.	3667 <i>Labichea lanceolata</i> (Tall Labichea)			
432.	11289 <i>Labichea lanceolata</i> subsp. <i>lanceolata</i>			
433.	3669 <i>Labichea punctata</i> (Lance-leaved Cassia)			
434.	18585 <i>Lagenophora huegelii</i>			
435.	24367 <i>Lalage tricolor</i> (White-winged Triller)			
436.	14083 <i>Lambertia multiflora</i> var. <i>darlingensis</i>			
437.	<i>Lancetes lanceolatus</i>			
438.	45081 <i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>		P3	
439.	17000 <i>Lasiopetalum pterocarpum</i>		T	
440.	<i>Latrodectus hasseltii</i>			
441.	11911 <i>Laxmannia ramosa</i> subsp. <i>ramosa</i>			
442.	1309 <i>Laxmannia squarrosa</i>			
443.	7568 <i>Lechenaultia biloba</i> (Blue Leschenaultia)			
444.	<i>Lectrides parilis</i>			
445.	41620 <i>Lepidosperma asperatum</i>			
446.	936 <i>Lepidosperma leptostachyum</i>			
447.	940 <i>Lepidosperma pubisquamum</i>			
448.	29141 <i>Lepidosperma</i> sp. Gosnells (A. Markey 1145)			
449.	29150 <i>Lepidosperma</i> sp. Margaret River (B.J. Lepschi 1841)			
450.	945 <i>Lepidosperma squamatum</i>			
451.	949 <i>Lepidosperma tuberculatum</i>			
452.	46375 <i>Leptocarpus decipiens</i>			
453.	<i>Leptoceridae</i> sp.			
454.	2342 <i>Leptomeria cunninghamii</i>			
455.	<i>Leptoperla australica</i>			
456.	5847 <i>Leptospermum erubescens</i> (Roadside Teatree)			
457.	1085 <i>Lepyrodia glauca</i>			
458.	25131 <i>Lerista distinguenda</i>			
459.	6367 <i>Leucopogon capitellatus</i>			
460.	6400 <i>Leucopogon gracillimus</i>			
461.	6416 <i>Leucopogon nutans</i> (Drooping Leucopogon)			
462.	6436 <i>Leucopogon propinquus</i>			
463.	6439 <i>Leucopogon pulchellus</i> (Beard-heath)			
464.	6447 <i>Leucopogon strictus</i>			
465.	7676 <i>Levenhookia pusilla</i> (Midget Stylewort)			
466.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
467.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
468.	<i>Limnesiidae</i> sp.			
469.	<i>Limnoxenus zelandicus</i>			
470.	4363 <i>Linum trigynum</i> (French Flax)	Y		
471.	25388 <i>Litoria moorei</i> (Motorbike Frog)			

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472.	9289 <i>Lobelia anceps</i> (Angled Lobelia)			
473.	7402 <i>Lobelia gibbosa</i> (Tall Lobelia)			
474.	7403 <i>Lobelia heterophylla</i> (Wing-seeded Lobelia)			
475.	7405 <i>Lobelia rarifolia</i>			
476.	9356 <i>Logfia gallica</i>			
477.	478 <i>Lolium rigidum</i> (Wimmera Ryegrass)	Y		
478.	1222 <i>Lomandra brittanii</i>			
479.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
480.	1228 <i>Lomandra hermaphrodita</i>			
481.	1229 <i>Lomandra integra</i>			
482.	1232 <i>Lomandra micrantha</i> (Small-flower Mat-rush)			
483.	14542 <i>Lomandra micrantha</i> subsp. <i>micrantha</i>			
484.	1234 <i>Lomandra nigricans</i>			
485.	1236 <i>Lomandra odora</i> (Tiered Matrush)			
486.	1239 <i>Lomandra preissii</i>			
487.	1240 <i>Lomandra purpurea</i> (Purple Mat Rush)			
488.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
489.	1244 <i>Lomandra sonderi</i>			
490.	1245 <i>Lomandra spartea</i>			
491.	<i>Lophocitina isura</i>			
492.	4059 <i>Lotus angustissimus</i> (Narrowleaf Trefoil)	Y		
493.	8564 <i>Lotus subbiflorus</i>	Y		
494.	1092 <i>Loxocarya cinerea</i>			
495.	<i>Macrogyrus angustatus</i>			
496.	85 <i>Macrozamia riedlei</i> (Zamia, Djiridji)			
497.	25650 <i>Malurus elegans</i> (Red-winged Fairy-wren)			
498.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
499.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
500.	17636 <i>Marianthus coeruleopunctatus</i> (Blue-spotted Marianthus)			
501.	17630 <i>Marianthus tenuis</i>			
502.	<i>Maydenoptila baynesi</i>			
503.	18394 <i>Melaleuca parviceps</i>			
504.	5958 <i>Melaleuca radula</i> (Graceful Honey-myrtle)			
505.	5959 <i>Melaleuca raphiophylla</i> (Swamp Paperbark)			
506.	5964 <i>Melaleuca seriata</i>			
507.	5983 <i>Melaleuca trichophylla</i>			
508.	13280 <i>Melaleuca viminea</i> subsp. <i>viminea</i>			
509.	25663 <i>Melithreptus brevirostris</i> (Brown-headed Honeyeater)			
510.	953 <i>Mesomelaena graciliceps</i>			
511.	955 <i>Mesomelaena pseudostygia</i>			
512.	11473 <i>Mesomelaena stygia</i> subsp. <i>stygia</i>			
513.	957 <i>Mesomelaena tetragona</i> (Semaphore Sedge)			
514.	<i>Microcarbo melanoleucos</i>			
515.	485 <i>Microlaena stipoides</i> (Weeping Grass)			
516.	11747 <i>Microlaena stipoides</i> var. <i>stipoides</i>			
517.	<i>Micronecta gracilis</i>			
518.	<i>Micronecta robusta</i>			
519.	15419 <i>Microtis media</i> subsp. <i>media</i>			
520.	14344 <i>Millotia tenuifolia</i> var. <i>tenuifolia</i> (Soft Millotia)			
521.	4090 <i>Mirbelia dilatata</i> (Holly-leaved Mirbelia)			
522.	4091 <i>Mirbelia floribunda</i> (Purple Mirbelia)			
523.	4100 <i>Mirbelia spinosa</i>			
524.	37440 <i>Monopsis debilis</i> var. <i>depressa</i>	Y		
525.	<i>Naididae</i> sp.			
526.	<i>Nannoperca vittata</i>			
527.	<i>Necterosoma darwini</i>			
528.	<i>Necterosoma</i> sp.			
529.	<i>Nematoda</i> sp.			
530.	<i>Nemertini</i> sp.			
531.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
532.	24739 <i>Neophema petrophila</i> (Rock Parrot)			
533.	<i>Neosilurus hyrtlii</i>			
534.	492 <i>Neurachne alopecuroidea</i> (Foxtail Mulga Grass)			
535.	<i>Newmanoperla exigua</i>			
536.	<i>Notalina</i> nr. sp. AV14			
537.	25252 <i>Notechis scutatus</i> (Tiger Snake)			
538.	<i>Nousia</i> sp. AV16			
539.	<i>Nunciella aspera</i>			
540.	<i>Occiperipatoides gilesii</i>			
541.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
542.	<i>Oecetis</i> sp.			
543.	<i>Offadens soror</i> (ex genus 1 WA sp. 1)			
544.	2365 <i>Olox benthamiana</i>			
545.	8143 <i>Olearia paucidentata</i> (Autumn Scrub Daisy)			
546.	18254 <i>Opercularia apiciflora</i>			
547.	7346 <i>Opercularia echinocephala</i> (Bristly Headed Stink Weed)			
548.	18255 <i>Opercularia vaginata</i> (Dog Weed)			
549.	<i>Opisthopora</i> sp.			
550.	<i>Oribatida</i> sp.			
551.	11749 <i>Orthrosanthus laxus</i> var. <i>laxus</i> (Morning Iris)			
552.	24085 <i>Oryctolagus cuniculus</i> (Rabbit)	Y		
553.	<i>Ostracoda</i> (unident.)			
554.	4349 <i>Oxalis corniculata</i> (Yellow Wood Sorrel)	Y		
555.	4355 <i>Oxalis perennans</i>			
556.	<i>Oxyethira</i> sp.			
557.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
558.	<i>Paracladopelma</i> M1 [SFM]			
559.	20101 <i>Paragonis grandiflora</i>			
560.	<i>Paralimnophyes pullulus</i> (V42)			
561.	<i>Parameliidae</i> sp.			
562.	<i>Paramerina levidensis</i>			
563.	25253 <i>Parasuta gouldii</i>			
564.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
565.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
566.	7089 <i>Parentucellia latifolia</i> (Common Bartsia)	Y		
567.	7090 <i>Parentucellia viscosa</i> (Sticky Bartsia)	Y		
568.	27922 <i>Parmotrema chinense</i>			
569.	527 <i>Paspalum dilatatum</i>	Y		
570.	1542 <i>Patersonia babianoides</i>			
571.	1550 <i>Patersonia occidentalis</i> (Purple Flag, Koma)			
572.	30472 <i>Patersonia occidentalis</i> var. <i>occidentalis</i>			
573.	1551 <i>Patersonia pygmaea</i> (Pygmy Patersonia)			
574.	1552 <i>Patersonia rudis</i> (Hairy Flag)			
575.	11550 <i>Patersonia umbrosa</i> var. <i>xanthina</i> (Yellow Flags)			
576.	<i>Pentaneurini</i> genus V20			
577.	6245 <i>Pentapeltis peltigera</i>			
578.	6006 <i>Pericalymma ellipticum</i> (Swamp Teatree)			
579.	39058 <i>Perichaena depressa</i>			
580.	2267 <i>Persoonia longifolia</i> (Snottygobble)			
581.	2273 <i>Persoonia saccata</i> (Snottygobble)			
582.	<i>Perthiidae</i> sp.			
583.	48061 <i>Petrochelidon nigricans</i> (Tree Martin)			
584.	48066 <i>Petroica boodang</i> (Scarlet Robin)			
585.	2284 <i>Petrophile biloba</i> (Granite Petrophile)			
586.	2312 <i>Petrophile striata</i>			
587.	25698 <i>Phalacrocorax melanoleucos</i> (Little Pied Cormorant)			
588.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
589.	32409 <i>Philonotis australiensis</i>			
590.	18529 <i>Philothea spicata</i> (Pepper and Salt)			
591.	1173 <i>Philydrella pygmaea</i> (Butterfly Flowers)			
592.	<i>Phreodrilidae</i> sp.			
593.	48071 <i>Phylidonyris niger</i> (White-cheeked Honeyeater)			
594.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
595.	16177 <i>Phyllangium paradoxum</i>			
596.	4675 <i>Phyllanthus calycinus</i> (False Boronia)			
597.	<i>Phytophthora cinnamomi</i>			
598.	11667 <i>Pimelea brevistyla</i> subsp. <i>brevistyla</i>			
599.	5251 <i>Pimelea imbricata</i>			
600.	11402 <i>Pimelea imbricata</i> var. <i>piligera</i>			
601.	5259 <i>Pimelea preissii</i>			
602.	5260 <i>Pimelea rara</i> (Summer Pimelea)		P4	
603.	12041 <i>Pimelea suaveolens</i> subsp. <i>suaveolens</i>			
604.	8165 <i>Pithocarpa pulchella</i> (Beautiful Pithocarpa)			
605.	18353 <i>Pithocarpa pulchella</i> var. <i>pulchella</i>			
606.	<i>Planorbidae</i> sp.			
607.	25720 <i>Platycercus icterotis</i> (Western Rosella)			
608.	24747 <i>Platycercus spurius</i> (Red-capped Parrot)			
609.	25721 <i>Platycercus zonarius</i> (Australian Ringneck, Ring-necked Parrot)			
610.	<i>Platynectes</i> sp.			
611.	6253 <i>Platysace filiformis</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
612.	32413 <i>Pleuridium ecklonii</i>			
613.	573 <i>Poa drummondiana</i> (Knotted Poa)			
614.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
615.	<i>Poecilopta smaragdinea</i>			
616.	2419 <i>Polygonum aviculare</i> (Wireweed)	Y		
617.	<i>Polypedilum nr. convexum</i> (SAP)			
618.	<i>Polypedilum nubifer</i>			
619.	<i>Polypedilum watsoni</i>			
620.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
621.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
622.	1672 <i>Prasophyllum fimbria</i> (Fringed Leek Orchid)			
623.	1677 <i>Prasophyllum macrostachyum</i> (Laughing Leek Orchid)			
624.	10853 <i>Prasophyllum plumiforme</i>			
625.	<i>Procladius paludicola</i>			
626.	25259 <i>Pseudonaja affinis</i> subsp. <i>affinis</i> (Dugite)			
627.	25433 <i>Pseudophryne guentheri</i> (Crawling Toadlet)			
628.	13255 <i>Pterochaeta paniculata</i>			
629.	24173 <i>Pteropus scapulatus</i> (Little Red Flying-fox)			
630.	1686 <i>Pterostylis barbata</i> (Bird Orchid)			
631.	1693 <i>Pterostylis recurva</i> (Jug Orchid)			
632.	2720 <i>Ptilotus esquamatus</i>			
633.	2742 <i>Ptilotus manglesii</i> (Pom Poms, Mulamula)			
634.	<i>Purpureicephalus spurius</i>			
635.	32480 <i>Racopilum cuspidigerum</i> var. <i>convolutaceum</i>			
636.	<i>Raveniella cirrata</i>			
637.	6012 <i>Regelia ciliata</i>			
638.	<i>Rheotanytarsus trivittatus</i>			
639.	<i>Rheotanytarsus underwoodi</i>			
640.	48096 <i>Rhipidura albiscapa</i> (Grey Fantail)			
641.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
642.	15035 <i>Rhodanthe corymbosa</i>			
643.	13234 <i>Rhodanthe manglesii</i>			
644.	<i>Riethia v4</i>			
645.	<i>Riethia v5</i>			
646.	1556 <i>Romulea rosea</i> (Guildford Grass)	Y		
647.	20506 <i>Rubus anglocandicans</i>	Y		
648.	23990 <i>Rubus ulmifolius</i> var. <i>ulmifolius</i>	Y		
649.	2433 <i>Rumex crispus</i> (Curled Dock)	Y		
650.	40426 <i>Rytidosperma occidentale</i>			
651.	40427 <i>Rytidosperma setaceum</i>			
652.	7602 <i>Scaevola calliptera</i>			
653.	7613 <i>Scaevola glandulifera</i> (Viscid Hand-flower)			
654.	7635 <i>Scaevola pilosa</i> (Hairy Fan-flower)			
655.	6263 <i>Schoenolaena juncea</i>			
656.	972 <i>Schoenus armeria</i>			
657.	975 <i>Schoenus bifidus</i>			
658.	978 <i>Schoenus brevisetis</i>			
659.	979 <i>Schoenus caespititius</i>			
660.	991 <i>Schoenus grammatophyllus</i>			
661.	1002 <i>Schoenus nanus</i> (Tiny Bog Rush)			
662.	17614 <i>Schoenus plumosus</i>			
663.	1013 <i>Schoenus sculptus</i> (Gimlet Bog-rush)			
664.	18164 <i>Schoenus</i> sp. <i>smooth culms</i> (K.R. Newbey 7823)			
665.	1023 <i>Schoenus tenellus</i>			
666.	1026 <i>Schoenus unispiculatus</i>			
667.	17409 <i>Schoenus variicellae</i>			
668.	<i>Scirtidae</i> sp.			
669.	<i>Scolopendra laeta</i>			
670.	32433 <i>Sematophyllum homomallum</i>			
671.	8203 <i>Senecio diaschides</i>			
672.	8212 <i>Senecio leucoglossus</i>		P4	
673.	20663 <i>Senecio multicaulis</i> subsp. <i>multicaulis</i>			
674.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
675.	8225 <i>Siloxerus humifusus</i> (Procumbent Siloxerus)			
676.	<i>Simuliidae</i> sp.			
677.	30948 <i>Smicromis brevisrostris</i> (Weebill)			
678.	8231 <i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
679.	617 <i>Sorghum halepense</i> (Johnson Grass)	Y		
680.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
681.	4205 <i>Sphaerolobium linophyllum</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
682.	4207 <i>Sphaerolobium medium</i>			
683.	41623 <i>Sphaeromorphaea australis</i>	Y		
684.	4716 <i>Stachystemon vermicularis</i>			
685.	4733 <i>Stackhousia monogyna</i>			
686.	24645 <i>Stagonopleura oculata</i> (Red-eared Firetail)			
687.	39083 <i>Stemonitis fusca</i>			
688.	16197 <i>Stenanthemum emarginatum</i>			
689.	<i>Sternopriscus browni</i>			
690.	<i>Sternopriscus marginatus</i>			
691.	<i>Sternopriscus minimus</i>			
692.	<i>Sternopriscus</i> sp.			
693.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
694.	<i>Stratiomyidae</i> sp.			
695.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
696.	25589 <i>Streptopelia chinensis</i> (Spotted Turtle-Dove)	Y		
697.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
698.	7684 <i>Stylidium amoenum</i> (Lovely Triggerplant)			
699.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
700.	7694 <i>Stylidium bulbiferum</i> (Circus Triggerplant)			
701.	7696 <i>Stylidium calcaratum</i> (Book Triggerplant)			
702.	7699 <i>Stylidium carnosum</i> (Fleshy-leaved Triggerplant)			
703.	7702 <i>Stylidium ciliatum</i> (Golden Triggerplant)			
704.	7712 <i>Stylidium despectum</i> (Dwarf Triggerplant)			
705.	11808 <i>Stylidium diuroides</i> subsp. <i>diuroides</i>			
706.	7719 <i>Stylidium ecome</i> (Foot Triggerplant)			
707.	7721 <i>Stylidium emarginatum</i> (Biddy-four-legs)			
708.	19251 <i>Stylidium eriopodium</i>			
709.	7736 <i>Stylidium hispidum</i> (White Butterfly Triggerplant)			
710.	7745 <i>Stylidium junceum</i> (Reed Triggerplant)			
711.	7783 <i>Stylidium pycnostachyum</i> (Downy Triggerplant)			
712.	33106 <i>Stylidium recurvum</i>			
713.	7785 <i>Stylidium repens</i> (Matted Triggerplant)			
714.	7790 <i>Stylidium roseoalatum</i> (Pink-wing Triggerplant)			
715.	25806 <i>Stylidium scariosum</i>			
716.	<i>Stylidium</i> sp.			
717.	45594 <i>Stylidium tenue</i> subsp. <i>majusculum</i> (Showy Fountain Triggerplant)			
718.	23511 <i>Stylidium thesioides</i> (Delicate Triggerplant)			
719.	7806 <i>Stylidium utricularioides</i> (Pink Fan Triggerplant)			
720.	40947 <i>Stylidium xanthellum</i>			
721.	1260 <i>Stypandra glauca</i> (Blind Grass)			
722.	6476 <i>Styphelia tenuiflora</i> (Common Pinheath)			
723.	2323 <i>Synaphea gracillima</i>			
724.	16865 <i>Synaphea odocoileops</i>		P1	
725.	18590 <i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)		T	
726.	30751 <i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)		T	
727.	28354 <i>Synaphea</i> sp. Serpentine (G.R. Brand 103)		T	
728.	<i>Synsphyronus mimulus</i>			
729.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
730.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck, Mountain Duck)			
731.	<i>Tandanus bostocki</i>			
732.	<i>Tanytarsus fuscithorax/semibarbitarsus</i>			
733.	<i>Tanytarsus</i> nr K5			
734.	<i>Tanytarsus palmatus</i>			
735.	<i>Tanytarsus</i> sp. I (SAP)			
736.	24167 <i>Tarsipes rostratus</i> (Honey Possum, Noolbenger)			
737.	<i>Taschorema pallescens</i>			
738.	<i>Tasmanocoenis tillyardi</i>			
739.	20135 <i>Taxandria linearifolia</i>			
740.	<i>Tetragnatha maeandrata</i>			Y
741.	1033 <i>Tetralia australiensis</i>		T	
742.	1034 <i>Tetralia capillaris</i> (Hair Sedge)			
743.	1036 <i>Tetralia octandra</i>			
744.	667 <i>Tetrarrhena laevis</i> (Forrest Ricegrass)			
745.	4535 <i>Tetralthea hirsuta</i> (Black Eyed Susan)			
746.	4536 <i>Tetralthea hispidissima</i>			
747.	4537 <i>Tetralthea nuda</i>			
748.	1705 <i>Thelymitra crinita</i> (Blue Lady Orchid)			
749.	1707 <i>Thelymitra flexuosa</i> (Twisted Sun Orchid)			
750.	11143 <i>Thelymitra graminea</i>			
751.	11053 <i>Thelymitra macrophylla</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
752.	1715 <i>Thelymitra spiralis</i> (Curlylocks)			
753.	<i>Thienemanniella</i> sp. (V19) (SAP)			
754.	5080 <i>Thomasia foliosa</i>			
755.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
756.	32486 <i>Thuidium sparsum</i> var. <i>hastatum</i>			
757.	1317 <i>Thysanotus anceps</i>		P3	
758.	1328 <i>Thysanotus dichotomus</i> (Branching Fringe Lily)			
759.	1338 <i>Thysanotus manglesianus</i> (Fringed Lily)			
760.	1339 <i>Thysanotus multiflorus</i> (Many-flowered Fringe Lily)			
761.	1351 <i>Thysanotus sparteus</i>			
762.	1354 <i>Thysanotus tenellus</i>			
763.	1357 <i>Thysanotus thyrsoides</i>			
764.	1358 <i>Thysanotus triandrus</i>			
765.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
766.	<i>Tipulidae</i> sp.			
767.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
768.	8248 <i>Tolpis barbata</i> (Yellow Hawkweed)	Y		
769.	19041 <i>Trachymene coerulea</i> subsp. <i>coerulea</i>			
770.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
771.	1482 <i>Tribonanthes brachypetala</i>			
772.	39098 <i>Trichia favoginea</i>			
773.	8251 <i>Trichocline spathulata</i> (Native Gerbera)			
774.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
775.	24158 <i>Trichosurus vulpecula</i> subsp. <i>vulpecula</i> (Common Brushtail Possum)			
776.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
777.	1362 <i>Tricoryne humilis</i>			
778.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
779.	4293 <i>Trifolium cernuum</i> (Drooping Flower Clover)	Y		
780.	4304 <i>Trifolium ornithopodioides</i> (Birdsfoot Fenugreek)	Y		
781.	<i>Triplectides australis</i>			
782.	4737 <i>Tripterooccus brunonis</i> (Winged Stackhousia)			
783.	13479 <i>Trymalium ledifolium</i> var. <i>rosmarinifolium</i>			
784.	33418 <i>Trymalium odoratissimum</i> subsp. <i>odoratissimum</i>			
785.	24983 <i>Underwoodisaurus milii</i> (Barking Gecko)			
786.	<i>Urodacus novaehollandiae</i>			
787.	<i>Urodacus planimanus</i>			
788.	<i>Uromycladium tepperianum</i>			
789.	8255 <i>Ursinia anthemoides</i> (Ursinia)	Y		
790.	15431 <i>Verticordia acerosa</i> var. <i>acerosa</i>			
791.	12411 <i>Verticordia densiflora</i> var. <i>cespitosa</i>			
792.	15432 <i>Verticordia densiflora</i> var. <i>densiflora</i>			
793.	15433 <i>Verticordia huegellii</i> var. <i>huegellii</i>			
794.	14714 <i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>		P4	
795.	6107 <i>Verticordia pennigera</i>			
796.	12448 <i>Verticordia plumosa</i> var. <i>ananeotes</i>		T	
797.	12449 <i>Verticordia plumosa</i> var. <i>brachyphylla</i>			
798.	15618 <i>Verticordia plumosa</i> var. <i>plumosa</i>			
799.	4325 <i>Viminaria juncea</i> (Swishbush, Koweda)			
800.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
801.	724 <i>Vulpia myuros</i> (Rat's Tail Fescue)	Y		
802.	7389 <i>Wahlenbergia preissii</i>			
803.	1567 <i>Watsonia meriana</i> (Bulbil Watsonia)	Y		
804.	18108 <i>Watsonia meriana</i> var. <i>bulbillifera</i>	Y		
805.	32456 <i>Weissia rutilans</i>			
806.	34113 <i>Westralunio carteri</i> (Carter's Freshwater Mussel)		T	
807.	<i>Wheenyoides cooki</i>			
808.	1394 <i>Wurmbea dioica</i> (Early Nancy)			
809.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
810.	<i>Xanthagrion erythronurum</i>			
811.	1249 <i>Xanthorrhoea acanthostachya</i>			
812.	1253 <i>Xanthorrhoea gracilis</i> (Graceful Grass Tree, Mimidi)			
813.	1256 <i>Xanthorrhoea preissii</i> (Grass tree, Palga)			
814.	6284 <i>Xanthosia candida</i>			
815.	6285 <i>Xanthosia ciliata</i>			
816.	6289 <i>Xanthosia huegellii</i>			
817.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye, Silvereye)			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
S	Other specially protected fauna			
1	Priority 1			
2	Priority 2			
3	Priority 3			
4	Priority 4			
5	Priority 5			

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix B

Land Capability Assessment (Emerge Associates 2017b)



Document Reference: EP17-071(02)--011

Emerge contact: Anna Welker

10 October 2017

Attention: Shire of Serpentine Jarrahdale
Paterson Street
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Dear Sir/Madam

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LAND CAPABILITY ASSESSMENT – LOT 9 HARDEY ROAD, SERPENTINE

Emerge Associates was engaged by Serene Environs to prepare a *Land Capability Assessment* (LCA) (Emerge Associates 2017) for Lot 9 Hardey Road, Serpentine (herein referred to as 'the site'). The LCA was undertaken to support the initiation of a amendment to the Shire of Serpentine Jarrahdale's *Town Planning Scheme No. 2* (TPS No.2) to rezone the site from 'Rural' to 'Rural Living A'.

Specifically, the LCA was prepared on the assumption that the proposed development would include rural-residential lots of approximately 4,000 m², where each future lot would include an onsite effluent treatment and disposal system. This approach is allowable under the proposed Rural Living A zone; however, as the site is located within an identified Sewerage Sensitive Area, under the *draft Government Sewerage Policy* (DoP 2016), a minimum lot size of 1 ha is mandated for any Lots that are proposed to include onsite effluent treatment and disposal.

The LCA was prepared to outline, based on site specific environmental characteristics and detailed calculations of nutrient loading and discharge areas, how smaller lots could adequately support the use of onsite effluent disposal systems without negatively impacting on the environment. The LCA demonstrated that for 4,000 m² lots, this approach could satisfy the *draft Country Sewerage Policy* (DoH 2003) and could meet the intent of the *draft Government Sewerage Policy* (DoP 2016). The LCA has been provided as an attachment to this letter for your reference.

Since the preparation of the LCA, the development concept for the site has been revised to increase the size of the rural-residential lots to a minimum of 1 ha, while still proposing onsite effluent treatment and disposal. While the justification for small lots within the LCA is no longer relevant, the assessment of the environmental characteristics of the site and their ability to support onsite effluent treatment and disposal is still considered relevant for the revised concept.

The LCA demonstrates that, regardless of the concept, the site has the capacity for onsite effluent treatment and disposal. In addition to this, the revised concept now also meets the minimum 1 ha lots size mandated under the *draft Government Sewerage Policy* (DoP 2016).

Yours sincerely
Emerge Associates



Anna Welker
SENIOR ENVIRONMENTAL CONSULTANT

Encl: Land Capability Assessment (Emerge Associates 2017)

OCM 18 December 2017

Enclosure A

Land Capability Assessment (Emerge Associates 2017)



Land Capability Assessment

Lot 9 Hardey Road, Serpentine

Project No: EP17-071(02)

**Prepared for Serene Environs
August 2017**

Land Capability Assessment

Lot 9 Hardey Road, Serpentine



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Appendix B

Wastewater Generation Analysis

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Application of Draft Government Sewerage Policy (2016)

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1 Introduction

1.1 Background

Emerge Associates was engaged by Serene Environs to undertake a land capability assessment for 147 Hardey Road, Serpentine (herein referred to as 'the site'), as shown in the attached **Figure 1**. The site is situated within the Shire of Serpentine-Jarrahdale and is approximately 23 hectares (ha). It is currently zoned 'Rural' under both the *Metropolitan Region Scheme* and the Shire of Serpentine Jarrahdale's *Town Planning Scheme No. 2 (TPS No.2)*.

This assessment has been undertaken to support the initiation of a proposed amendment to TPS No.2 to allow for rural residential subdivision and land uses within the site. The landowner's intention is to pursue rural-residential subdivision to create lots of approximately 4,000 m², with onsite effluent treatment and disposal.

For the purposes of the draft Government Sewerage Policy (draft GSP) (Department of Planning 2016), it is not clear whether the proposed rural residential development qualifies for an exemption from the requirement to connect to reticulated sewerage (under Section 6.2 of the draft GSP); however, based on engineering and feasibility constraints, it is not considered reasonable for development within the site to be connected to reticulated sewer. In addition to this, the Water Corporation has advised that the Serpentine Township sits outside the wastewater scheme planning area, therefore no sewer services are to be provided in this area (JDSi 2017).

This land capability assessment has been undertaken specifically to determine the suitability of the site to support onsite domestic effluent treatment and disposal, while also addressing other relevant land capability and environmental considerations.

This report is intended to support the broad consideration of the proposed land use as part of the scheme amendment process. It is therefore intended to be preliminary and at an appropriate level for the consideration of the acceptability of the land use generally within the site. It should be acknowledged that additional and more specific and detailed investigations may be required to support future stages of the planning and development approvals process.

1.2 Proposed development

The site is proposed to be developed into 4,000 m² rural residential lots, in line with the proposed 'Rural Living A' land use zoning under the Shire of Serpentine Jarrahdale TPS No. 2. Each proposed lot will be a minimum 4,000 m² in size and is proposed to be serviced by an onsite effluent treatment and disposal system, utilising nutrient retentive secondary treatment systems as approved for use in Western Australia by the Department of Health.

The specific onsite disposal systems proposed within the site will be designated as part of future development planning and approval stages; however, the capability of the site to support onsite effluent disposal within lots less than 1 ha in size (as required under the draft GSP (Department of Planning 2016)) has been assessed and is outlined in this report.

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2 Description of the existing environment

As part of this assessment, Emerge Associates have undertaken a review of the existing available background contextual and environmental information for the site and its general surrounds. The findings of this review are summarised below.

2.1.1 Topography

LIDAR generated topographic contour data (DoW 2008) indicates that the site is generally gently sloping with a north-westerly aspect, with existing ground levels ranging from 43 metres Australian height datum (m AHD) in the south-eastern portion of the site, down to 38 m AHD in the north-western portion of the site. Topographic contours over the site are shown in **Figure 1**.

2.1.2 Landforms and soils

Regional soil mapping has been prepared across the Serpentine locality at a scale of 1:50 000 as part of a series of geological maps published by the Geological Survey of Western Australia (Jordan 1986). This mapping also outlines the expected broad level capability of soil and rock units to accommodate various land uses.

The mapping indicates that three soil units occur within the site, as shown in **Figure 2**. These include:

- **Sandy Clay (Cs)** which is described as ‘white grey to brown, fine to course, sub-angular to rounded, clay of moderate plasticity; gravel and silt layers near scarp, of alluvial origin’. Jordan (1986) identified that in terms of land capability within this soil type, possible issues could exist for the use of septic tanks due to the possibility of seasonal flooding in certain areas across this broadly mapped soil unit. In addition Jordan (1986) outlines that ‘sand pads’ may be required beneath building foundations.
- **Sand (S8)** which is described as ‘white to pale grey at surface, yellow at depth, fine to medium grained, moderately sorted sub-angular to sub-rounded, minor heavy minerals, or eolian origin’. Jordan (1986) identified that in terms of land capability, the use of septic tanks is considered compatible with this soil type.
- **Sand (S10)** which is described as ‘S8 over sandy clay to clayey sand of the Guildford formation’. Jordan (1986) identifies that in terms of land capability within this soil type, possible issues could exist for the use of septic tanks due to the high water table in certain areas across this broadly mapped soil unit.

The Cs soil unit is identified as occurring across the majority of the site, with a lesser extent of the S8 soil unit, and a very small (almost negligible) extent of the S10 soil unit. It is noted, that the above broad descriptions do not take into consideration site specific characteristics which have been further investigated as part of this assessment and are outlined below.

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Land resources in the northern section of the Peel-Harvey catchment, Swan Coastal Plain, Western Australia Map (van Gool 1990) was prepared for regional and catchment land use planning purposes. The associated soil and landform mapping was prepared at a scale of 1:50 000 and identified the site as being situated on three broadly defined soil-landform 'land units'. These land units include:

- **Pinjarra P1a Phase** which was broadly described as 'flat to very gently undulating plain. Imperfect to poorly drained and generally not susceptible to salinity'. It identified this soil-landform 'land unit' as having a 'Low' (IV) land use capability class for 'rural retreats housing and effluent disposal' attributed to the low soil absorption ability. The soil absorption rating is determined by a number of factors including waterlogging and inundation risk, soil permeability class, the presence of stones/boulders within the soil profile and the depth of the soil profile. Therefore these factors have been given particular consideration in the site specific investigations.
- **Pinjarra B1 Phase** which was broadly described as 'extremely low to very low relief dunes, undulating sandplain and discrete sand rises'. It identified this soil-landform 'land unit' as having a 'Low' (IV) land use capability class for 'rural retreats housing and effluent disposal' attributed to the microbial purification ability of this broadly mapped 'land unit'. Microbial purification is essentially a measure of the permeability and aeration within a soil profile, which influences its ability to remove undesirable micro-organisms from septic effluent and provide suitable conditions for the oxidation of some organic and inorganic compounds added to the soil as effluent. Therefore the microbial purification ability of the soils encountered at the site has been given consideration during the site specific investigations as outlined further below.
- **Forrestfield F2b Phase** which was broadly described as 'well drained low slopes and foot slopes up to 5-10%'. It identified this soil-landform 'land unit' as having a 'Fair' (III) land use capability class for 'rural retreats housing and effluent disposal'.

The Pinjarra P1a Phase land unit was identified as occurring across the majority of the site, with Pinjarra B1 Phase occurring in the western portion of the site, and the Forrestfield F2b Phase only marginally occurring in the north-eastern corner of the site.

The regional landform and soil mapping outlined above indicated that potential issues could arise for the use of onsite effluent disposal due to the potential for seasonal flooding, a high water table, low soil absorption and low microbial purification ability. Because of this, site-specific investigations have been undertaken to consider these factors within the site, and the suitability of the site for onsite effluent disposal based on site specific considerations, as detailed in **Section 3**.

2.1.3 Acid Sulfate Soils

Acid sulfate soil (ASS) risk mapping prepared by the Department of Environment Regulation (DER 2014) indicates that within the site there is a 'moderate to low risk of ASS occurring within 3 m of the natural soil surface, but a high to moderate risk of ASS occurring beyond 3 m of the natural soil surface.

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2.1.4 Groundwater

The site is found within the Serpentine Groundwater Area and the Serpentine 3 Groundwater Sub-area. Information on the regional groundwater resources obtained from the Department of Water (DoW) Water Register (DoW 2015) indicates that the site is underlain by a multi-layered aquifer system comprised of the following resources:

- Perth - Superficial Swan (unconfined).
- Perth – Cattamarra Coal Measures (confined).
- Perth - Leederville (confined).

There are no regional groundwater contours available for the site, although groundwater levels were considered as part of the site specific investigations described further in **Section 3**.

2.1.5 Surface water

Broadly speaking the site is located approximately 2 km south of the Serpentine River within the Serpentine sub-catchment of the broader Peel-Harvey Catchment.

Regional hydrographical mapping prepared by the Department of Water (DoW 2012) identifies three surface water features within the site, comprising two farm dams and the Arnold Road Main Drain situated in the east of the site. The drain flows from the south, through the site and then through the existing rural residential area to the north of the site, and ultimately discharges to the Serpentine River.

The majority of the site is mapped as multiple use wetland (MUW), with a small area in the western portion of the site mapped as a resource enhancement wetland (REW) (DPaW 2016). Given the general absence of remnant vegetation within the site, and the regional landforms and soils mapping, the extent of this mapped REW is unlikely to be reflective of wetland conditions on the ground. The extent of MUW and REW was specifically investigated further during the site specific on ground investigations, as outlined in **Section 3**.

2.1.6 Public Drinking Water Source Areas

Publically available Public Drinking Water Source Area (PDWSA) mapping (DoW 2015) indicates that the site is not located within or adjacent to any declared PDWSA.

2.1.7 Vegetation

Based on a review of historic aerial photography, the site has been largely cleared of vegetation to support pastoral land uses, primarily horse agistment. Regional vegetation complex mapping undertaken by Beard et al. (2013) indicates that one vegetation association would have historically occurred across the site. This vegetation association is Pinjarra 968 which is broadly described as 'Jarrah, Marri and wandoo *Eucalyptus marginata*, *Corymbia calophylla*, *E. wandoo*'. Given its current condition, vegetation within the site is unlikely to be representative of this association.

A preliminary site inspection was undertaken by Emerge Associates in July 2017 which confirmed that the vegetation across the site is in a highly degraded condition and consists predominantly of parkland cleared areas with planted native and exotic species and sparse remnant native species

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dotted throughout. Three vegetation communities were identified in the site which includes three areas of parkland cleared, characterised by slightly varying species or structure.

The proposed development of the site is unlikely to result in a significant impact on vegetation within the site as clearing is likely to be minimal with the promotion of vegetation retention within private lots, where possible. The consideration and management of vegetation as part of the proposed future development of the site is further considered in the Environmental Assessment and Justification Report (Emerge 2017).

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3 Site Specific Investigations

3.1 Methodology

Site specific investigations into the soil and groundwater conditions within the site were undertaken in November 2016. The methodology adopted for these investigations are described further below.

3.1.1 Soil test/observation pits

Four locations were chosen for the installation of soil test/observation pits, as shown in **Figure 2**. Test pits were excavated to a depth of approximately 2.5 m using a backhoe, as shown below in **Plate 1** and **Plate 2**. The soil profiles were logged, and depths at which groundwater was encountered was also recorded.



Plate 1: Test pit location 1 after being excavated

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Plate 2: Test pit location 2 after being excavated

3.1.2 Infiltration testing

The field investigation also included infiltration testing using a double ring infiltrometer, which allows for a direct measurement of the soil's infiltration capacity, or hydraulic conductivity.

The methodology involved the saturation of the soil for a period of at least 30 minutes prior to each test. This ensures that the measured infiltration rates are fully representative of saturated soil conditions. Where possible, the infiltration testing equipment was set to 300 mm below the ground surface to simulate the infiltration of subsurface effluent disposal structures. This was achieved by scraping away the top 300 mm of the soil profile with an excavator bucket.

3.2 Observations and findings from site specific investigations

3.2.1 General summary of site observations and conditions

During the site investigations, observations were made in relation to the general characteristics and physical conditions within the site. These observations confirmed that the topography, landform and vegetation descriptions provided in **Section 2** are generally consistent with the actual condition and characteristics of the site however the presence of features typically associated with wetland areas were not observed.

The topography of the site was observed to be gently sloping with minor undulations. The site has a general northwest aspect, with a small knoll in the western portion of the site where the existing dwelling is located. It was apparent that some earthworks had been undertaken to facilitate the construction of buildings, internal access tracks, minor drainage channels and dams.

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The site has been cleared to facilitate agricultural uses, with the majority of vegetation cover across the site comprising of pasture grasses. Some native trees have been retained, particularly along the site boundaries and around the dwelling in the western portion of the site. Regional vegetation mapping described in **Section 2** (Beard *et al.* 2013) is generally indicative of the remnant vegetation observed across the site, albeit it from a vegetation structure point of view it is no longer considered intact.

In addition to the farm dams in the western portion of the site and water course (Arnold Road Main Drain) along the eastern site boundary as noted in **Section 2**, there are a number of minor drainage channels which have been constructed within the site. These drains follow the trotting track and internal access roads, with some smaller drains observed along selected fence lines. Some of these drains appear to discharge into the constructed dams within the site however some of these drains appear to direct water toward a discharge point at the western boundary of the site.

At the time of the initial site inspection (November 2016) the site conditions were generally dry, and there was no evidence of wet or waterlogged soil conditions. Pasture grasses had started to dry and senesce, indicating the dry surface soils and the absence of moisture in the sub-soils.

3.2.2 Soil test/observation pits

The soil profiles observed in the test pits have been recorded as logged and are contained in **Appendix A**. A basic summary of these is provided below in **Table 1**.

Table 1: Basic soil profile descriptions

Test Pit/Soil Type	Soil Depth (metres below ground level (BGL))
Test Pit 1 (TP01)	
Silty SAND	0.0 – 0.6 m
Sandy CLAY	0.6 – 2.4 m
Sandy Gravelly CLAY	2.4 – 2.5 m
Test Pit 2 (TP02)	
Clayey Silty SAND	0.0- 0.5 m
Sandy CLAY	0.5- 2.3 m
Sandy Gravelly CLAY	2.3- 2.4 m
Test Pit 3 (TP03)	
Silty SAND	0.6 m
Sandy Gravelly CLAY	0.6 – 1.0 m
Sandy CLAY	1.0 – 2.5 m
Test Pit 4 (TP04)	
Silty SAND	0.0 – 0.6 m
Sandy CLAY	0.6 – 2.3 m
Sandy Gravelly CLAY	2.3- 2.6 m

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Duplex soils were encountered at all test pit locations, generally comprising of silty sand up to 0.6 m below ground level (BGL), over sandy clay and sandy gravelly clay from 0.5 m to 2.6 m (or the extent of the test pit). The depth of the soil profile (depth to bedrock or impervious layer) encountered at each of the test pit locations is considered to be 'very deep' in accordance with Table A1.2 of *Land evaluation standards for land resource mapping : assessing land qualities and determining land capability in south-western Australia* (Van Gool *et al.* 2005).

3.2.3 Groundwater observations

The depth to groundwater encountered at each test pit location ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site. Given that the site investigation was undertaken in November when groundwater levels are typically at a seasonal high, these levels are expected to be generally representative of annual maximum groundwater levels. The groundwater depths are summarised below in **Table 2**.

Table 2: Depths at which groundwater was encountered within test pits

Test location	Depth Groundwater Encountered
TP01	1.0 m
TP02	1.6 m
TP03	1.5 m
TP04	1.8 m

3.2.4 Infiltration testing

The results of the infiltration testing undertaken within the site are summarised below in **Table 3**.

Table 3: Hydraulic conductivity at various test locations

Test location	Infiltration Rate (m/day)	Infiltration Rate (mm/hour)	Classification (Van Gool <i>et al.</i> , 2005)	Comment
TP01	10.16	423	Very Rapid (VR)	Equipment set 300mm below ground surface. Sand, some silt, fine to medium grained.
TP03	1.10	45.8	Moderate (M)	Equipment set 300mm below ground surface. Ground is firm, silty sand, fine grained.
TP04	3.30	137.5	Rapid (R)	Equipment set at ground surface (Grass and roots scraped back). Ground is firm, silty sand, fine grained.

Based on the classification system provided in Van Gool *et al.* (2005) the permeability of the soils ranged from 'Moderate' to 'Very Rapid'.

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4 Land Capability Assessment

Based on engineering and feasibility constraints, it is not considered reasonable for development within the site to be connected to reticulated sewer and exemption from the requirement to connect to reticulated sewerage is considered appropriate. In addition to this, the Water Corporation has advised that the Serpentine Township sits outside the wastewater scheme planning area, therefore no sewer services are to be provided in this area (JDSi 2017).

Given the above, the following sections outline how the proposed development within the site, incorporating onsite effluent disposal, addresses the requirements of the *Australian/New Zealand Standard 1547:2012 On-site domestic wastewater management (AS/NZS 1547)* (Standards Australia and Standards New Zealand 2012), the draft Country Sewerage Policy (DoH 2002), and the draft GSP (Department of Planning 2016).

4.1 AS/NZS 1547:2012 On-site domestic wastewater management

AS/NZS 1547 (Standards Australia 2012) outlines a framework to consider the requirements for domestic wastewater treatment units and their land application systems to achieve sustainable and effective on-site domestic wastewater management, to protect public health and the environment. AS/NZS 1547 identifies the suitability of various land application systems for differing site, soil and climatic factors. These factors have been outlined below with specific consideration of the site characteristics and suitability for onsite effluent disposal.

Table 4: Site, soil and climatic considerations for land application systems (adapted from AS/NZS 1547)

Site, soil or climatic factor	Considerations for land application systems	Site specific considerations
Slope gradient	The maximum slope suitable depends on the type of system proposed but generally ranges from 10% to 30%. Soil disturbance and erosion during construction generally increases with slope.	Based on LIDAR derived topographic data (DoW 2008), the slope of the site ranges from <1% to 5% and therefore slope would not be considered a limiting factor for onsite effluent disposal systems.
Soil and seasonal water table depth	Soil depth must be deep enough to store effluent during periods of wet weather and low evapotranspiration. Generally a minimum of 0.6 m storage separation is required from the maximum seasonal water table however this may increase if soils are highly permeable. Soil depth is less important for certain land application systems such as mounds as these systems are designed to overcome shallow soil limitations.	As the depth to groundwater encountered across the site ranged from 1.0 m to 1.8 m, it is considered that the soil depth at the site is adequate to accommodate various land application systems.

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Site, soil or climatic factor	Considerations for land application systems	Site specific considerations
Soil permeability	Soils with high permeability can result in leaching of nutrients and groundwater pollution. Soils with low permeability may not adequately allow effluent to infiltrate, and land application systems in these soils require special design consideration.	Soil permeability within the site ranges from 'moderate' to 'very rapid'. Although soils with high permeability ('very rapid') can cause groundwater pollution, there are various systems which can accommodate these types of soils including mounds and evapotranspiration absorption (ETA) beds or trenches. In addition, the deeper soils within the site may have a higher ability to retain nutrients (particularly phosphorus) although this has not been specifically determined at this stage.
Duration of continuous seasonal soil saturation	Periods of continuous saturation of the upper 0.4 m of the soil should not exceed several weeks at any one time. Soils where this occurs are classed as 'poorly' or 'very poorly drained' and should not be used for land application systems unless the problem can be overcome.	Damp soil was not encountered above 0.8 m BGL. As outlined previously, the timing of the site investigation would have captured seasonal high groundwater levels and therefore saturation above 0.4 m BGL is not expected.
Dispersive (sodic) soil	All land application systems are potentially useable in sodic soils. Gypsum can be applied to the receiving soil if necessary.	Regional soil mapping indicates that the soils within the site are generally not susceptible to salinity and no evidence of salinity was encountered during the site investigation. As outlined in AS/NZS 1547, all land application systems are potentially useable in sodic soils.
High content of stones, cobbles, boulders	Stones and boulders have little or no water storage capacity and reduce water storage capacity in the soil. They also increase the difficulty of excavation.	Soils across the site are generally silty sand and sandy clay, with gravels only experienced at depths > 2m (with the exception of TP03 which was 0.6 m). Therefore the presence of stones, cobbles and/or boulders is not a limiting factor.
Lot size	All land application systems outlined in AS1547:2012 can be used within small lots however greater care is required for design to ensure desired land use can be accommodated. Consideration of any necessary setbacks is also required, including setbacks to water courses and water bodies.	Future lots are proposed to be 4,000 m ² . As outlined previously, a watercourse is located within the site. Table R1 of AS/NZS 1547 outlines that a setback distance of 15-100 m is required from the edge of the land application system to the edge of the waterbody. AS/NZS 1547 acknowledges that advice on buffer requirements should be sought from the relevant water authority and a hydrogeologist. Future development of the site will need to consider the necessary setbacks from surface water features, but this would not overly constrain the site.
Microbial purification ability	Management options for low microbial purification ability are similar to waterlogging. (DoA 2005) and include alternative methods for handling household effluent such as aerobic treatment units which utilise leach drains where the soil is amended with bauxite residue, or small local treatment plants. Less desirable is the provision of a sand pad to elevate leach drains two metres above the highest seasonal watertable. (DoA 2005).	Microbial purification ability was determined using Table 2.4 of DoA, 2005. Based on the results of the onsite permeability and depth to ground water investigation, microbial purification ability ranges from Low (at TP01 and TP04) to Moderate (at TP03). This may require further consideration, but is not expected to preclude onsite effluent treatment and disposal.

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4.2 Draft Country Sewerage Policy (DoH 2002)

Clause 5.2 of the Draft Country Sewerage Policy (DoH 2002) permits wastewater disposal on lots greater than 2,000 m² in size where specific requirements are met, including minimum clearance to groundwater, suitable soil characteristics to support onsite waste disposal, and suitable topographic characteristics. Based on these requirements, the site-specific characteristics (as discussed above) and the proposed minimum lot size of 4,000 m² within the site are compliant with the current policy.

4.3 Draft Government Sewerage Policy (DoP 2016)

It is not clear whether the proposed rural residential development qualifies for an exemption under Section 6.2 of the draft GSP, from the requirement to connect to reticulated sewerage, as it is not clear where rural residential development falls given the provisions that are outlined below.

The draft GSP (2016) designates Sewerage Sensitive Areas, which are defined as areas within specific distances of estuary catchments, major waterways or coastal areas, wetlands, and/or significant flora, vegetation or fauna habitat areas (Department of Planning 2016). A minimum lot size of 1 ha is required within designated Sewerage Sensitive Areas (Department of Planning 2016) in order to adequately accommodate the assumed nutrient loading associated with factors such as dwelling size and occupancy, garden size and fertiliser rates, water usage, etc.

The site is located within a Sewerage Sensitive Area; however, the assumptions used to inform the minimum lot size are considered to be highly conservative, and not likely to apply to this type of development. Detailed calculations have been undertaken to determine the nutrient loading and discharge area for 4,000 m² lots based on the use of nutrient retentive ATUs, as outlined in **Appendix B**. Based on this analysis, the potential nutrient loading to the site from the proposed 4,000 m² lots is less than the assumed loading from the larger 1 ha lots as shown in **Table 5** below.

Table 5: Results of nutrient analysis – total nutrient loading to site based on lot size

Total loading	1 ha lots		4,000 m ² lots	
	Min	Max	Min	Max
TN (kg/yr)	72,275	72,278	58,223	58,226
TP (kg/yr)	7,228	7,228	5,822	5,823

In addition to this, as outlined in **Appendix B**, the proposed 4,000 m² lots are easily able to accommodate the required discharge/application area.

Based on the findings from the assessment, the requirements of the draft GSP (2016) have been responded to in detail in **Appendix C**, with a summary of the key points provided below:

- The information requirements as outlined in Schedule 2 of the draft GSP (*Supporting information for planning applications where on-site sewage disposal is proposed*) have been addressed or can be addressed as part of the subdivision approval, detailed design and subdivision condition clearing process.
- All proposed lots within the site will meet the minimum requirements for onsite sewage disposal as outlined in Schedule 3 (*Site requirements for on-site sewage disposal systems*).

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- The reliance upon ATUs for sewerage disposal will impose limitations on the types of system used and the size of garden beds (i.e. fertilised areas) within lots, as outlined in **Appendix B**.
- The specific conditions at the site will allow for 4,000 m² lots with certain provisions/restrictions, including (but not limited to) necessitating the use of secondary treatment systems (i.e. nutrient retentive secondary treatment systems such as aerobic treatment units (ATUs) or alternative treatment systems) over traditional septic tank units, and limiting garden size within each lot.

It is expected that any requirements for future investigations, associated system selection and design responses can be addressed through scheme provisions within the proposed town planning scheme amendment.

4.4 Proposed treatment system

It is proposed that each lot will be provided with a secondary treatment system. These will be installed at the time of built form construction and will then be regularly maintained as part of the ongoing operating and maintenance arrangements for the leased facilities. Treated wastewater will be disposed of within each lot within the designated disposal area. Given the size of the proposed Rural Living lots, disposal will be more than adequately contained within the individual lot area. The calculations to demonstrate the area required for disposal are shown in **Appendix B**.

Only Department of Health approved wastewater systems can be used in Western Australia, and therefore premises owners who install an unapproved system contravene the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974*.

The ultimate selection of the most appropriate wastewater treatment and disposal systems for the site-specific characteristics can be determined at future planning stages through a more detailed engineering and servicing design. Notwithstanding this, it is recommended that nutrient retentive secondary systems (ATUs/alternative treatment systems) be used in order to allow for the proposed lot size (minimum 4,000 m²), to respond to localised soil and groundwater constraints and broader potential concerns regarding nutrient losses. It is also possible that conventional septic tank and leach drain systems could be adopted in part or all of the site, if localised responses (i.e. soil amendment and/or the placement of additional fill) are pursued where required. It is expected that the requirements for both future investigations and associated system selection and design responses can be addressed through scheme provisions associated with the future town planning scheme amendment.

5 Summary and Conclusions

Regional landform and soil mapping for the site indicates that there are no site characteristics of the site that would result in un-manageable issues due to the use of onsite effluent disposal systems. Potential aspects which may require some form of management/engineering response include seasonal flooding, a high water table, low soil absorption and low microbial purification ability. Site specific investigations undertaken in November 2016 have considered these factors.

Based on the site specific investigation undertaken in November 2016, the site is considered to provide adequate separation to groundwater (1.0 to 1.8 m) for land application systems in accordance with AS/NZS 1547. Therefore the site is not expected to be subject to seasonal flooding or a high water table that would limit the use of the site for onsite effluent treatment and disposal.

Soil absorption and microbial purification ability takes into consideration waterlogging and inundation risk, soil permeability class, the presence of stones/boulders within the soil profile and the depth of the soil profile. The site-specific investigation did not identify any characteristics that would suggest that the site has a low soil absorption ability. However, infiltration testing and the depth to groundwater recorded at TP01 indicates that permeability is high at this location, and this location also had the least separation to groundwater (1.0 m) which suggests potentially low microbial purification ability at some areas within the site. Potentially low microbial purification ability of soils within the site can be readily managed through the careful selection and design of future land application systems within the site, including measures such as secondary treatment, disinfection and/or nutrient removal.

In addition to this, detailed calculations have been undertaken to determine the nutrient loading and discharge area for 4,000 m² lots based on the use of nutrient retentive ATUs. Based on this analysis, the potential nutrient loading to the site from the proposed 4,000 m² lots is less than the assumed loading from the larger 1 ha lots specified in the draft GSP. In addition to this, the proposed 4,000 m² lots were found to easily accommodate the required discharge/application area. Based on this, the proposed 4,000 m² lots are considered appropriate for the use of onsite effluent treatment and disposal.

It is expected that future detailed designed will be informed by more detailed geotechnical investigations. The system selection and installation methodology should be further refined based on lot-scale assessment of soil conditions. Given that the site characteristics do not preclude the proposed land uses and that future investigations will further inform system selection and design, it is concluded that the potential regional characteristics and associated limitations are unlikely to be encountered within the site, or can be readily managed through careful selection and design of future land application systems.

6 References

6.1 General references

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Department of Planning 2016, *Draft Government Sewerage Policy*, Perth, Western Australia.

Department of Health (DoH) 2002, *Draft Country Sewerage Policy*, Department of Health, Perth.

Jordan, J. E. 1986, *Serpentine Part Sheets 2033 II and 2133 III*, Perth Metropolitan Region, Environmental Geology Series. Geological Survey of Western Australia, Perth.

Standards Australia and Standards New Zealand 2012, *AS/NZS 1547:2012 On-site domestic wastewater management*, Sydney, New South Wales.

Van Gool, D., Tille, P. and Moore, G. 2005, *Resource Management Technical Report 298: Land evaluation standards for land resource mapping - assessing land qualities and determining land capability in South-Western Australia*, Western Australia.

6.2 Online references

Department of Water (DoW) 2015, Water Register, viewed August 2017, <http://www.water.wa.gov.au/ags/WaterRegister>

Land Capability Assessment

Lot 9 Hardey Road, Serpentine



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Figures



Figure 1: Location and Site Plan

Figure 2: Regional Soil Mapping and Test Pit Locations

Figure 3: Geomorphic Wetlands and Watercourses

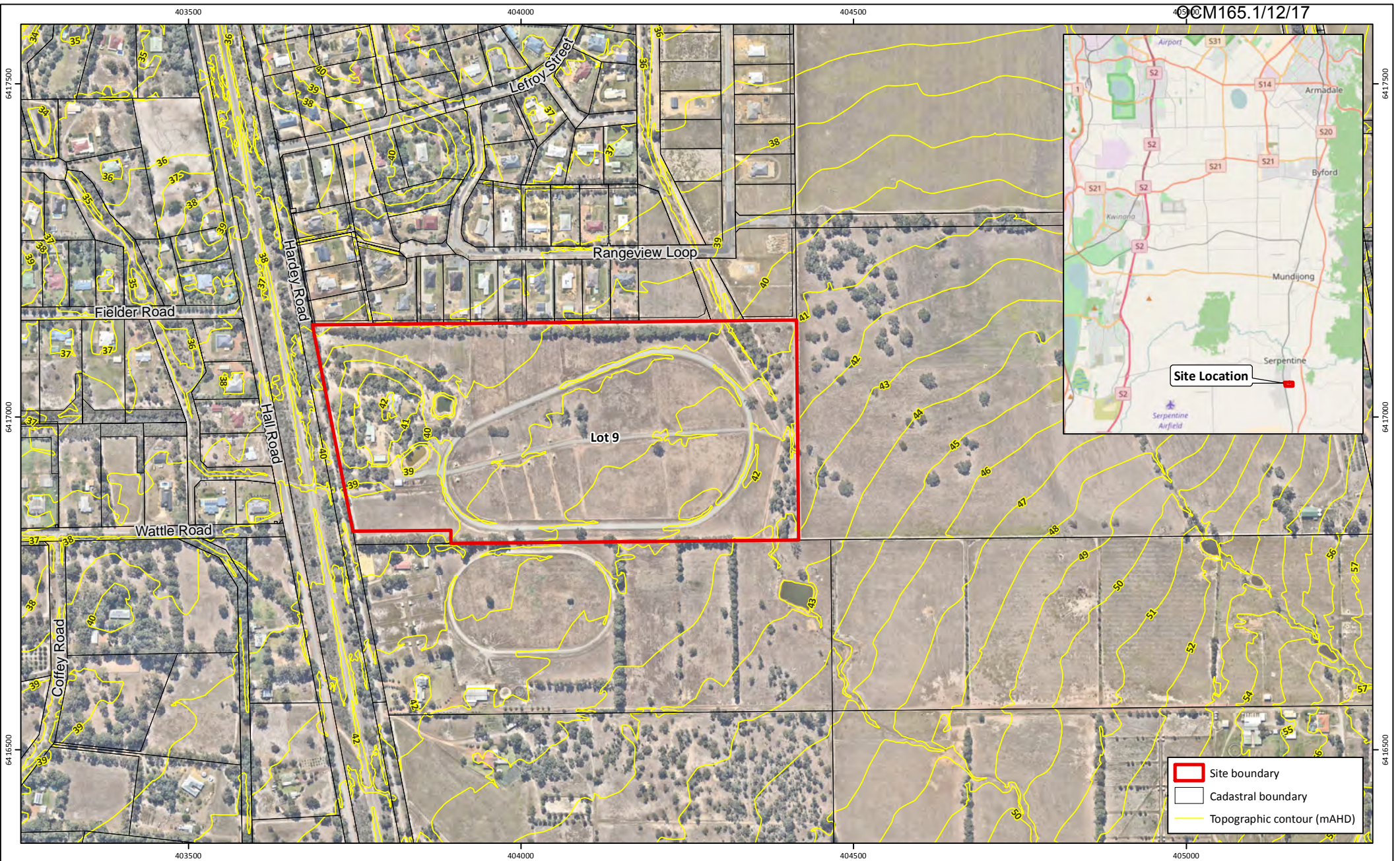


Figure 1: Location and Site Plan

Project: Land Capability Assessment
 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
 EP17-071(02)--F11

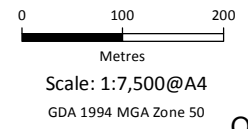
Drawn: KNM

Date: 02/08/2017

Checked: VMK

Approved: DPC

Date: 07/08/2017



- Site boundary
- Cadastral boundary
- Topographic contour (mAHd)



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

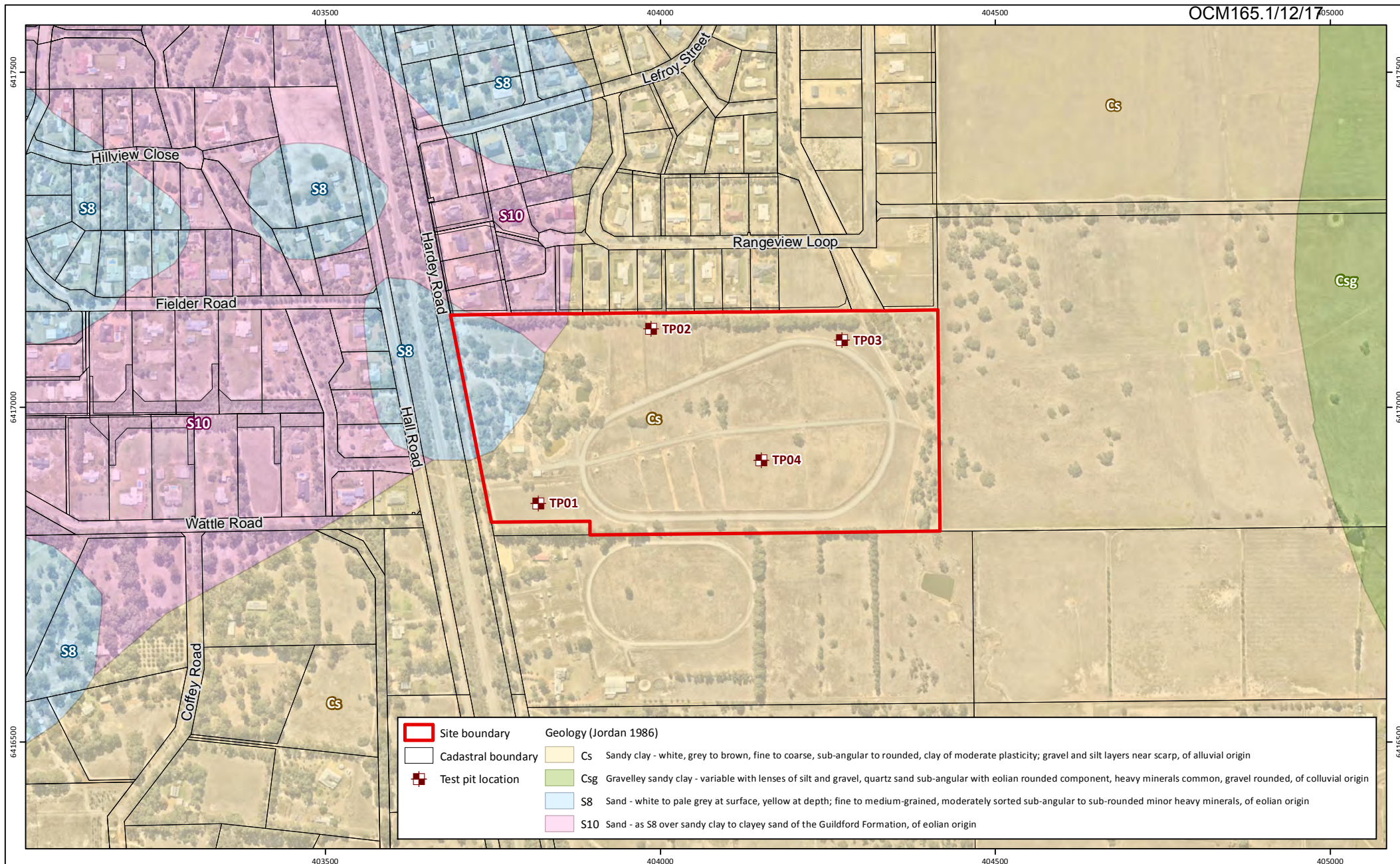


Figure 2: Regional Soil Mapping

Project: Land Capability Assessment
 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
 EP17-071(02)--F12

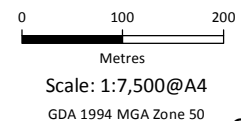
Drawn: KNM

Date: 02/08/2017

Checked: VMK

Approved: DPC

Date: 07/08/2017



OCM 18 December 2017

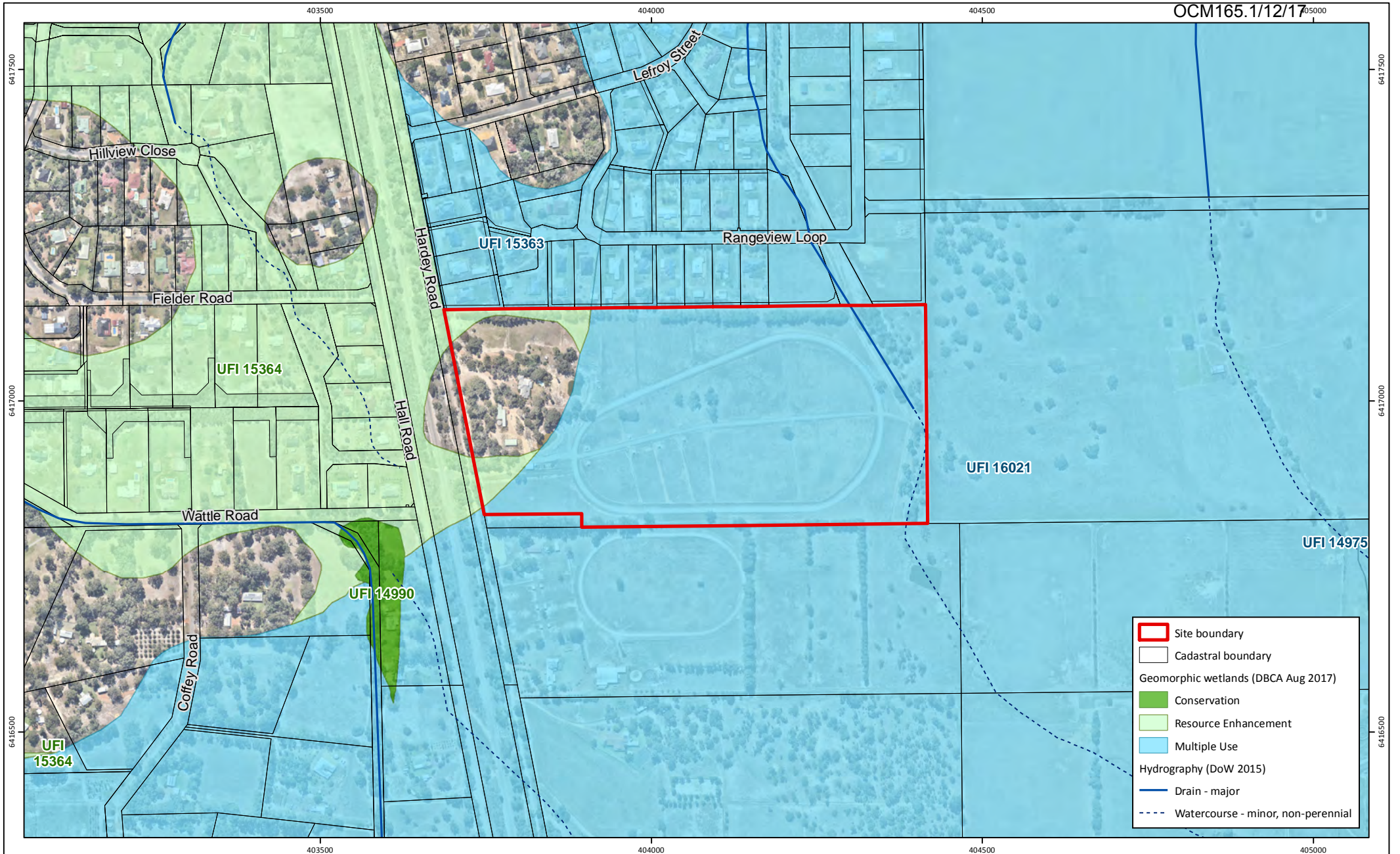


Figure 3: Geomorphic Wetlands and Waterways

Project: Land Capability Assessment
 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
 EP17-071(02)--F13

Drawn: KNM

Date: 02/08/2017

Checked: VMK

Approved: DPC

Date: 07/08/2017



0 100 200
 Metres

Scale: 1:7,500@A4
 GDA 1994 MGA Zone 50



OCM 18 December 2017

Appendix A

Test Pit Observation Log





Test Pit ID: TP01

PROJECT NAME: 147 Hardey Road, Serpentine
CLIENT: Wormall Civil

PROJECT NUMBER: EP16-103(01)
PROJECT LOCATION: Serpentine-Jarrahdale Shire

DATE: 14/11/2016
CONTRACTOR: Wormall
METHOD: Excavator
LOGGED BY: PML

SURVEY SOURCE: GPS
EASTING: 403818
NORTHING: 6416857
PROJECTION: MGA, GDA94

ELEVATION (GROUND LEVEL):
ELEVATION (GROUNDWATER):
TOTAL DEPTH: 2.50 mBGL

DEPTH (mBGL)	DEPTH (mAHD)	SAMPLE I.D	GRAPHIC LOG	MATERIAL DESCRIPTION	MOISTURE CONTENT
0.0		TP01-Topsoil		0.0m: Silty SAND: Brown to grey with pockets of cream colouring. Fine to medium grained.	Dry
0.5		TP01-0.6m		0.6m: Sandy CLAY: Grey with orange mottling. Fine to medium grained.	Dry
1.0		TP01-1.0m		0.8m: Sandy CLAY: Grey with orange mottling. Fine to medium grained. 1.0m: Water inflow observed.	Damp
1.5		TP01-1.2m			
2.0		TP01-1.8m			
2.5		TP01-2.5m		2.4m: Sandy Gravelly CLAY: Consolidated dark red to dark brown sandy clayey gravel, interspersed with orange and grey clay.	

Total Depth: 2.5 mBGL

COMMENTS:



Test Pit ID: TP02

PROJECT NAME: 147 Hardey Road, Serpentine
CLIENT: Wormall Civil

PROJECT NUMBER: EP16-103(01)
PROJECT LOCATION: Serpentine-Jarrahdale Shire

DATE: 14/11/2016
CONTRACTOR: Wormall
METHOD: Excavator
LOGGED BY: PML

SURVEY SOURCE: GPS
EASTING: 403986
NORTHING: 6417117
PROJECTION: MGA, GDA94

ELEVATION (GROUND LEVEL):
ELEVATION (GROUNDWATER):
TOTAL DEPTH: 2.40 mBGL

DEPTH (mBGL)	DEPTH (mAHD)	SAMPLE I.D	GRAPHIC LOG	MATERIAL DESCRIPTION	MOISTURE CONTENT
0.0		TP02-Topsoil		0.0m: Clayey Silty SAND: Brown to grey with pockets of cream colouring. Fine to medium grained.	Dry
0.5		TP02-0.6m		0.5m: Sandy CLAY: Brown to grey with orange mottling. Fine to medium grained.	Dry
1.0		TP02-1.2m		0.7m: Sandy CLAY: Grey with orange mottling. Fine to medium grained.	Dry
1.5		TP02-1.8m		1.6m: Water inflow observed.	
2.0		TP04-2.4m		2.3m: Sandy Gravelly CLAY: Consolidated dark red to dark brown sandy clayey gravel, interspersed with orange and grey clay.	

Total Depth: 2.4 mBGL

COMMENTS:



Test Pit ID: TP03

PROJECT NAME: 147 Hardey Road, Serpentine
CLIENT: Wormall Civil

PROJECT NUMBER: EP16-103(01)
PROJECT LOCATION: Serpentine-Jarrahdale Shire

DATE: 14/11/2016
CONTRACTOR: Wormall
METHOD: Excavator
LOGGED BY: PML

SURVEY SOURCE: GPS
EASTING: 404271
NORTHING: 6417100
PROJECTION: MGA, GDA94

ELEVATION (GROUND LEVEL):
ELEVATION (GROUNDWATER):
TOTAL DEPTH: 2.50 mBGL

DEPTH (mBGL)	DEPTH (mAHD)	SAMPLE I.D	GRAPHIC LOG	MATERIAL DESCRIPTION	MOISTURE CONTENT	
0.0		TP03-Topsoil		0.0m: Silty SAND: Brown, fine to medium grained.	Dry	
				0.3m: Silty SAND: Light brown, fine to medium grained.	Dry	
0.5						
		TP03-0.6m		0.6m: Sandy Gravelly CLAY: Orange and grey clay interspersed with dark red and brown gravel, with pockets of light brown sand.	Dry	
1.0		TP03-1.0m		1.0m: Sandy CLAY: Orange and grey, fine to medium grained.	Damp	
		TP03-1.3m				
1.5				1.5m: Water inflow observed.		
				1.6m: Sandy CLAY: Orange with some grey mottling. Fine to medium grained.	Damp	
		TP03-1.8m				
2.0						
		TP03-2.5m				
2.5		Total Depth: 2.5 mBGL				

COMMENTS:



Test Pit ID: TP04

PROJECT NAME: 147 Hardey Road, Serpentine
CLIENT: Wormall Civil

PROJECT NUMBER: EP16-103(01)
PROJECT LOCATION: Serpentine-Jarrahdale Shire

DATE: 14/11/2016
CONTRACTOR: Wormall
METHOD: Excavator
LOGGED BY: PML

SURVEY SOURCE: GPS
EASTING: 404151
NORTHING: 6416921
PROJECTION: MGA, GDA94

ELEVATION (GROUND LEVEL):
ELEVATION (GROUNDWATER):
TOTAL DEPTH: 2.60 mBGL

DEPTH (mBGL)	DEPTH (mAHD)	SAMPLE I.D	GRAPHIC LOG	MATERIAL DESCRIPTION	MOISTURE CONTENT
0.0		TP04-Topsoil		0.0m: Silty SAND: Brown to light brown, fine to medium grained.	Dry
0.5		TP04-0.6m		0.6m: Sandy CLAY: Orange to brown, some grey mottling. Fine to medium grained.	Dry
1.0		TP04-1.2m		1.2m: Sandy CLAY: Orange and grey mottling, fine to medium grained.	Damp
1.5		TP04-1.8m		1.8m: Water inflow observed.	
2.0		TP04-2.5m		2.3m: Sandy Gravelly CLAY: Consolidated dark red to dark brown sandy clayey gravel, interspersed with orange and grey clay.	

Total Depth: 2.6 mBGL

COMMENTS:

Appendix B

Wastewater Generation Analysis



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Lot 9 Hardey Road, Serpentine



Wastewater Generation and Nutrient Balance Analysis

The following is an outline of how Serene Environs have arrived at their expected wastewater generation volumes and predicted nutrient balance.

Aerial Analysis

An aerial analysis of other rural residential areas immediately surrounding the site with similar lot sizes to the proposed development was carried out to determine likely uses within the individual Rural Living lots. Areas measured include total roof/paved area, turfed/manicured garden areas and remaining cleared/unmanaged areas within each lot. The outcomes of this analysis are outlined in **Table B1**.

The most pertinent outcome of the aerial analysis relates to the area of turf/manicured gardens provided in smaller (4,000 m²) rural residential lots. While a small number of lots provided significantly more or less manicured area, the overall manicured garden area that was provided was generally consistent with an average of 1,000 m².

Table B1: Summary of aerial analysis

Category	Basis of identification	Determined area
Roof and paved area	The area within each lot identified as buildings and paved areas including driveways	30 - 40% of total lot area
Turf/managed garden area	The area within each lot assumed to be maintained garden area including garden beds and turf. Maintained turf areas are identified from unmaintained by the intensity of colour	5 - 62% of total lot area with an average of 1,000 m ² per lot
Unmanaged/cleared garden area	The remaining cleared area that does not appear to be actively managed and may potentially be utilised for paddock for keeping animals (including horses)	25 - 65% of total lot area

A similar aerial analysis has been carried out by Emerge Associates in other rural areas with lot sizes ranging from 1 ha to 5 ha, and found that an average 1,000 m² manicured garden area is consistent across all lot sizes.

Fertilisation rates

A review of appropriate fertiliser rates was also carried out. A number of products available from local suppliers and online were reviewed to understand the nutrient content of products likely to be purchased by lot owners (for both turf and garden areas). Guideline documents relating to turf management were also reviewed including *Environmental Guidelines for the establishment and maintenance of turf and grassed areas* (DEP and WRC 2001) and the *Western Australian environmental guidelines for the establishment and maintenance of turf grass areas* (SRT 2014).

A range of fertiliser rates were used in the analysis (detailed in **Table B2**) with the upper end of the range representing DoW assumed current practice usage rates (as advised through previous project

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consultation with DoW) and the lower range representing a best management practice assuming rates associated with passive turf areas (as detailed in the documents mentioned above).

Waste generation and nutrient balance

In order to demonstrate the suitability of the proposed 4,000 m² lot sizes, a comparison of the total nutrient loading to the site against an equivalent development with 1 ha lots (as required under the draft GSP 2016) has been undertaken.

Analysis assumed a total lot area of 22 ha, with equivalent number of lots calculated based on either 1 ha or 4,000 m² lots. This assumption does not consider POS areas or foreshore reserve, or the road and drainage network, and therefore it overestimates the total lot area that will contribute to nutrient loading via lot use practices.

The assumptions used in the nutrient analysis for the site are detailed in **Table B2**, with details of how assumptions have been identified provided. **Table B3** provides a summary of the nutrient analysis results.

Table B2: Assumptions into waste generation and nutrient balance analysis

Wastewater/nutrient balance component	Assumptions		Commentary/response
	1 ha lots	0.4 ha (4,000 m ²) lots	
Lot land use	22 lots with gardens	55 lots with gardens	Number of lots possible across total 22 ha site.
	1 dwelling per lot, average 6 occupants per dwelling	1 dwelling per lot, average 2.59 occupants per dwelling	Occupancy rate for 1 ha lots taken from the draft GSP (2016). Occupancy rate for 0.4 ha lots taken from the Australian Bureau of Statistics (ABS) data for average household occupancy (2017).
	Average 0.1 ha garden area	Average 0.1 ha garden	Informed by aerial analysis of similar developments in the area (discussed previously in 'Aerial Analysis'.
Hydraulic loading	150L/person/day sewerage design flow	100L/person/day sewerage design flow	Hydraulic loading for 1 ha lots taken from the draft GSP (2016). Hydraulic loading for 0.4 ha lots taken from Water Corporation data for average household flows (2017).
	Fertilisation rates	Lawn fertilisation rates TN = 50 - 84.7 kg/ha/yr TP = 5 - 13.3 kg/ha/yr	The lower range fertiliser rates were informed by the passive turf rates indicated in <i>Environmental Guidelines for the establishment and maintenance of turf and grassed areas</i> (DoEP and WaRC 2001) and <i>Western Australian environmental guidelines for the establishment and maintenance of turf grass areas</i> (SRT 2014). The upper range fertiliser rates were informed by <i>Survey of urban nutrient</i>

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Lot 9 Hardey Road, Serpentine



Wastewater/nutrient balance component	Assumptions		Commentary/response
	1 ha lots	0.4 ha (4,000 m ²) lots	
			<i>inputs on the Swan Coastal Plain (DoW 2010)</i>
Sewerage treatment system and resulting nutrient loading rate	1 nutrient retentive ATU/secondary treatment system per lot TN = 10 mg/L TP = 1 mg/L		Nutrient loads taken from designated nutrient limits for ATU systems, under the Department of Health guidelines.
Land application area/discharge area	180 m ²	50 m ²	Conversion factors taken from Table 4 of Schedule 3 of the Draft GSP (2016), assuming soil texture of "gravels and sands" with secondary treatment. Area calculated = Hydraulic load (L/day) x conversion factor

Table B3: Results of nutrient analysis – total nutrient loading to site based on lot size

Total loading	1 ha lots		4,000 m ² lots	
	Min	Max	Min	Max
TN (kg/yr)	72,275	72,278	58,223	58,226
TP (kg/yr)	7,228	7,228	5,822	5,823

The nutrient analysis results indicate that the potential nutrient loading to the site from the proposed 4,000 m² lots is less than the assumed loading from 1 ha lots. In addition, the proposed 4,000 m² are easily able to accommodate the required discharge/application area based on the above assumptions, and the identified internal lot uses (informed by aerial analysis previously discussed).

It is unlikely that horses or stock animals would be approved on lots of 4,000 m². However, comparatively the 1 ha lots would potentially allow for livestock which would increase the total nutrient loading potential on the site.

Appendix C

Application of Draft Government Sewerage Policy (2016)



Application of draft Government Sewerage Policy

The following sections outline how the proposed development responds to the draft GSP (2016).

Exemptions for the requirement for connection to reticulated sewer, Clause 6.1

Table C1 outlines how the proposed development of the site responds to the requirements for the provision of reticulated sewerage, as outlined in Section 6.1 of the draft GSP.

Table C1: Exemptions for the provision of reticulated sewer (Clause 6.1 of the draft GSP 2016)

Instance	Response
1. Where the provision of reticulated sewerage is required by a local planning scheme or a policy, strategy or plan endorsed by the Western Australian Planning Commission;	There are no specific planning requirements for reticulated sewerage for the site.
2. When any stage or part of the subdivision or development is already connected to reticulated sewerage;	There is no part of the site that is already connected to reticulated sewerage. This is one of the primary drivers behind the feasibility constraints associated with the provision of reticulated sewerage.
3. Where the decision-maker determines the subdivision or development can be reasonably connected to reticulated sewerage, having consideration of the best practicable servicing option;	The best practicable servicing option has been summarised in this report, and from a feasibility perspective it is suggested that the proposed subdivision cannot be reasonably connected to reticulated sewerage.
4. Where the responsible authority determines connection to reticulated sewerage is required on planning grounds. This includes instances where the absence of reticulated sewerage will jeopardise future land uses proposed through a strategic planning document such as a subregional structure plan or local planning strategy;	The Shire of Serpentine Jarrahdale has not indicated that the site must be connected to reticulated sewer. The intended rural living land use can be accommodated in this instance without requiring the provision of reticulated sewerage. There is no compromise in the intended planning or development outcomes within the site through the use of onsite sewerage disposal.
5. Where the absence of reticulated sewerage is determined by the responsible authority to prejudice the ability to provide sewerage to the local area; or	Given the site is located outside of the Water Corporation's reticulated sewerage catchment, not providing reticulated sewerage to the site will not prejudice the ability to provide sewerage to the local area.
6. When the absence of reticulated sewerage is determined by the responsible authority to pose an unacceptable risk to public health, the environment or water resources. This includes, though is not restricted to, instances where: <ul style="list-style-type: none"> the minimum site requirements for on-site sewage disposal systems (as defined in provision 6.4) cannot be reasonably met; the cumulative impact of on-site sewage disposal are deemed likely to have a detrimental impact on the water quality of a public drinking water source area, sewage sensitive area or other waterway or wetland; and urban, industrial or commercial subdivision is proposed in public drinking water source areas. 	The minimum site requirements can be met, as summarised in this Appendix. There are no unacceptable cumulative impacts associated with the development of approximately 45 rural residential lots (minimum 0.4 ha in size) without reticulated sewerage on the basis that the site conditions are conducive for onsite sewage disposal and secondary treatment will be provided. The site is not situated within a public drinking water source area, and will not have a detrimental impact on any identified wetland or waterway. While the site is located within a sewerage sensitive area, development can be managed to avoid impacts to the waterway within the site and the Serpentine River downstream of the site.

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Lot 9 Hardey Road, Serpentine Lot 9 Hardey Road, Serpentine



Exemptions to Requirement to Connect to Reticulated Sewerage, Clause 6.2

Exemptions to the mandatory requirement for connection to reticulated sewerage outlined in Section 6.2 of the draft GSP (2016) will only be considered where provisions outlined in Section 6.1 do not apply. As outlined above, the proposed development does not trigger any of the provisions within 6.1 of the draft GSP (*6.1 Requirement to connect to reticulated sewerage*) that would preclude exemption.

However, based on a review of Section 6.2 of the draft GSP, it is not clear whether the proposed rural residential development qualifies for an exemption from the requirement to connect to reticulated sewerage, as it is not clear where rural residential development falls given the provisions outlined in this assessment. Based on engineering and feasibility constraints, it is not considered reasonable for development within the site to be connected to reticulated sewer and exemption from the requirement to connect to reticulated sewerage should be granted.

Minimum requirements for on-site effluent disposal, Clause 6.4

Where onsite effluent disposal is proposed, the minimum requirements outlined in Section 6.4 of the draft GSP (2016) should be met. **Table C2** outlines how the proposed development of the site accommodates or addresses these requirements.

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Lot 9 Hardey Road, Serpentine



Table C2: Minimum requirements for onsite sewage disposal (Clause 6.4 of the draft GSP 2016)

Requirement	Response
<p>1. All proposed lot(s) must be capable of the treatment and disposal of all sewage within a designated land application area within the property boundary of each individual green title lot or survey strata, outside of any applicable public health and environmental setbacks as follows:</p> <p>a) Separation from groundwater – the discharge point of the on-site sewage disposal system should be at least the following distances above the highest known groundwater level:</p> <ul style="list-style-type: none"> • two metres above in public drinking water source areas; • 1.2 to 1.5 metres, depending on soil type, in sewage sensitive areas; and • 0.6 to 1.5 m in all other areas, depending on soil type and the type of treatment system used (refer to schedule 3). 	<p>The site is located within a sewerage sensitive area. The depth to groundwater encountered at the sampling locations ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site.</p> <p>Fill material can be used to achieve required separation to groundwater where needed, however based on the sampled groundwater levels the majority of the site experienced groundwater at least 1.5 m BGL, as outlined in Section 2.2.3. Therefore sufficient clearance will be provided.</p>
<p>b) Within public drinking water source areas, an on-site sewage disposal system should not be located within a wellhead protection zone or on Crown land within a reservoir protection zone. Where this will render existing lots undevelopable, a smaller setback may be considered on a case-by-case basis. Where a wellhead protection zone or reservoir protection zone has not been defined, or existing lots are within these zones, an on-site sewage disposal system should not be located:</p> <ul style="list-style-type: none"> • within 100 metres of any bores used for public drinking water supply; or • within 100 metres of the high water mark of a reservoir or waterway. 	<p>The site is not located within a Public Drinking Water Source Area or within a reservoir protection zone, therefore this item is not applicable to the site.</p>
<p>c) An on-site sewage disposal system should not be located within 30 metres of a private bore used for household/drinking water purposes.</p>	<p>Lots are of sufficient size for effluent disposal systems to be appropriately set back to accommodate any private bores outside of site, noting however that the surrounding local area is provided with a reticulated scheme water supply. There will be no bores used for household/drinking water purposes within the site, with potable water to be supplied via either an extension to the surrounding scheme network or through rainwater tanks.</p>
<p>d) An on-site sewage disposal system should not be located within 100 metres of a waterway. The separation distance should be measured outwards from the outer edge of riparian or wetland vegetation. Setbacks between 30 metres and 100 metres may be considered in low risk situations such as a small (five lots or under) subdivision in consultation with the Department of Water. In the Swan Canning catchment reduced setbacks may be considered on a case-by-case basis in consultation with the Department of Parks and Wildlife.</p>	<p>The site is not located within a Public Drinking Water Source Area or within a reservoir protection zone. The Serpentine River is the nearest major waterway, and is located approximately 2 km north of the site.</p> <p>The Main Drain that runs through the east of the site has been provided with an appropriate buffer, as detailed within the Environmental Assessment and Management Strategy (Emerge Associates 2017). Given the proposed development and potential land uses within the site are considered low risk, as demonstrated in this report, a minimum 30 m setback will be provided between the drain and any on-site disposal system within lots. Based on the size of proposed lots adjacent to the drain it is likely that greater setback will be provided, however the ultimate separation will be determined as part of detailed design stages.</p>

Land Capability Assessment

Lot 9 Hardey Road, Serpentine



Requirement	Response
e) An on-site sewage disposal system should not be located within 100m of a significant wetland. The separation distance for wetlands should be measured outwards from the outer edge of wetland vegetation. Setbacks may also be required from other wetlands identified for protection or rehabilitation through relevant planning or environmental plans or strategies. These will be determined on a case-by-case basis. The Department of Parks and Wildlife may provide advice.	The site is not located within 100 m of a significant wetland. A mapped Conservation Category Wetland (CCW) is located approximately 130 m west of the site (DPaW 2016), west of Hardey Road and the freight railway line. The majority of the site is mapped as a multiple use wetland (MUW), with a small area in the western portion of the site mapped as a resource enhancement wetland (REW) (DPaW 2016). Based on site specific observations as well as the regional landforms and soil mapping, the extent of this mapped REW is unlikely to be reflective of wetland conditions on the ground (Emerge Associates 2017).
f) An on-site sewage disposal system should not be located within 100 metres of a surface or subsurface drainage system that discharges directly into a downstream waterway or waterbody. Setbacks between 30 metres and 100 metres may be considered on a case-by-case basis (for example low risk situations such as a small [five lots or under] subdivision) in consultation with the Department of Water. In the Swan Canning catchment, reduced setbacks may be considered on a case-by-case basis in consultation with the Department of Parks and Wildlife.	The Serpentine River is the nearest major waterway, and is located approximately 2 km north (downstream) of the site. The Main Drain that runs through the east of the site, eventually discharging to the Serpentine River, has been provided with an appropriate buffer, as detailed within the Environmental Assessment and Management Strategy (Emerge Associates 2017). Given the proposed development and potential land uses within the site are considered low risk, as demonstrated in this report, a minimum 30 m setback will be provided between the drain and any on-site disposal system within lots. Based on the size of proposed lots adjacent to the drain it is likely that greater setback will be provided, however the ultimate separation will be determined as part of detailed design stages.
g) An on-site sewage disposal system should not be located within any area subject to inundation and/or flooding in a 10 per cent Annual Exceedance Probability (AEP) rainfall event.	The hydrological characteristics of the site can be suitably addressed through the standard water management process to support the proposed development, and no onsite disposal system will be located within areas subject to inundation and/or flooding as specified.
2. Land with a highest known groundwater level that is less than 0.5 metres below the natural ground level should only be rezoned for urban development where reticulated sewerage will be provided.	The site is proposed to be rezoned from Rural to Rural Living A under the Shire of Serpentine Jarrahdale's TPS, and therefore this requirement is not relevant.
3. Land that is already zoned for urban development may be subdivided and developed in accordance with the provisions of the local planning scheme, provided that the proponent demonstrates that correctly engineered drainage solutions or fill can be used to achieve separation from groundwater required under clause 6.4 (1), subject to such works being environmentally acceptable.	The site is proposed to be rezoned from Rural to Rural Living A under the Shire of Serpentine Jarrahdale's TPS, and therefore this requirement is not relevant. Subdivision will be progressed in line with the relevant TPS provisions.
4. The provision of on-site sewage disposal systems including calculation of land application area shall be in accordance with minimum site requirements contained in Schedule 3.	The size of onsite sewage systems required will vary based on lot size and loading. The design and implementation of these systems will comply with the relevant technical requirements including Schedule 3. Generally, an average lot (4,000m ²) will need approximately 50 m ² for disposal, as outlined in Appendix B .
5. Development intensification proposals (other than a single house on a single lot) that require the provision of on-site sewage disposal will be assessed on a case-by-case basis.	The proposed development of the site involves the subdivision of the site into approximately 45 lots.
6. All on-site sewage disposal systems proposed must be approved for use in Western Australia by the Department of	Specific onsite disposal systems for use within the site will be designated as part of future development planning and

Land Capability Assessment

Lot 9 Hardey Road, Serpentine



Requirement	Response
<p>Health.</p>	<p>approval stages. Designated systems will only include nutrient retentive secondary treatment systems (ATUs) and will only include products approved for use in Western Australia by the Department of Health.</p>
<p>7. The type of on-site sewage disposal system used should be determined in response to the site and soil conditions, vulnerability of the receiving environment and the nature of the proposal. For example: a) secondary treatment systems with nutrient removal should be used in public drinking water source areas and sewage sensitive areas; b) where setbacks of less than 100 metres from waterways, drainage systems or marine reserves are proposed, secondary treatment systems with nutrient removal may be required; c) secondary treatment systems may be required in heavy soils and/or rock; d) Where lots are less than 2,000m² secondary treatment systems with nutrient removal may be required; and e) systems dealing with trade waste should be designed to ensure that environmentally hazardous material is not disposed of on site.</p>	<p>Specific onsite disposal systems for use within the site will be designated as part of future development planning and approval stages. Designated systems will only include nutrient retentive secondary treatment systems (ATUs) and will only include products approved for use in Western Australia by the Department of Health.</p>
<p>8. Where on-site sewage disposal is to be provided by a secondary treatment system, the Western Australian Planning Commission will require a notification on title pursuant to s. 70A of the Transfer of Land Act 1893 (as amended) advising that an on-site secondary treatment sewage disposal system and unencumbered area to which treated sewage is to be distributed are required.</p>	<p>The proponent has accepted that notifications will be applied to titles.</p>
<p>9. Where the Western Australian Planning Commission determines that the absence of reticulated sewerage will affect the use and enjoyment of the land, it may require a notification on the title pursuant to s. 70A of the Transfer of Land Act 1893 (as amended) advising that no reticulated sewerage is provided and as a consequence, on-site sewage disposal will be required and the developable area of the lot is reduced.</p>	<p>The proponent has accepted that notifications will be applied to titles.</p>
<p>10. Where secondary treatment systems are proposed, local government should consider its capacity to audit, inspect and enforce compliance with the Department of Health endorsed maintenance schedules and operating standards.</p>	<p>The Shire of Serpentine Jarrahdale are experienced in the audit, inspection and compliance monitoring of ATU systems as these systems are widely used within their municipality. It is likely that the secondary treatment systems will be monitored and maintained by corporate entities with a vested interest to ensure the systems are well maintained.</p>

Supporting information for planning applications where onsite sewerage disposal is proposed, Schedule 2(b) – Rezoning and Structure Planning

Any application to rezone land through region or local planning scheme amendment and any local structure plan should be accompanied by the information outlined in Schedule 2(b) of the draft GSP (2016). All supporting information has been provided as part of the scheme amendment application, or will be provided as part of future subdivision/development design and approval stages.

Land Capability Assessment

Lot 9 Hardey Road, Serpentine Lot 9 Hardey Road, Serpentine



General site features for on-site sewage disposal, Schedule 3

Onsite effluent disposal should only be proposed where the general site features outlined in Schedule 3 of the draft GSP (2016) can be met. **Table C3** outlines how the proposed development of the site addresses these requirements.

Table C3: General site features for onsite sewerage disposal

Site feature	Minimum requirement	Development area
Separation from groundwater – outside public drinking water source areas and sewage sensitive areas (The minimum requirements for public drinking water source areas and sewage sensitive areas are found at Section 6.4 of this policy)	<p>Where land is not within a Public Drinking Water Source Area or a sewage sensitive area, the discharge point of the on-site sewage disposal system should be located the following distances above the highest known groundwater level:</p> <ul style="list-style-type: none"> • For loams and heavy soils, the base of the proposed land application system should have a depth of at least 0.6 metres above the highest seasonal post development water table. • For gravels, the base of the proposed land application system should have a depth of at least one metre above the highest seasonal post development water table. • For sands the base of the proposed land application system should have a depth of at least 1.5 metres above the highest seasonal post development water table. • Where a nutrient retentive secondary treatment system will be used, the proposed land application system should have a depth of at least 0.6 metre above the highest seasonal post development water table. 	The site is located within a sewerage sensitive area. This item has been addressed in Table C2 above.
Land application area	Depending on the soil type, a land application area should be provided for all development in accordance with tables 2 and 4 of this schedule for the disposal of sewage.	This can be easily accommodated given the size of the proposed lots.
	The land application area excludes the area required for the apparatus. It should be kept free of any temporary or permanent structures.	This can be easily accommodated given the size of the proposed lots.
	<p>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 (which does not include the apparatus) should:</p> <ul style="list-style-type: none"> • not be built on or paved in a manner which precludes reasonable access; • not be subject to vehicular traffic (other than a pedestrian controlled lawnmower); • not be subject to regular foot traffic such as pathways and clothes line areas; and • should be kept in a manner which enables servicing and maintenance of the disposal system. 	This can be easily accommodated given the size of the proposed lots.
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.	Given the flat nature of the site, slopes will not exceed 1:5.

Appendix C

Transportation Noise Assessment
(Lloyd George Acoustics 2017)





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Transportation Noise Assessment

Lot 9 Hardey Road, Serpentine

Reference: 17074064-01

Prepared for:

Emerge

Report: 17074064-01

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Date:	Rev	Description	Prepared By	Verified
6/10/17	-	Issued to client as final	Daniel Lloyd	Terry George

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1 INTRODUCTION

It is proposed to develop Lot 9 Hardey Road, Serpentine for residential housing. The locality is shown in *Figure 1-1*. As the proposed subdivision, shown in *Figure 1-2*, is adjacent to a freight railway, the potential noise impacts must be considered. The project is at Scheme Amendment stage.

The results of the assessment are compared against the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* and recommendations are provided on noise mitigation requirements under this policy.

Appendix B contains a description of some of the terminology used throughout this report.



Figure 1-1 Locality of Proposed Subdivision

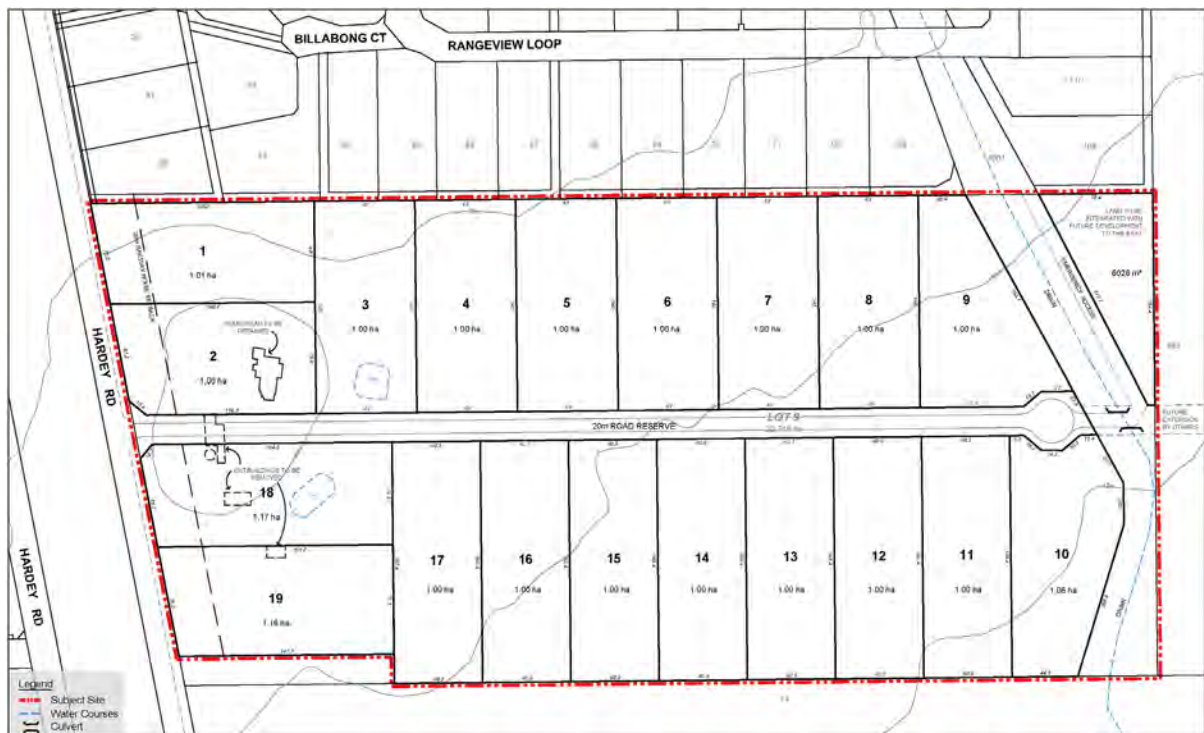


Figure 1-2 Proposed Subdivision Layout

2 CRITERIA

2.1 Noise Criteria

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are to:

- Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals;
- Protect major transport corridors and freight operations from incompatible urban encroachment;
- Encourage best practice design and construction standards for new development proposals and new or redevelopment transport infrastructure proposals;
- Facilitate the development and operation of an efficient freight network; and
- Facilitate the strategic co-location of freight handling facilities.

The Policy's outdoor noise criteria are shown below in *Table 2-1*. These criteria apply at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

Note: The 5 dB difference between the target and limit is referred to as the margin.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of this Policy is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- a 'reasonable' degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the *target*, no further measures are required under this policy.

In areas where the *target* is exceeded, customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

For residential buildings, "acceptable indoor noise levels" are taken to be 40 dB $L_{Aeq(Day)}$ in living areas and 35 dB $L_{Aeq(Night)}$ in bedrooms.

2.2 Vibration Criteria

Exposure limits for vibration are normally defined in terms of a multiplying factor that is applied to the base curves defined in AS 2670.2:1990 *Evaluation of human exposure to whole-body vibration Part 2: Continuous and shock induced vibration in buildings (1 to 80Hz)*. The base curve is the point at which adverse comment is considered rare. It also states that at levels above the base curve, vibration may or may not give rise to adverse comment depending on circumstances.

The multiplying factors for the various curves are given in Appendix A of AS 2670.2-1990, and for this project the relevant criteria would be Curve 2, which is consistent with other projects in the area.

For assessing the potential for structural damage to buildings, a criterion of 5mm/s is generally accepted as the threshold above which superficial damage, such as cracking plaster, can occur. Structural damage measurements are normally undertaken as peak component particle velocity (PCPV). The Curves of AS2670.2 are not relevant for structural damage.

It should be noted that structural damage occurs at significantly higher values than human perception or vice versa; a person will perceive the vibration at levels well before any structural damage will occur.

3 METHODOLOGY

3.1 Noise Measurements

Noise monitoring was undertaken adjacent to the proposed subdivision between 2 and 5 August 2017, in order to:

- Quantify the existing noise levels; and
- Calibrate the noise model.

The instrument used was an ARL Ngarra noise data logger located on the lot boundary (approximately 47 metres from the track). The microphone was 1.4 metres above ground level. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.



Figure 3-1 Typical Noise Data Logger

3.2 Vibration Measurement

Vibration monitoring was undertaken adjacent to the proposed subdivision between 2 and 5 August 2017. Vibration levels were logged at 1-minute intervals using a Texcel GTM Vibration Logger connected to a tri-axial geophone. The logger was set to record the worst case frequency, peak component particle velocity (PCPV) and the component root mean square (rms).

3.3 Noise Modelling

The computer programme *SoundPLAN 7.4* has been utilised incorporating a modified version of the Nordic Rail Prediction Method (Kilde Rep. 130) algorithm. The algorithm was modified to align with measured noise levels of freight trains in the Perth region.

The noise prediction methodology takes into consideration the following variables:

- ❑ Number of train movements per hour;
- ❑ Effects of distance from the rail to receivers;
- ❑ Height above ground of the noise source; and
- ❑ Barrier effects from land topography and buildings.

As required in the Policy, the number of trains has been set to one per hour during the night period. The locomotive source height has been set to 4.0m above the rail head and the wagons at 0.5m.

4 RESULTS

4.1 Noise Monitoring

The results of the noise monitoring are summarised below in *Table 4-1* and shown graphically in *Figure 4-1*.

Table 4-1 Measured Average Noise Levels – Monitoring Locations

Date	Average Weekday Noise Level, dB		Highest Maximum Level dB
	L _{Aeq} (Day)	L _{Aeq} (Night)	L _{Amax}
2 August 2017	50.1	48.5	85
3 August 2017	52.2	48.5	88
4 August 2017	52.8	49.3	83
5 August 2017	52.9	49.5	86
Average	52.0	49.0	86

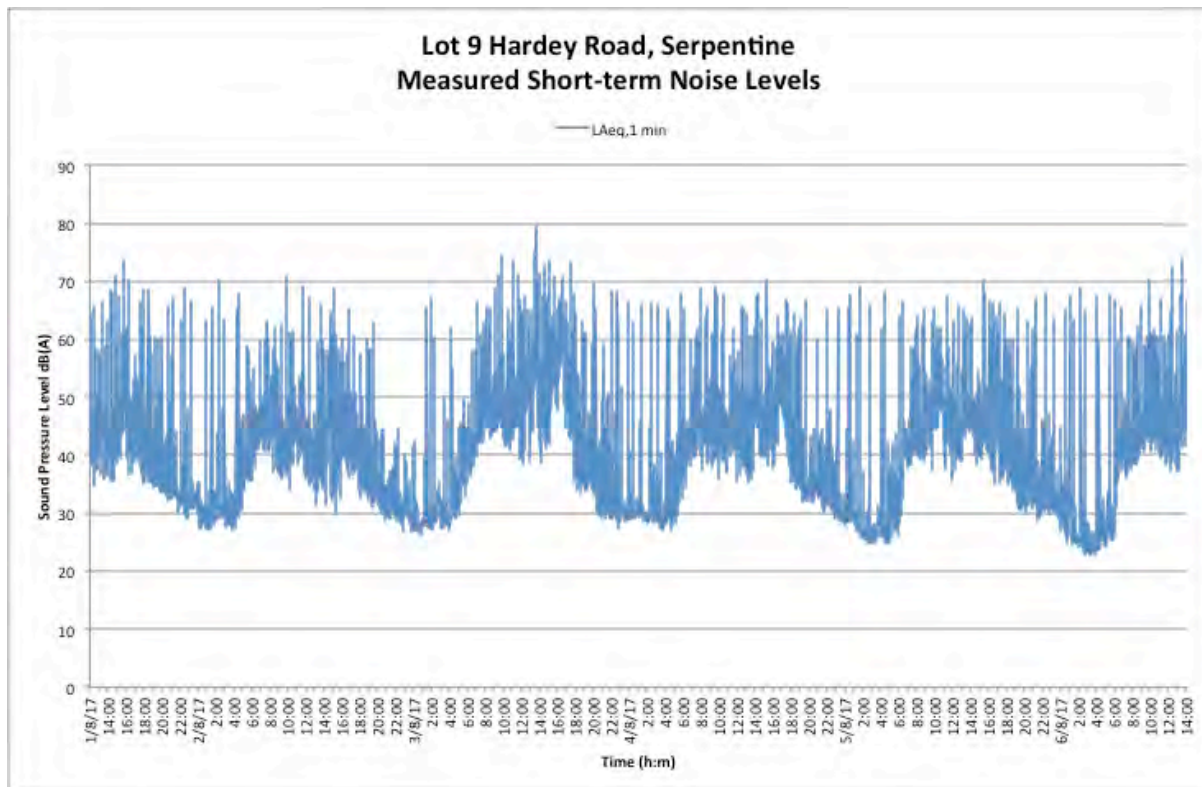


Figure 4-1 Noise Monitoring Results

The Policy requires freight noise to be assessed assuming eight (8) train movement during the night period (approximately one per hour). From the short-term measurements presented in *Figure 4-1*, it can be seen that this is currently the situation at this location, so adjustment to the levels is not required.

4.2 Vibration Monitoring

The results of the vibration measurements and comparison against the criteria are shown in *Figures 4-2 and 4-3*. *Figure 4-2* being for the R.M.S. (used to assess annoyance) levels and *Figure 4-3* showing the peak component particle velocity (used to assess structural damage).

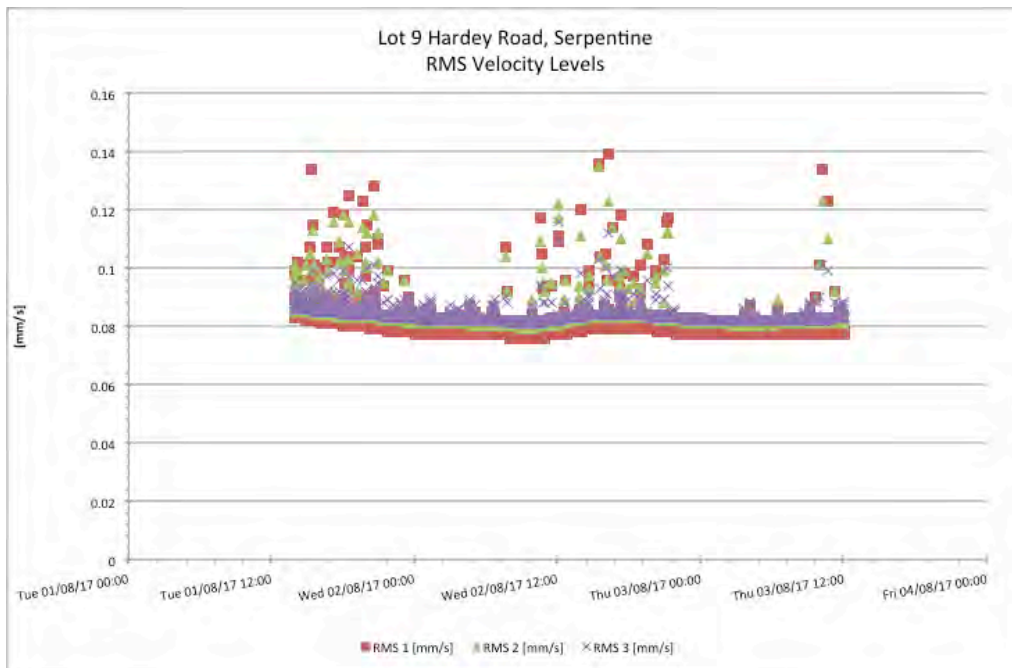


Figure 4-2 R.M.S. Vibration Levels

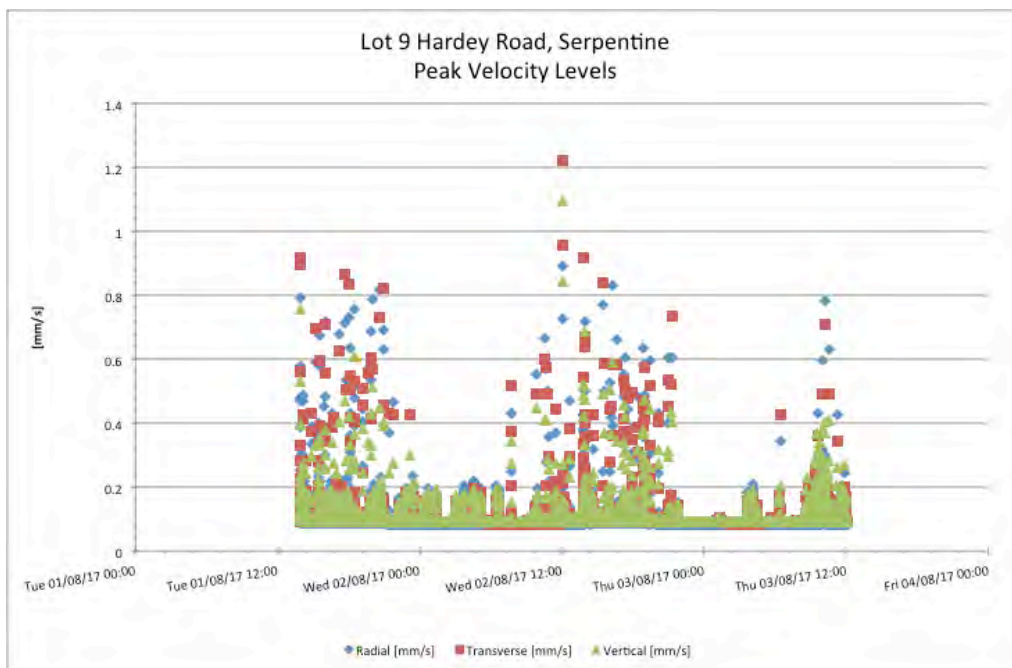


Figure 4-3 Peak Vibration Levels

4.3 Noise Modelling

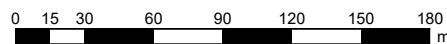
The results of the noise modelling are presented in *Figure 4-4*. They represent the $L_{Aeq(Night)}$ levels and include an adjustment of +2.5 dB for building facade reflection as required under the Policy.

Lot 9 Hardey Road, Serpentine - Freight Rail Noise Levels During Night Period Predicted $L_{Aeq,night}$ dB Levels

Figure 4-4



Scale



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5 ASSESSMENT

5.1 Noise Assessment

The objectives of the Policy criteria are for noise at all houses to be no more than the *limit* and preferably no more than the *target*. Where the *target* is achieved, no further controls are required. Where the *limit* is achieved or noise levels are within the *margin* (between the *limit* and *target*), further controls are necessary.

As the project is in Scheme Amendment stage, the exact location of the proposed lots is unknown. However, as the rail line is parallel to the proposed subdivision, advice on buffer distances from the railway to the building envelope can be provided for planning purposes.

From *Figure 4-4*, it can be seen that assuming no noise control measures, the $L_{Aeq(Night)}$ level is below the *target* criterion for houses greater than 80 metres from the railway. From the preliminary layout it can be seen that this can be achieved for all houses and our understanding is a buffer zone will be incorporated into the design.

Therefore noise mitigation would not be required provided houses remain greater than 80 metres from the railway.

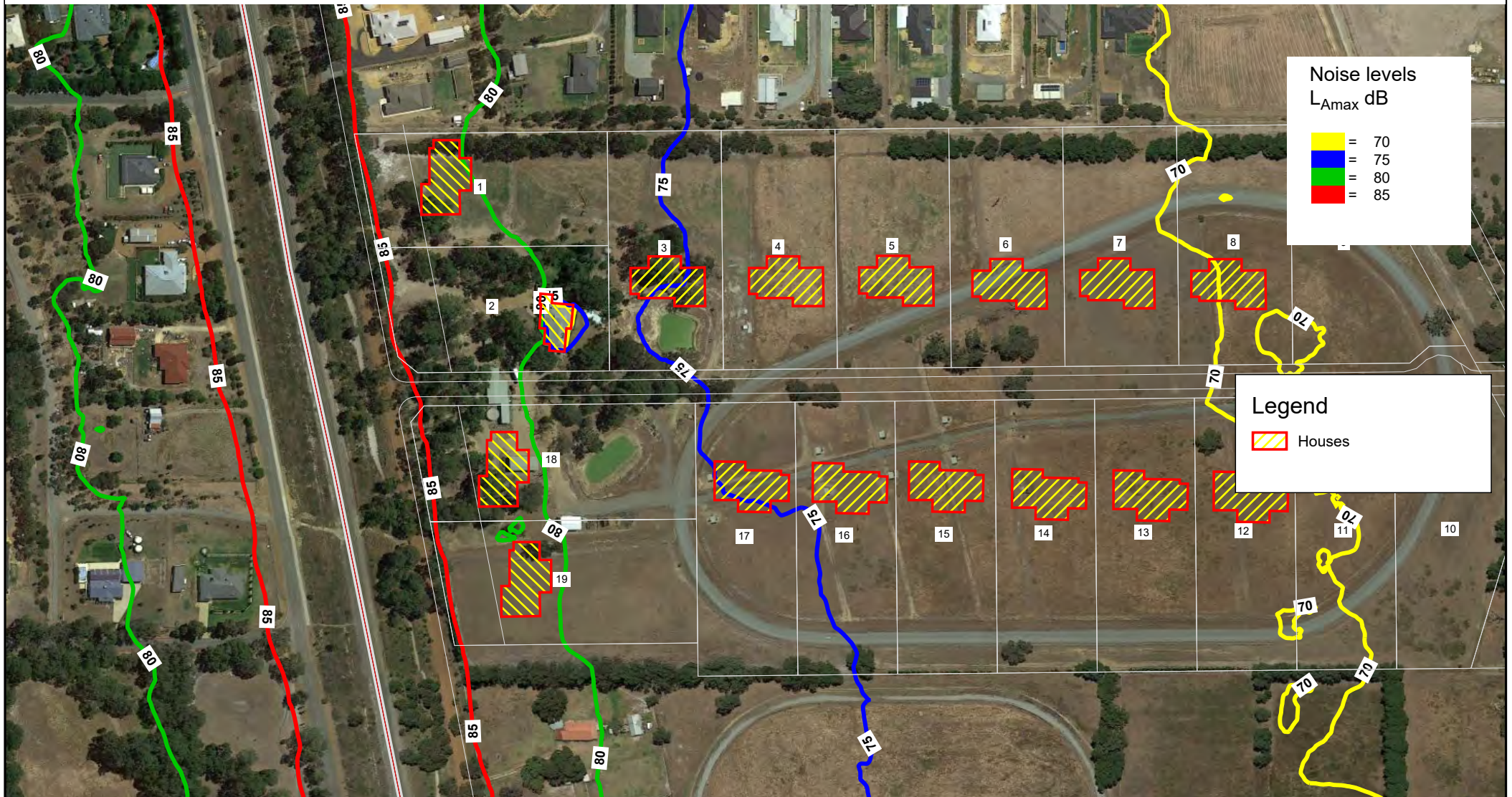
While the Policy does not consider the maximum noise level (L_{Amax}) from transportation noise sources, the high passby noise level from locomotives can result in sleep disturbance issues in some cases. The predicted L_{Amax} levels, presented in *Figure 5-1*, show a level of exceeding 80 dB L_{Amax} is expected at the house facades. While not mandatory, it is recommended that for habitable spaces that are to be located facing the railway and are predicted to receive a noise level exceeding 75 dB L_{Amax} , then the Policy deemed to comply "Package A" treatment should be considered. This treatment would also be considered appropriate in mitigating some of the low-frequency noise components associated with freight transportation. The deemed to comply treatments are provided at *Appendix A*.

5.2 Vibration Assessment

The results of the vibration monitoring show that the levels would comply with the suggested criteria of Curve 2. In addition, the peak vibration levels, which are used to assess the likelihood of building damage, are below vibration levels that are likely to result in superficial damage such as plaster cracking.

Lot 9 Hardey Road, Serpentine - Freight Rail Maximum Noise Levels Predicted L_{Amax} dB Levels

Figure 5-1



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6 CONCLUSION

This assessment shows that for the proposed subdivision at Lot 9 Hardey Road, Serpentine, if buildings are not constructed closer than 80 metres from the freight railway, the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* are met at all locations. Therefore providing a sufficient “no-build” buffer is included in the design of the subdivision, mandatory noise mitigation is not required.

However, to address the possible sleep disturbance impacts resulting from the locomotive passby, we would recommend “Package A” treatments for any facade facing and within 200 metres of the railway.

Ground-borne vibration levels are predicted to comply with acceptable criteria for both structural damage and annoyance.

Appendix A

Deemed to Comply Packages

The packages and information provided on the following pages are taken from *Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and freight Considerations in Land Use Planning*; December 2014.

Where outdoor noise levels are above the *target* level, excluding the effect of any boundary fences, the Guidelines propose acceptable treatment packages that may be implemented without requiring detailed review. The packages are also intended for residential development only. At higher noise levels or for other building usages, specialist acoustic advice will be needed.

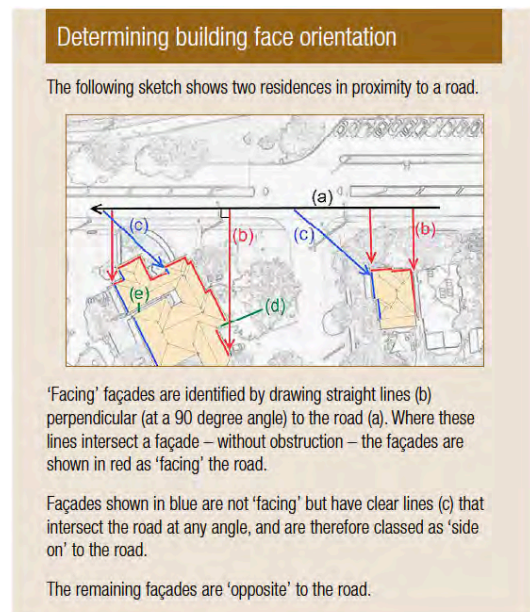
The acceptable treatment packages are intended to simplify compliance with the noise criteria, and the relevant package should be required as a condition of development in lieu of a detailed assessment.

Transition between each package should be made on the basis of the highest incident $L_{Aeq(Day)}$ or $L_{Aeq(Night)}$ value to the nearest whole number determined for the building development under assessment.

Any departures from the acceptable treatment specifications need to be supported by professional advice from a competent person that the proposal will achieve the requirements of the Policy.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor: Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor: Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor: Neither 'side on' nor 'facing', as defined above.



Package A

Area	Orientation to Road or Rail Corridor	Package A (up to 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	<ul style="list-style-type: none"> Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	<ul style="list-style-type: none"> Windows systems: As above.
	Opposite	No requirements
Other Habitable Rooms Including Kitchens	Facing	<ul style="list-style-type: none"> Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.
	Side	<ul style="list-style-type: none"> Windows and external door systems: As above.
	Opposite	No requirements
General	Any	<ul style="list-style-type: none"> Walls (minimum $R_w + C_{tr}$ 45) – Two leaves of 90mm thick brick with minimum 50mm cavity Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. Eaves to be closed using 4mm compressed fibre cement sheet. Mechanical ventilation – Refer following pages.
Outdoor Living Area		<ul style="list-style-type: none"> Boundary wall to be minimum 2m high; or Locate on the side of the building that is opposite to the corridor; or Locate within alcove area so that the house shields it from corridor.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Package B

Area	Orientation to Road or Rail Corridor	Package B (up to 63 dB $L_{Aeq}(\text{Day})$ and 58 dB $L_{Aeq}(\text{Night})$)
Bedrooms	Facing	<ul style="list-style-type: none"> Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	<ul style="list-style-type: none"> Windows systems: As above.
	Opposite	<ul style="list-style-type: none"> Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 25) – 4mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Alternatively, 6mm thick glass (monolithic, toughened or laminated) in sliding frame.
Other Habitable Rooms Including Kitchens	Facing	<ul style="list-style-type: none"> Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to have laboratory certificate confirming $R_w + C_{tr}$ 31 performance. Alternative, change to hinged door with perimeter acoustic seals and 10mm thick glass.
	Side	<ul style="list-style-type: none"> Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.
	Opposite	No requirements
General	Any	<ul style="list-style-type: none"> Walls (minimum $R_w + C_{tr}$ 50) – Two leaves of 90mm thick brick with minimum 50mm cavity. Cavity to include 50mm thick insulation and where wall ties are required, these are to be anti-vibration/resilient type. Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. Eaves to be closed using 4mm thick compressed fibre cement sheet. Mechanical ventilation – Refer following pages.
Outdoor Living Area		<ul style="list-style-type: none"> Boundary wall to be minimum 2.4m high; or Locate on the side of the building that is opposite to the corridor; or Locate within alcove area so that the house shields it from corridor.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Package C

Area	Orientation to Road or Rail Corridor	Package C (up to 65 dB $L_{Aeq(Day)}$ and 60 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	<ul style="list-style-type: none"> Windows systems: Glazing up to 20% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	<ul style="list-style-type: none"> Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Opposite	<ul style="list-style-type: none"> Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
Other Habitable Rooms Including Kitchens	Facing	<ul style="list-style-type: none"> Windows and external door systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to have laboratory certificate confirming $R_w + C_{tr}$ 31 performance. Alternative, change to hinged door with perimeter acoustic seals and 10mm thick glass.
	Side	<ul style="list-style-type: none"> Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to have laboratory certificate confirming $R_w + C_{tr}$ 31 performance. Alternative, change to hinged door with perimeter acoustic seals and 10mm thick glass.
	Opposite	<ul style="list-style-type: none"> Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
General	Any	<ul style="list-style-type: none"> Walls (minimum $R_w + C_{tr}$ 50) – Two leaves of 90mm thick brick with minimum 50mm cavity. Cavity to include 50mm thick insulation and where wall ties are required, these are to be anti-vibration/resilient type. Roof and ceiling (minimum $R_w + C_{tr}$ 40) – Standard roof construction with 2 x 10mm plasterboard ceiling and minimum R3.0 insulation between ceiling joists. Eaves to be closed using 6mm thick compressed fibre cement sheet. Mechanical ventilation – Refer following pages.
Outdoor Living Area		<ul style="list-style-type: none"> Locate on the side of the building that is opposite to the corridor; or Locate within alcove area so that the house shields it from corridor.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Mechanical Ventilation requirements

It is noted that natural ventilation must be provided in accordance with F4.6 and F4.7 of Volume One and 3.8.5.2 of Volume Two of the National Construction Code. Where the noise *limit* is likely to be exceeded, a mechanical ventilation system is usually required. Mechanical ventilation systems will need to comply with AS 1668.2 – *The use of mechanical ventilation and air-conditioning in buildings*.

In implementing the acceptable treatment packages, the following must be observed:

- Evaporative air conditioning systems will meet the requirements for Packages A and B provided attenuated air vents are provided in the ceiling space and designed so that windows do not need to be opened.
- Refrigerant based air conditioning systems need to be designed to achieve fresh air ventilation requirements.
- External openings (e.g. air inlets, vents) need to be positioned facing away from the transport corridor where practicable.
- Ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

Notifications on certificates of title and advice to prospective purchasers warning of the potential for noise impacts from major transport corridors help with managing expectations.

The area of land for which notification is required should be identified in the noise management plan and contain a description of major noise sources nearby (e.g. 24-hour freight rail).

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise sensitive development or planning approval involving noise sensitive development, where external noise levels are forecast or estimated to exceed the 'target' criteria as defined by the Policy.

In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under Section 165 of the Planning and Development Act 2005 and Section 70A of the Transfer of Land Act 1893. An example of a suitable notice is:

Notice: This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected, by transport noise. Transportation noise controls and Quiet House design strategies at potential cost to the owner may be required to achieve an acceptable level of noise reduction. Further information is available on request from the relevant local government offices.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)

The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1

An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}

An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the “intrusive” noise level.

L_{90}

An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the “background” noise level.

L_{eq}

The L_{eq} level represents the average noise energy during a measurement period.

L_{Amax}

The maximum noise level during a measurement period.

$L_{Aeq,24hour}$

The $L_{Aeq,24hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

$L_{Aeq,8hour} / L_{Aeq} (Night)$

The $L_{Aeq} (Night)$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour} / L_{Aeq} (Day)$

The $L_{Aeq} (Day)$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day.

R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

C_{tr}

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of -4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -14 dB.

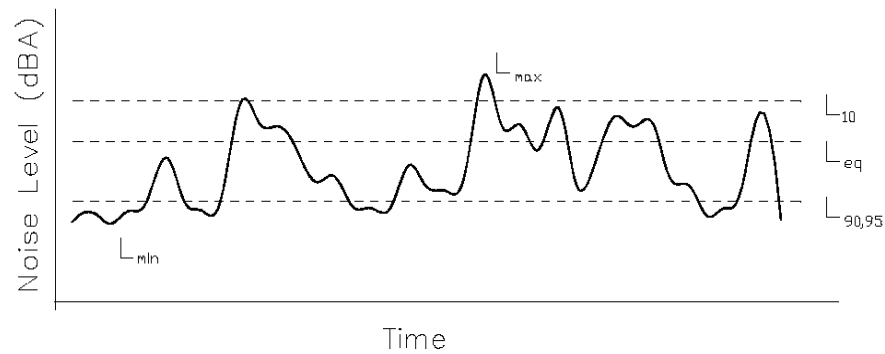
Satisfactory Design Sound Level

The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

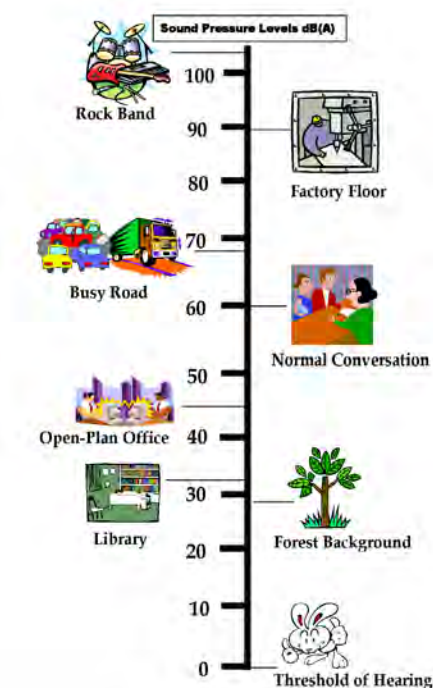
Maximum Design Sound Level

The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

Chart of Noise Level Descriptors



Typical Noise Levels



District Water Management Strategy

Lot 9 Hardey Road, Serpentine

Project No: EP17-071(04)

**Prepared for Serene Environs
October 2017**

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



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District Water Management Strategy

Lot 9 Hardey Road, Serpentine



Executive Summary

Serene Environs (the proponent) is seeking to amend the land use zoning over Lot 9 Hardey Road, Serpentine (herein referred to as 'the site'), to facilitate the future subdivision of the site into rural residential lots.

The site is approximately 22.8 hectares (ha) in size, situated approximately 50 km south-east of the Perth Central Business District (CBD) within the Shire of Serpentine Jarrahdale (Shire of SJ). It is currently zoned 'Rural' under both the Metropolitan Region Scheme (MRS) and the Shire of SJ's Town Planning Scheme (TPS) No. 2. The proposed TPS amendment seeks to rezone the site from 'Rural' to 'Rural Living A,' consistent with the Shire's *Draft Rural Strategy Review (2013)*.

This District Water Management Strategy (DWMS) details the water management approach proposed for the development. The DWMS has been prepared in accordance with *Better Urban Water Management (WAPC 2008)*, and *State Planning Policy 2.9 Water Resources (WAPC 2006)*.

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

- The site receives an annual average rainfall of 1,159 mm. The majority of rainfall is received between May and September.
- The site ranges from 38 m Australian height datum (AHD) to 43 m AHD in elevation and has a north-westerly aspect.
- The site is primarily underlain by silty sand to clayey silty sand over sandy clay/sandy gravelly clay.
- Acid sulfate soil (ASS) risk mapping indicates that there is a moderate to low risk of encountering ASS within 3 m of the natural ground surface.
- The majority of the site is mapped as a multiple use wetland with a small area in the western portion of the site mapped as a resource enhancement wetland. Given the general absence of remnant vegetation within the site, and the regional landforms and soils mapping, the extent of this mapped REW is unlikely to be reflective of wetland conditions on the ground.
- The site includes two farm dams in the west of the site and a defined drainage channel in the east of the site. Hydrological mapping (DoW 2015) indicates the northern portion of this drainage channel is the Arnold Road Main Drain, while the southern portion of the surface water feature is a minor watercourse, indicating that the natural waterway has been altered historically to serve as an agricultural drain.
- Previous peak flow estimates for the Arnold Road Main Drain indicate that flows range between 4 m³/sec and 12 m³/sec in a 100 year ARI event.
- Stormwater runoff generated within the site is expected to either infiltrate within lots or will be conveyed and discharged to the existing drainage networks within Hardey Road west of the site.
- There is currently no available regional groundwater contours covering the site; however, groundwater levels were observed during the site investigations, undertaken as part of the Land Capability Assessment (Emerge 2017a). The depth to groundwater encountered at the sampling

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



locations ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site.

- The site has historically been cleared for rural purposes.

The development of the 22.8 ha site will allow for the creation of approximately 19 rural residential lots each a minimum one hectare in size, a single area to be integrated with future development to the east and a foreshore area for the Arnold Road Main Drain.

The overall objective for integrated water cycle management for the development is to mimic the existing hydrological regime of the site. The design objectives seek to deliver best practice outcomes using a water sensitive urban design (WSUD) approach, including detailed management approaches for:

- Water supply and conservation
- Flood mitigation
- Surface water quality
- Groundwater management.

The objectives and principles proposed in this DWMS are based on the characteristics of the existing environment and a contemporary best-practice approach to integrated water cycle management.

The primary objectives which have informed the preparation of this DWMS are as follows:

- Provide a broad level stormwater management framework to support future rural residential development.
- Incorporate appropriate best management practices (BMP) into the drainage system that address the environmental and stormwater management issues identified.
- Minimise development construction costs, which will result in reduced land costs for future home owners.
- Minimise ongoing operation and maintenance costs for the land owners and Shire of SJ.
- Develop a water supply and conservation strategy for the site that will aim to meet water use targets.
- Manage runoff water quality to protect downstream environments.
- Protect infrastructure and downstream environments from flooding during large storm events.
- Protect underlying groundwater resources by minimising nutrient export from the site.
- Gain support from Department of Water and Environmental Regulation (DWER) (previously the Department of Water (DoW)) and Shire of SJ for the proposed method to manage stormwater within the site and potential impacts on downstream areas.

The objectives described above have been used to develop a set of design criteria that are proposed to guide the development of the site, as outlined in **Section 3**. These proposed criteria can be used in future planning stages to demonstrate that the agreed objectives for water management at the site have actually been achieved.

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Appendices

Appendix A

Proposed Development Concept (Michael Glendinning 2017)

Appendix B

Regional Catchment Plan (Cardno 2013) with annotation by Emerge Associates

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



1 Introduction

1.1 Background

Serene Environs (the proponent) is seeking to amend the land use zoning over Lot 9 Hardey Road, Serpentine (herein referred to as 'the site'), to facilitate the future subdivision of the site into Rural Living lots. The location of the site is shown in **Figure 1**.

1.2 Proposed scheme amendment

The site is comprised of a single lot, zoned 'Rural' under both the Metropolitan Region Scheme and the Shire of Serpentine Jarrahdale (Shire of SJ) TPS No. 2, as shown in **Figure 2**. The Shire of SJ will need to initiate a scheme amendment to rezone the site to 'Rural Living A' under TPS No. 2, consistent with the Shire's Draft Rural Strategy Review (2013) and the Draft South Metropolitan Sub-Regional Planning Framework. The proposed development concept which complies with the proposed zoning is attached as **Appendix A**.

The site has been identified as an area suitable for 'Rural Living A' development under the Shire of SJ's Draft Rural Strategy Review (2013), based on its proximity to the Serpentine town site and its contiguous southward extension of the 'Rural Living A' zone east of Hardey Road.

1.3 Purpose of this report

This District Water Management Strategy (DWMS) details the water management approach proposed for the development to support a local scheme amendment application to rezone the site from 'Rural' to 'Rural Living A', and has been prepared in accordance with *Better Urban Water Management* (WAPC 2008).

1.4 Policy framework

There are a number of State Government policies of relevance to the site. These policies include:

- State Water Strategy (Government of WA 2003)
- State Planning Policy 2.9 Water Resources (WAPC 2006)
- Guidance Statement No. 33: Environmental Guidance for Planning and Development (EPA 2008)
- Liveable Neighbourhoods Edition 4 (WAPC 2007)
- Planning Bulletin No. 64: Acid Sulfate Soils (WAPC 2009)
- Draft Country Sewerage Policy (DoH 2002)
- Draft Government Sewerage Policy (DoP 2016)

In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water discharge characteristics that rural residential developments should aim to achieve.

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These are key inputs that relate either directly or indirectly to the site and include:

- Better Urban Water Management (WAPC 2008)
- Australian Runoff Quality (Engineers Australia 2006)
- Australian Rainfall and Runoff (Engineers Australia 1987)
- Decision Process for Stormwater Management in Western Australia (DoW 2009)
- Stormwater Management Manual for Western Australia (DoW 2007)
- Guidelines for district water management strategies (DoW 2013)
- National Water Quality Management Strategy (ANZECC 2000)

The guidance documents listed indicate a need for accurate water quality baseline data prior to residential development. This will ensure that any future development is able to fulfil the stormwater management requirements of the Department of Water and Environmental Regulation (DWER) and engineering standards specified by the Shire of SJ, but will also ensure that realistic water quality criteria that are practically achievable are adopted.

1.5 DWMS objectives

This DWMS has been developed in consideration of the objectives and principles detailed in Better Urban Water Management (WAPC 2008). It is intended to support the rezoning of the site from 'Rural' to 'Rural Living A' under the Shire of SJ's TPS No. 2, and is further based on the following major objectives:

- Provide a broad level stormwater management framework to support future rural residential development.
- Incorporate appropriate best management practices (BMP) into the drainage system that address the environmental and stormwater management issues identified.
- Minimise development construction costs, which will result in reduced land costs for future home owners.
- Minimise ongoing operation and maintenance costs for the land owners and Shire of Serpentine Jarrahdale.
- Maintain existing runoff regimes entering and leaving the site.
- Manage runoff water quality to protect downstream environments.
- Protect infrastructure and downstream environments from flooding during large storm events.
- Maintain and protect sensitive riparian vegetation within the site.
- Protect underlying groundwater resources by minimising nutrient export from the site.
- Gain support from DWER and Shire of SJ for the proposed method to manage stormwater within the site and potential impacts on downstream areas.

Detailed objectives for water management within the site are further discussed in **Section 3**.

2 Description of Existing Environment

2.1 Local context

The site is currently used for horse agistment purposes and contains a residential dwelling and associated outbuildings. The site is largely composed of cleared paddocks with a number of mature trees around the dwelling and lot boundary. The site is bound by surrounding rural and rural residential land uses to the north, east and south and by Hardey Road and a freight railway line to the west, as shown in **Figure 1**.

2.2 Proposed development

The site is proposed to be developed into approximately 19 rural residential lots, each a minimum 1 ha in size. The proposed development concept is attached as **Appendix A**, and includes a foreshore corridor associated with the Arnold Road Main Drain which runs in a northerly direction through the eastern portion of the site. While the *Land Capability Assessment* (Emerge Associates 2017) prepared for the site supports the development of 0.4ha lots within the site similar to the adjoining landholdings to the north, the proposed 1ha lots (see **Appendix A**) are considered an appropriate response to the contextual setting of the site which will see the local land use transition between the 0.4ha lots to the north and the larger rural landholdings to the south.

2.3 Climate

The closest weather station to the site which records rainfall and temperature data is located in Karnet (Bureau of Meteorology (BoM) station number 9111), situated approximately 11 km east of the site. Based on weather data collected from 1963 to 2017 at this weather station, the local area experiences an average of 1,159.3 mm of annual rainfall, a mean annual maximum temperature of 22.5°C and a mean annual minimum temperature of 10.6°C (BoM 2017).

2.4 Topography, landform and soils

2.4.1 Topography

The site is gently sloping with a north-westerly aspect, with existing ground levels ranging from 43 metres Australian height datum (m AHD) in the south-eastern portion of the site, to 38 m AHD in the north-western portion of the site (DoW 2008). Topographic contours over the site are shown in **Figure 1**.

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2.4.2 Landforms and soils

Regional landform mapping identifies the site as being situated on three broadly defined soil-landform 'land units'. These land units include:

- **Pinjarra P1a Phase** which was broadly described as 'flat to very gently undulating plain. Imperfect to poorly drained and generally not susceptible to salinity'.
- **Pinjarra B1 Phase** which was broadly described as 'extremely low to very low relief dunes, undulating sandplain and discrete sand rises'.
- **Forrestfield F2b Phase** which was broadly described as 'well drained low slopes and foot slopes up to 5-10%'.

The Pinjarra P1a Phase land unit was identified as occurring across the majority of the site, with Pinjarra B1 Phase occurring in the western portion of the site, and the Forrestfield F2b Phase only marginally occurring in the north-eastern corner of the site.

2.4.3 Surface soils and geology

Regional soil mapping indicates that three soil units occur within the site, as shown in **Figure 3**. These include:

- **Sandy Clay (Cs)** which is described as 'white grey to brown, fine to course, sub-angular to rounded, clay of moderate plasticity; gravel and silt layers near scarp, of alluvial origin'.
- **Sand (S8)** which is described as 'white to pale grey at surface, yellow at depth, fine to medium grained, moderately sorted sub-angular to sub-rounded, minor heavy minerals, or eolian origin'.
- **Sand (S10)** which is described as 'S8 over sandy clay to clayey sand of the Guildford formation'.

The Cs soil unit is identified as occurring across the majority of the site, with a lesser extent of the S8 soil unit, and a very small (almost negligible) extent of the S10 soil unit.

A limited number of soil samples were taken at the site, as outlined in the Land Capability Assessment, which indicate that soils within the site generally consist of silty sand to clayey silty sand over sandy clay/sandy gravelly clay.

2.4.4 Acid sulfate soils

Acid sulfate soil (ASS) risk mapping prepared by the then Department of Environment Regulation (DER 2015) indicates that within the site there is a 'moderate to low risk of ASS occurring within 3 m of the natural soil surface, but a high to moderate risk of ASS occurring beyond 3 m of the natural soil surface.

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2.5 Hydrology

2.5.1 Groundwater

The site is within the Serpentine Groundwater Management Area and the Serpentine 3 Sub-area. Information on the regional groundwater resources obtained from DWER (2017) indicates that the site is underlain by a multi-layered aquifer system comprised of the following resources:

- Perth - Superficial Swan (unconfined).
- Perth – Cattamarra Coal Measures (confined).
- Perth - Leederville (confined).

The current landowner holds a licence to take 18,500 kL per annum from the Superficial Aquifer from the Serpentine 3 subarea (GWL156099).

There is currently no available regional groundwater contours covering the site, however groundwater levels were observed during site investigations undertaken as part of the Land Capability Assessment (Emerge 2017a).

The depth to groundwater encountered at the sampling locations (shown in **Figure 4**) ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site. Given that the site investigation was undertaken in November 2016, when groundwater levels are typically near a seasonal high, these levels are expected to be generally representative of annual maximum groundwater levels within the area. These levels could be further refined by additional monitoring in the future prior to on-ground development.

2.5.2 Surface water

The site is located approximately 2 km south of the Serpentine River within the Serpentine sub-catchment of the broader Peel-Harvey Catchment.

Several surface water features occur within the site, including two farm dams in the west of the site and the Arnold Road Main Drain (ARMD) situated just inside the eastern boundary. The ARMD flows from the south, through the site and then to the existing rural residential area to the north of the site. The ARMD ultimately discharges to the Serpentine River. Hydrological mapping by DoW (2015), (see **Figure 4**) indicates the northern portion of this drainage channel is the ARMD, while the southern portion of the surface water feature is a minor watercourse, indicating that the natural waterway has been altered historically to serve as an agricultural drain.

A regional catchment plan was prepared as part of the *Serpentine Downs Estate Stage 6 Drainage Report* (Cardno 2013) (drawing number E02004-005-SK100; Revision D) and is included in **Appendix B**. The catchment plan was prepared for the existing rural residential development immediately north of the site. The catchment plan shows that flows through the ARMD in the eastern portion of the site are carried from a larger 660 ha catchment extending south-east of the site, identified as the Serpentine Downs sub-catchment in **Appendix B**.

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Data from Cardno (2013) and the Water Corporation indicates that flows through the South Western Highway culvert (see **Appendix B**) ranges between 4 m³/sec and 12 m³/sec in a 100 year ARI event. Further detailed modelling of existing flows through the ARMD within site should be undertaken as part of future detailed design stages to refine this estimate, however it is conservatively assumed that the ARMD conveys 12 m³/sec in a 100 year ARI event.

Rainfall runoff from the Arnold Road catchment flows north through the development within the ARMD into two compensating basins that discharge through the Arnold Road Western Culvert into the Serpentine River via a section of a Water Corporation drain (Cardno 2013).

Runoff from the Hardey Road catchment (i.e. the majority of the site) flows north-west to the railway reserve. These flows eventually discharge to the Water Corporation controlled subsection F2 drain which in turn discharges into the Serpentine River (Cardno 2013).

As outlined by Cardno (2013), although the rail corridor is undulating and irregular, it slopes gradually to the north at approximately 0.4%. The corridor is also vegetated by medium dense scrub which presents a natural barrier to stormwater flows, and as a result it is common for small pools to form within the corridor, which infiltrate through the soil and gradually make their way north in larger events (Cardno 2013).

2.5.3 Wetlands

The majority of the site is mapped as a multiple use wetland (MUW) (UFI 16021), with a small area in the western portion of the site mapped as a resource enhancement wetland (REW) (UFI 15364) (Department of Biodiversity, Conservation and Attractions 2017), as shown in **Figure 4**. Given the general absence of remnant vegetation within the site, and the regional landforms and soils mapping, the extent of this mapped REW is unlikely to be reflective of wetland conditions on the ground.

MUWs do not require specific conservation or protection measures, and the hydrological characteristics of these wetlands (i.e. groundwater levels and surface water flows) can be suitably addressed through the standard water management process.

2.5.4 Public Drinking Water Source Areas

Publically available Public Drinking Water Source Area (PDWSA) mapping (DoW 2015) indicates that the site is not located within or adjacent to any declared PDWSA.

District Water Management Strategy

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2.6 Summary of existing environment

In summary, the environmental investigations conducted to date indicate that:

- The site receives an annual average rainfall of 1,159 mm. The majority of rainfall is received between May and September.
- The site ranges from 38 m to 43 m AHD in elevation and has a north-westerly aspect.
- The site is primarily underlain by silty sand to clayey silty sand over sandy clay/sandy gravelly clay.
- Acid sulfate soil (ASS) risk mapping indicates that there is a moderate to low risk of encountering ASS within 3 m of the natural ground surface.
- The majority of the site is mapped as a MUW with a small area in the western portion of the site mapped as a REW. The REW is unlikely to be reflective of wetland conditions on the ground.
- The site supports two farm dams in the west of the site and a portion of the ARMD.
- Previous peak flow estimates for the ARMD indicate that flows range between 4 m³/sec and 12 m³/sec in a 100 year ARI event.
- Stormwater runoff generated within the site is expected to either infiltrate within lots or will be conveyed and discharged to the existing drainage networks within Hardey Road west of the site.
- Groundwater levels were observed during the site investigations. Depth to groundwater encountered at the sampling locations ranged from 1.0 m within the south-western portion of the site to 1.8 m within the south-eastern portion of the site.
- The site has historically been cleared for rural purposes.

3 Design Criteria and Objectives

This section outlines the objectives and design criteria that this DWMS and future management strategies must achieve. The water management strategy covers stormwater management, groundwater management and water supply and conservation.

3.1 Integrated water cycle management

The *State Water Strategy* (Government of WA 2003) and *Better Urban Water Management* (WAPC 2008) endorse the promotion of integrated water cycle management and application of WSUD principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies.

Integrated water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Stormwater management design objectives should therefore seek to deliver best practice outcomes in terms of:

- Water supply and conservation
- Flood mitigation
- Surface water quality
- Groundwater management.

The first step in applying integrated water cycle management in rural residential catchments is to establish agreed environmental values for receiving environments. The existing environmental context of the site has been discussed in **Section 2** of this document. Guidance regarding environmental values and criteria is provided by a number of National and State policies and guidelines and site specific studies undertaken in and around the site, as detailed in **Section 1.4**.

The design criteria discussed in the following sections are based on the assessment of the existing environment within the site and downstream, and with the aim of achieving the integrated water cycle outcomes discussed above.

3.2 Water supply and conservation

Water conservation design criteria have been determined in line with the guidelines presented in *Better Urban Water Management* (WAPC 2008). This DWMS proposes the following criteria.

Criteria WC1 Utilise fit for purpose water sources throughout the development.

Criteria WC2 Consumption target for water of 100 kL/person/year.

The manner in which these objectives will be achieved is further detailed in **Section 4**.

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



3.3 Stormwater management

The principle behind stormwater management at the site is to mimic the pre-development hydrological conditions, as described in **Section 2.4**. This DWMS proposes the following stormwater management criteria:

Criteria SW1 Post-development peak discharge rates should not exceed pre-development peak discharge rates.

Criteria SW 2 Provide adequate land area for conveyance of peak flows within the ARMD.

Criteria SW3 Provide 300 mm clearance between habitable floor levels and the 100 year ARI event flood levels in the Arnold Road Main Drain.

Criteria SW4 Minor roads must remain passable in the 5 year ARI rainfall event.

Criteria SW5 Retain and treat the 1 year 1 hour ARI event as close to source as possible.

Criteria SW6 Utilise appropriate structural and non-structural measures to reduce nutrient loads.

The manner in which these objectives will be achieved is further detailed in **Section 5**.

3.4 Groundwater management

The principle behind the groundwater management strategy is to maintain the existing groundwater hydrology. This DWMS proposes the following groundwater management criteria:

Criteria GW1 Maintain or improve the quality of groundwater leaving the site.

The manner in which these objectives will be achieved is further detailed in **Section 6**.

4 Water Conservation Strategy

4.1 Fit-for-purpose water use

Conservation of water through fit-for-purpose use and best management practices is encouraged so that water is not wasted. Fit-for-purpose principles have been utilised in the water conservation strategy for the site and will achieve **Criteria WC1**.

4.1.1 Scheme water

The Water Corporation owns and maintains the existing water reticulation system in Serpentine. An existing DN100 water main on the western side of Hardey Road terminates opposite the north-western corner of the site (JDSi 2017).

The water reticulation system is proposed to be extended to service the site, and the design will need to be approved by the Water Corporation and all construction will need to be undertaken in accordance with Water Corporation specifications. In the event that the system is not extended, lots within the site can be serviced by rainwater tanks.

4.1.2 Groundwater

The site is within the Serpentine Groundwater Area and the Serpentine 3 Groundwater Sub-area. Groundwater is not proposed to be used at either a lot or estate scale.

The current landowner holds a licence to take 18,500 kL per annum from the Superficial Aquifer from the Serpentine 3 subarea (GWL156099). This licence may be used to support the construction of the proposed road network within the site (for dust suppression purposes) pending the appropriate transfer of the licence, or an alternative source may be utilised by the proponent as required.

It is not proposed that groundwater would be used at the site in the long term for any ongoing uses.

4.1.3 Rainwater

Collection of rainwater from roof surfaces can potentially be undertaken, with this water stored within rainwater tanks for later use. Rainwater can be utilised for all at-lot purposes including potable and non-potable supply.

It is not proposed that the installation of rainwater tanks will be mandated given that scheme water is envisaged to be available. However if scheme water were not available, rainwater tanks would become mandatory. If rainwater tanks are to be included in the proposed water conservation strategy, this will be described in the future LWMS.

4.1.4 Recycled water

The site is not proposed to be connected to a reticulated sewer network; instead each lot will have an onsite effluent treatment and disposal system fully contained within the lot. A Land Capability Assessment has been undertaken by Emerge Associates (2017a), which demonstrates that this approach can satisfy the draft Country Sewerage Policy (DoH 2003) and can meet the intent of the

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



draft Government Sewerage Policy (DoP 2016). The use of recycled water for potable or non-potable uses may be possible, depending on the level of treatment and the manner which the DoH approval allows the water to be used on site.

4.2 Water conservation measures

4.2.1 Water efficient fixtures and appliances

A significant reduction of in-house water consumption can be achieved with the adoption of water efficient fixtures and appliances (WEFA). The water conservation strategy for the site proposes that all dwellings implement WEFA. Water efficient fittings will be mandated through the building licence, while uptake of water efficient appliances can be encouraged by state and local government rebates, as well as education from the proponent at point of sale.

4.2.2 Water wise gardens

Water use efficiency measures can significantly reduce the total consumption for irrigation purposes. Water use can be reduced on a development scale by employing water wise gardening (WWG) measures including:

- Improve soil with conditioner certified to Australian Standard AS4454 to a minimum depth of 150 mm where turf is to be planted and a minimum depth of 300 mm for garden beds.
- Design and install the irrigation system according to best water efficient practices.
 - Control systems must be able to irrigate different zones with different irrigation rates.
 - Emitters must disperse coarse droplets or be subterranean.
 - Utilise subsoil irrigation where appropriate.
- Minimise the amount of turf areas.
- Mulch garden beds to 75 mm with a product certified to Australian Standard AS4454.
- Retain remnant native trees and vegetation where possible.
- Minimise use of fertiliser and utilise slow release fertilisers.
- Use treated wastewater for irrigation purposes where appropriate (and consistent with the approved method of disposing of treated effluent within the lot).

WWG principles should be promoted to lot owners at point of sale.

The adoption of WEFA and WWG principles will assist in achieving **Criteria WC2**.

4.2.3 Educational material

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Educational material will be provided to lot purchasers to provide information on water efficiency and quality protection measures that they can implement within lots. Provision of educational material will assist in achieving **Criteria WC2** and **GW1**.

Specific water conservation and protection topics may include:

- Water use reduction
- Water efficient technologies
- Fertiliser use
- Planting species.

4.3 Wastewater

The Water Corporation has advised that the Serpentine Township sits outside the wastewater scheme planning area, therefore no sewer services are to be provided in this area (JDSi 2017). Therefore based on engineering and feasibility constraints, the proposed development will not be connected to reticulated sewer. A Land Capability Assessment has been undertaken by Emerge Associates (2017a), and this document demonstrates that this approach can satisfy the draft Country Sewerage Policy (DoH 2003) and can meet the intent of the draft Government Sewerage Policy (DoP 2016).

Regional landform and soil mapping for the site indicates that there are no characteristics of the site that would result in un-manageable issues due to the use of onsite effluent disposal systems. Potential aspects which may require some form of management/engineering response include seasonal flooding, a high water table, low soil absorption and low microbial purification ability. Site specific investigations undertaken in November 2016 and subsequent assessments have considered these factors.

Based on the site specific investigation undertaken in November 2016, the site is considered to provide adequate separation to groundwater (1.0 to 1.8 m) for land application systems in accordance with AS/NZS 1547. Further, the flows within the ARMD are contained within the ARMD corridor, with localised topography directing ARMD inflows to the north, and not into the majority/remainder of the site. Therefore the site is not expected to be subject to seasonal flooding or a high water table that would limit the use of the site for onsite effluent treatment and disposal.

Soil absorption and microbial purification ability takes into consideration waterlogging and inundation risk, soil permeability class, the presence of stones/boulders within the soil profile and the depth of the soil profile. The site-specific investigation did not identify any characteristics that would suggest that the site has a low soil absorption ability. However, infiltration testing and the depth to groundwater recorded at TP01 indicates that permeability is high at this location, and this location also had the least separation to groundwater (1.0 m) which suggests potentially low microbial purification ability at some areas within the site. Potentially low microbial purification ability of soils within the site can be readily managed through the careful selection and design of future land application systems within the site, including measures such as secondary treatment, disinfection and/or nutrient removal.

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Detailed calculations were undertaken as part of the Land Capability Assessment to determine the nutrient loading and discharge area for 1 ha lots based on the use of nutrient retentive Aerobic Treatment Units (ATUs), which concluded that the proposed lots are considered appropriate for the use of onsite effluent treatment and disposal.

Department of Health approved wastewater systems are the only systems that can be used in Western Australia, and therefore it is assumed that this will occur. While the ultimate selection of the most appropriate wastewater treatment and disposal systems for the site-specific characteristics will be determined as part of future detailed engineering and servicing design for each individual lot, it is recommended that nutrient retentive secondary systems (ATUs/alternative treatment systems) be used to respond to localised soil and groundwater constraints and broader potential concerns regarding nutrient losses.

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5 Stormwater Management

The principle behind the stormwater management strategy is to maintain the existing hydrology of the site. The adoption of the development drainage system and the utilisation of various WSUD strategies will achieve the design criteria stated in **Section 3.3**.

5.1 WSUD Strategies

Examples of possible WSUD techniques that may be utilised are discussed below. Further WSUD measures which may be suitable for the site shall be investigated at future planning stages. Where practical, these measures will be described in future LWMS and UWMP documents.

5.1.1 Lot scale storage

A primary objective in the stormwater management strategy is to maintain predevelopment hydrology. Within lots this could potentially be achieved by the use of soakwells, typically sized to retain the first 15 mm. Runoff captured in this way will infiltrate into the underlying soils and ultimately to groundwater. Infiltration of runoff through the underlying soils will provide treatment through adsorption of nutrients to sand particles. Other lot scale storage systems may also be considered, and where proposed will be detailed in future LWMS and UWMP documents.

5.1.2 Roadside Swales

Drainage from the proposed road network within the site will be conveyed via roadside swales to the existing drainage outlets in Hardey Road as shown in **Figure 5** (JDSi 2017). Given the measured permeability of the site, it is expected that some infiltration will be achieved by the swales, potentially for minor events. Existing culverts within the Hardey Road reserve are shown in **Appendix B**, and discussed in **Section 2.4.2**.

The development of the site will see approximately 4,000 m² of the site becoming road pavement (based on an approximate pavement width of 6.5 m), which is approximately 1.7% of the site area. Given the very minor change in impervious area, this change will easily be managed within the volume that could be provided within a roadside swale adjacent to the road pavement.

Further detail on the conveyance of runoff through the site to the existing culverts will be provided in future LWMS and UWMP documents.

5.2 Arnold Road Main Drain

There will be no runoff conveyed from the site to the ARMD.

As outlined in **Section 2.4.2**, data from Cardno (2013) and the Water Corporation indicates that flows through the South Western Highway culvert (see **Appendix B**) range between 4 m³/sec and 12 m³/sec in a 100 year ARI event.

Further detailed modelling of existing flows through the ARMD within the site may be undertaken as part of future detailed design stages, however based on the conservative assumption that the ARMD

District Water Management Strategy

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conveys $12 \text{ m}^3/\text{sec}$, the flood widths for the ARMD can be readily accommodated within a 30 m flood corridor. This is based on a Manning's n of 0.022 and a V shaped drain with 1:8 side slopes, which results in a flood width of 14 m and a flood depth less than 1 m.

6 Groundwater Management

The main objective for the management of groundwater is to maintain or improve the existing groundwater quality. Improvements to groundwater quality can be achieved by reducing the total nutrient load directly to groundwater and by the treatment of surface water runoff prior to infiltration to groundwater. Treatment of surface runoff is detailed in **Section 5**.

6.1 Infiltration at source

As discussed in **Section 5**, the proposed stormwater management approach includes measures to encourage the infiltration of stormwater runoff as close to source as possible. The swale conveyance proposed will also encourage nutrient removal by sedimentation, and contact with vegetation and soils. These measures reduce the mobilisation of contaminants that are typically transported within the 'first flush' of a rainfall event, which will be treated on site.

6.2 Change of land use

As detailed in **Section 2**, the site is currently used for rural residential and agricultural purposes. The use of fertilisers associated with agricultural activities provides a source of nutrient loads to the underlying groundwater system and downstream environment.

The proposed low density development will change the land use from a single large rural landholding to smaller 1 ha rural residential lots, which will remove the nutrient loading from horses/livestock and will reduce the total nutrient loading to groundwater, as outlined further in the Land Capability Assessment (Emerge Associates 2017). The two existing farm dams will likely be filled to facilitate development.

While the proposed development is not proposed to be connected to reticulated sewer, the provision of nutrient retentive secondary onsite effluent treatment and disposal systems will reduce the potential level of nutrients being discharged the environment from dwellings.

6.3 Landscaping

There is no requirement to provide public open space within rural residential development, however a small area in the east of the site (east of the ARMD) will remain an unirrigated and unfertilised parcel of land. Native vegetation will be retained where possible within this area and the foreshore area associated with the ARMD.

The use of WWG principles will minimise the overall fertiliser requirements and therefore the nutrient load that could be transported to groundwater through infiltration. Lot owners will be encouraged to implement WWG principles and minimise fertiliser use within lot through provision of promotional material (discussed in **Section 4.2.3**).

Future LWMS and UWMP documents will detail specific measures that will be implemented to reduce nutrient loading to groundwater beneath and downstream of landscaped areas.

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6.4 Non-structural measures

A series of non-structural measures may also be implemented to assist with the management of nutrient loading to underlying groundwater resources and downstream environments, and may include:

- Stormwater system maintenance
- Provision of educational material to residents
- Street sweeping to reduce particulate and sediment loads
- Water wise gardening principles
- Application of fertilisers at rates not exceeding manufacturer's recommendations.

7 Matters to be addressed at LWMS Stage

It is anticipated that future LWMS and UWMP documents will provide significantly more detail regarding a number of aspects of water management. These will include (but are not limited to):

- WSUD strategies
- Design and location of stormwater drainage structures
- Modelling of local road drainage network
- Water allocation and supply
- Water conservation strategies
- Non-structural water quality improvement measures
- Monitoring, where required

7.1 WSUD strategies

WSUD strategies for the site will focus on maintaining the predevelopment hydrology for the site, utilising in-lot detention and conveyance systems where required as outlined in **Section 5**. Further WSUD measures will be investigated at future planning stages.

7.2 Design and location of drainage structures

This DWMS has proposed nominally located and sized areas for drainage. Future LWMS and UWMP documents will provide specific details on location, configuration and required volumes of infiltration/detention structures, ensuring that the stormwater management system can achieve all of the required objectives and integrate into the surrounding environment.

7.3 Modelling of local road drainage network

Modelling and runoff calculations for the local road drainage network will need to be carried out for the 5 year and 100 year ARI rainfall events to demonstrate compliance with the stormwater management criteria, detailed in **Section 3.3**. Calculations to support the sizing of infiltration structures will need to be provided so that detailed designs can proceed and future water planning stages (i.e. UWMP) can demonstrate compliance with the design criteria.

7.4 Water allocation and supply

The Water Corporation owns and maintains the existing water reticulation system in Serpentine. An existing DN100 water main on the western side of Hardey Road terminates opposite the north-western corner of the site, as outlined in the Servicing Report (JDSi 2017). The design of the water reticulation system would need to be approved by the Water Corporation and all construction will need to be undertaken in accordance with Water Corporation specifications. If scheme water is not available to the site, lots will be serviced through the provision of rainwater tanks.

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



7.5 Water conservation strategies

A number of potential measures have been discussed that can assist in reducing total water consumption. It is expected that future LWMS documents will clarify which measures are proposed to be integrated into the future built system.

7.6 Non-structural water quality improvement measures

Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia* (DoW 2007). Some measures will be more appropriately implemented by the Shire of SJ, however many can be implemented relatively easily within the design and maintenance of the development.

It is expected that future LWMS and UWMP documents will provide reference to measures in relation to both surface and groundwater quality. It is also expected that future UWMPs will provide detailed management and maintenance plans that will set out maintenance actions (e.g. rubbish removal from roadside swales), timing (when actions are to occur), locations (where actions will occur) and responsibilities (party responsible for implementing the actions).

Approval for the proposed measures will need to be sought from the Shire of SJ and DWER. It is therefore anticipated that consultation with these agencies will be undertaken and referral to guiding policies and documents will be made.

7.7 Monitoring

Given the low density development proposed pre-development hydrological monitoring is not proposed. However, if required to inform single lot design parameters (e.g. onsite effluent disposal systems) this could be collected prior to on-ground work. The requirement for any post-development groundwater and surface water monitoring program will be further discussed in future LWMS and UWMP documents.

8 Implementation

This DWMS is a key supportive document for the proposed development. It has been prepared with the intention of providing a structure within which subsequent development can occur consistent with the integrated water cycle management approach, establishing water management methods that have been based on site-specific investigations, and are consistent with relevant State and Shire of SJ policies. It is also intended to provide guidance to the general stormwater management principles for the area and to guide the development of future LWMS and UWMP documents.

The responsibility for working within the framework established within the DWMS rests with the developers of the land, although it is anticipated that future LWMS and UWMP documents will be developed in consultation with the Shire of SJ, DWER and any other relevant authorities (e.g. Water Corporation) and in consideration of other relevant policies and documents.

The future implementation framework, inclusive of management plans for relevant aspects of the site will be guided by the planning scheme provisions. The management framework, the issues addressed within these plans and the responsibility for their preparation and implementation is summarised in **Table 1**.

Table 1: Summary of implementation framework

Planning Stage	Supportive technical document	Purpose of technical document	Portion of development to which document applies	Entity responsible for preparation	Approving authority	Entity responsible for implementation
Subdivision Guide Plan/Structure Plan	LWMS	Refine water management design objectives from DWMS, demonstrate spatial allocation of land to manage water to achieve design objectives.	Subdivision/ Structure Plan area	Proponent and Shire of SJ	Shire of SJ and WAPC on advice from DWER	Proponent
Subdivision	UWMP	Demonstrate compliance with design objectives, as well as implementation and ongoing management requirements for the drainage system. Identify roles and responsibilities for ongoing management.	Approved subdivision area	Proponent	Shire of SJ on advice from DWER	Proponent
House construction	Building designs	Demonstrate that detailed designs comply with design criteria detailed in UWMP.	Private lots	Lot owner	Shire of SJ	Lot owner

8.1 Funding

The DWMS area comprises a single landholding, and the proposed development will be privately funded.

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



8.2 Review

It is not anticipated that this DWMS will be reviewed. The next stage of development will be supported by a Subdivision Guide Plan or Structure Plan. Where a Subdivision Guide Plan or Structure Plan is produced this should be supported by a LWMS. The LWMS will largely be an extension of the DWMS as it should provide designs and measures for water management from the options proposed within the DWMS.

The next stage of development following the LWMS is lot planning through subdivision which is to be supported by an UWMP. It is recognised that certain elements (i.e. non-structural controls) of the DWMS and LWMS will not be finalised until this late stage and that there is little or no statutory control that can be applied to ensure the implementation of any remaining measures. While the remaining measures are unlikely to be enforced at this stage, their implementation could be encouraged by the Shire of SJ through policy (or modification of these where necessary) or awareness programs.

District Water Management Strategy

Lot 9 Hardey Road, Serpentine



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9 References

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District Water Management Strategy

Lot 9 Hardey Road, Serpentine



9.2 Online references

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<http://www.bom.gov.au/climate/data/>

Department of Water and Environmental Regulation (DWER) 2017, *Water Register*, viewed August 2017, <http://www.water.wa.gov.au/ags/WaterRegister>

Figures



Figure 1: Site Location and Topographic Contours

Figure 2: Surrounding Land Uses and MRS Mapping

Figure 3: Regional Soil Mapping

Figure 4: Geomorphic Wetlands and Waterways

Figure 5: Stormwater Management Plan

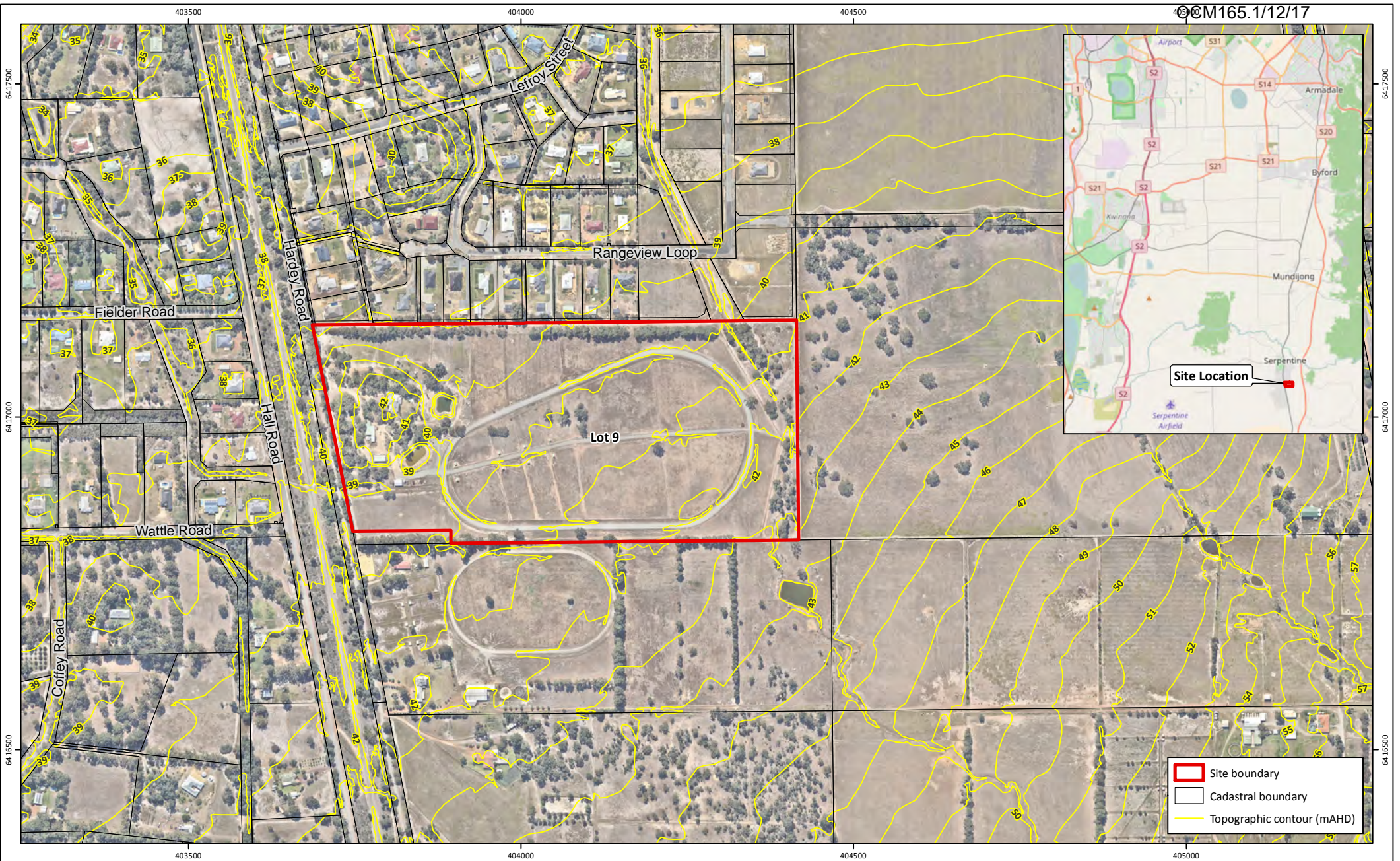


Figure 1: Site Location and Topographic Contours

Project: District Water Management Strategy
 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
 EP17-071(04)--F15

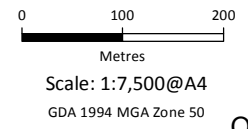
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Date: 10/08/2017

Checked: VMK

Approved: DPC

Date: 10/08/2017



OCM 18 December 2017

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

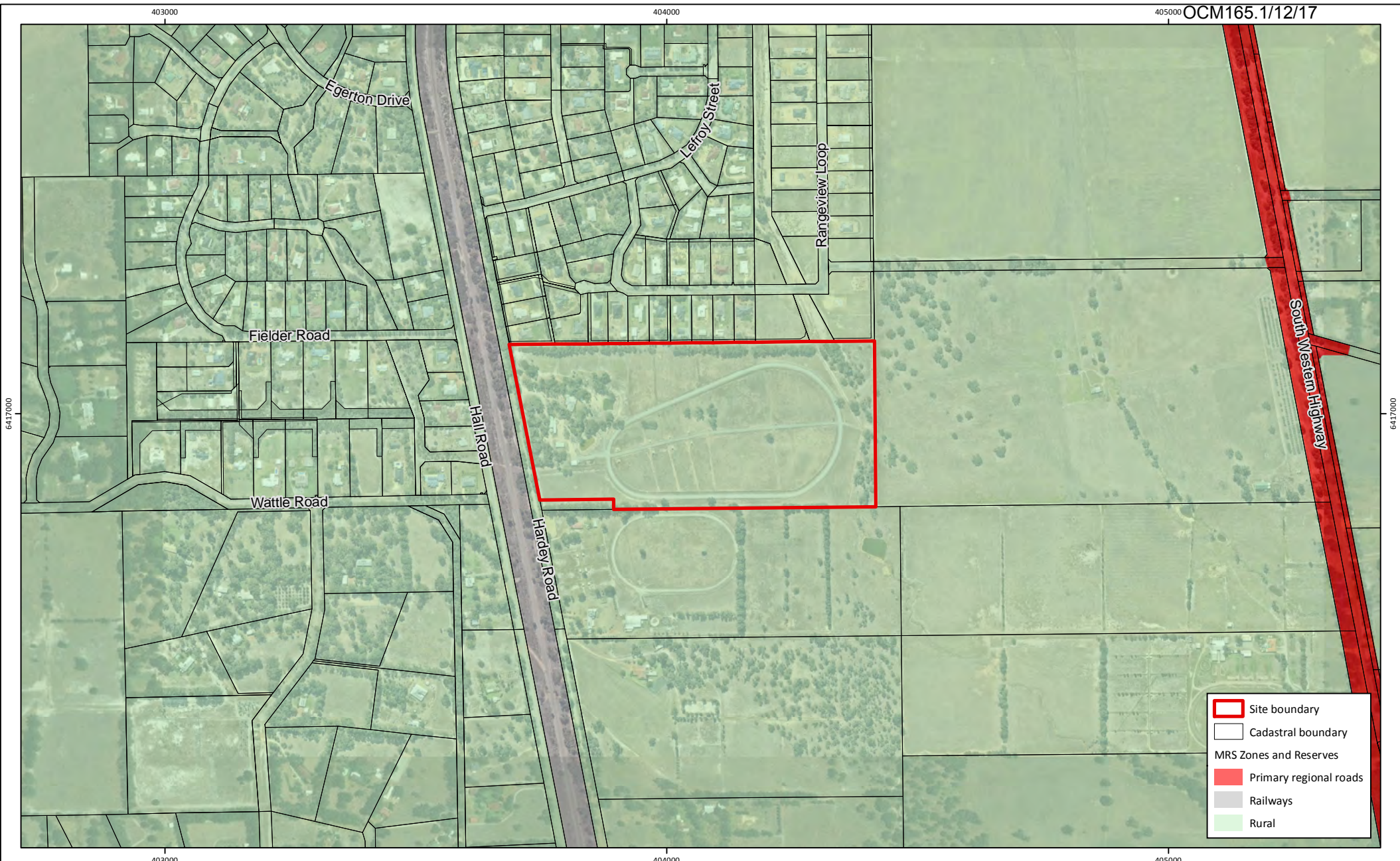


Figure 2: Surrounding Land Use and MRS Mapping

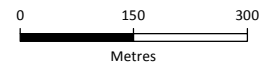
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 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

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Date: 10/08/2017

Checked: VMK
Approved: DPC
Date: 10/08/2017



Scale: 1:10,000@A4
 GDA 1994 MGA Zone 50



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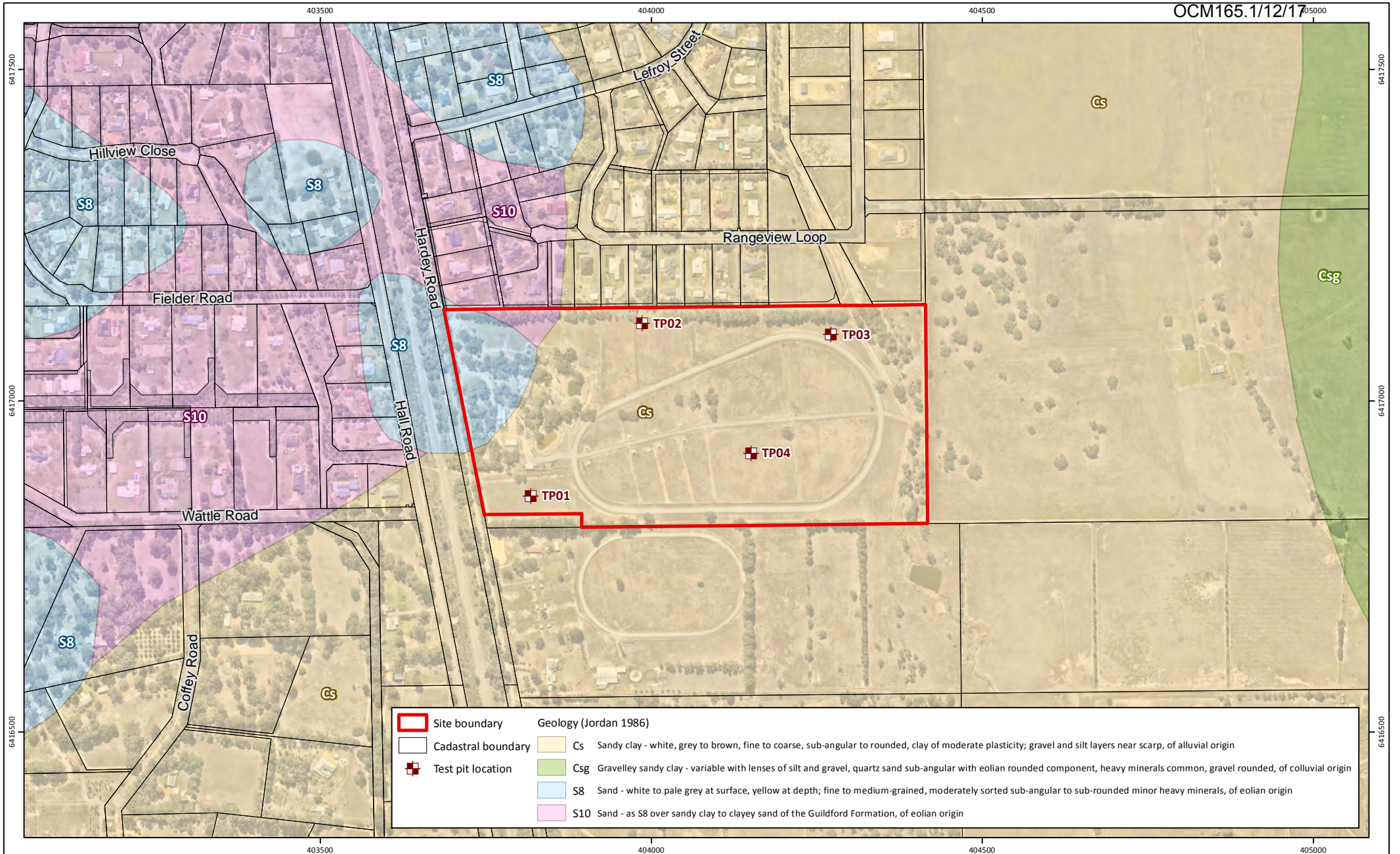


Figure 3: Regional Soil Mapping

Project: District Water Management Strategy
 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
 EP17-071(04)--F17

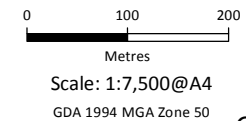
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Approved: DPC

Date: 10/08/2017



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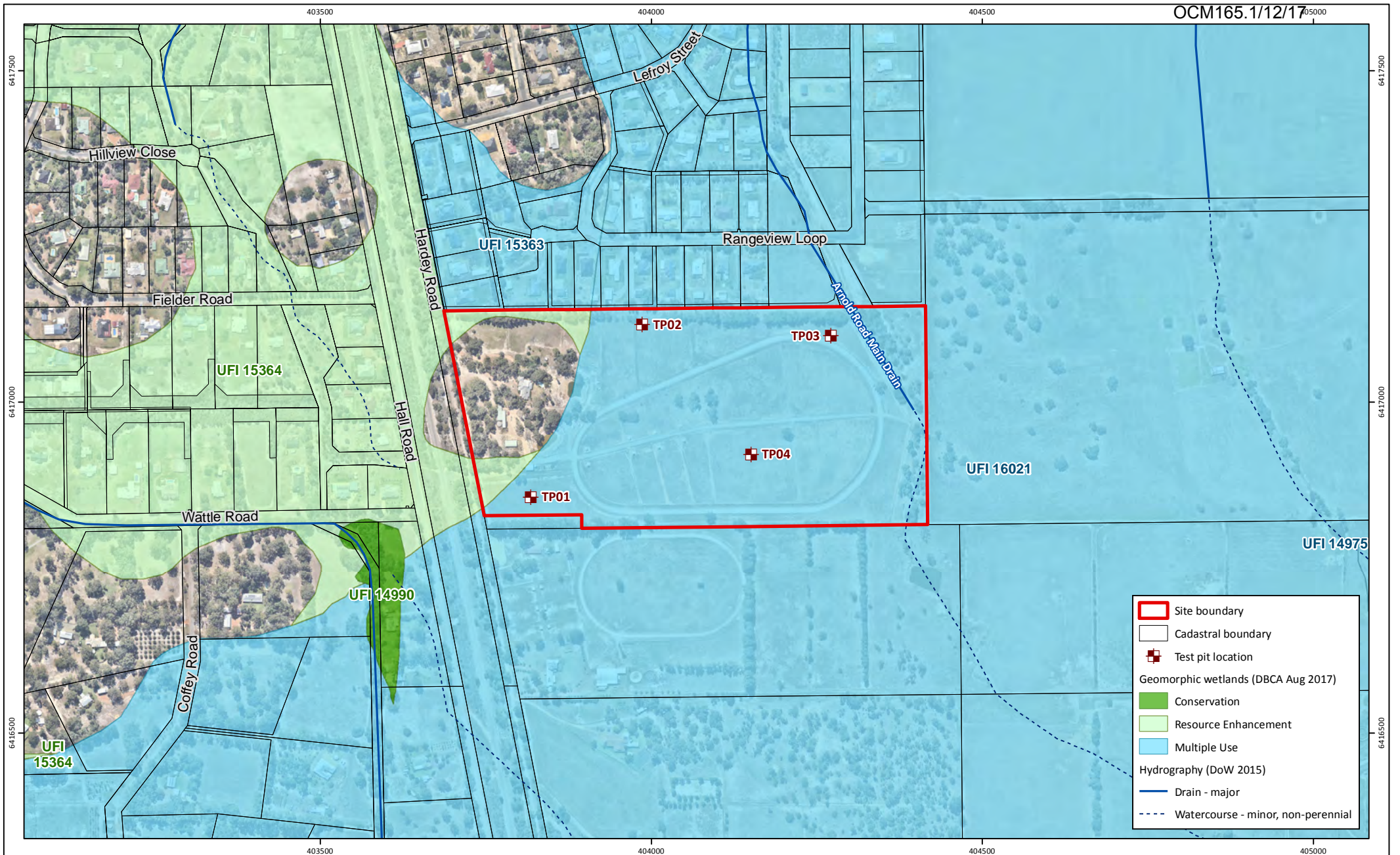


Figure 4: Geomorphic Wetlands and Waterways

Project: District Water Management Strategy
 Lot 9 Hardey Road, Serpentine
Client: Serene Environs

Plan Number:
 EP17-071(04)--F18
Drawn: KNM
Date: 10/08/2017
Checked: VMK
Approved: DPC
Date: 10/08/2017



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OCM 18 December 2017

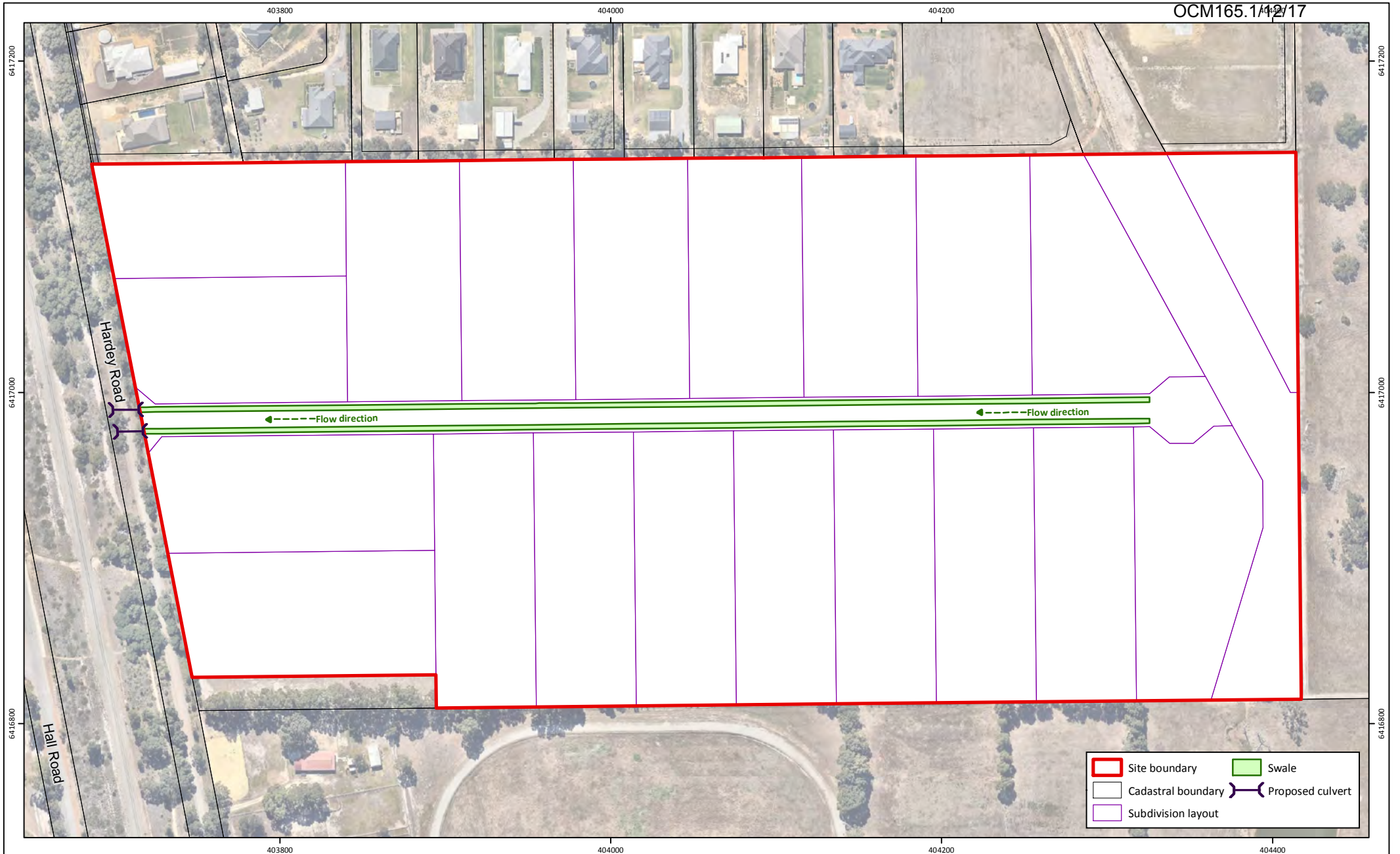
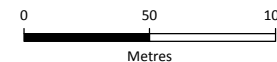


Figure 5: Stormwater Management Plan

Project: District Water Management Strategy
 Lot 9 Hardey Road, Serpentine
Client: Serene Environs

Plan Number:
 EP17-071(04)-F20
Drawn: KNM
Date: 09/10/2017
Checked: DPC
Approved: DPC
Date: 10/10/2017



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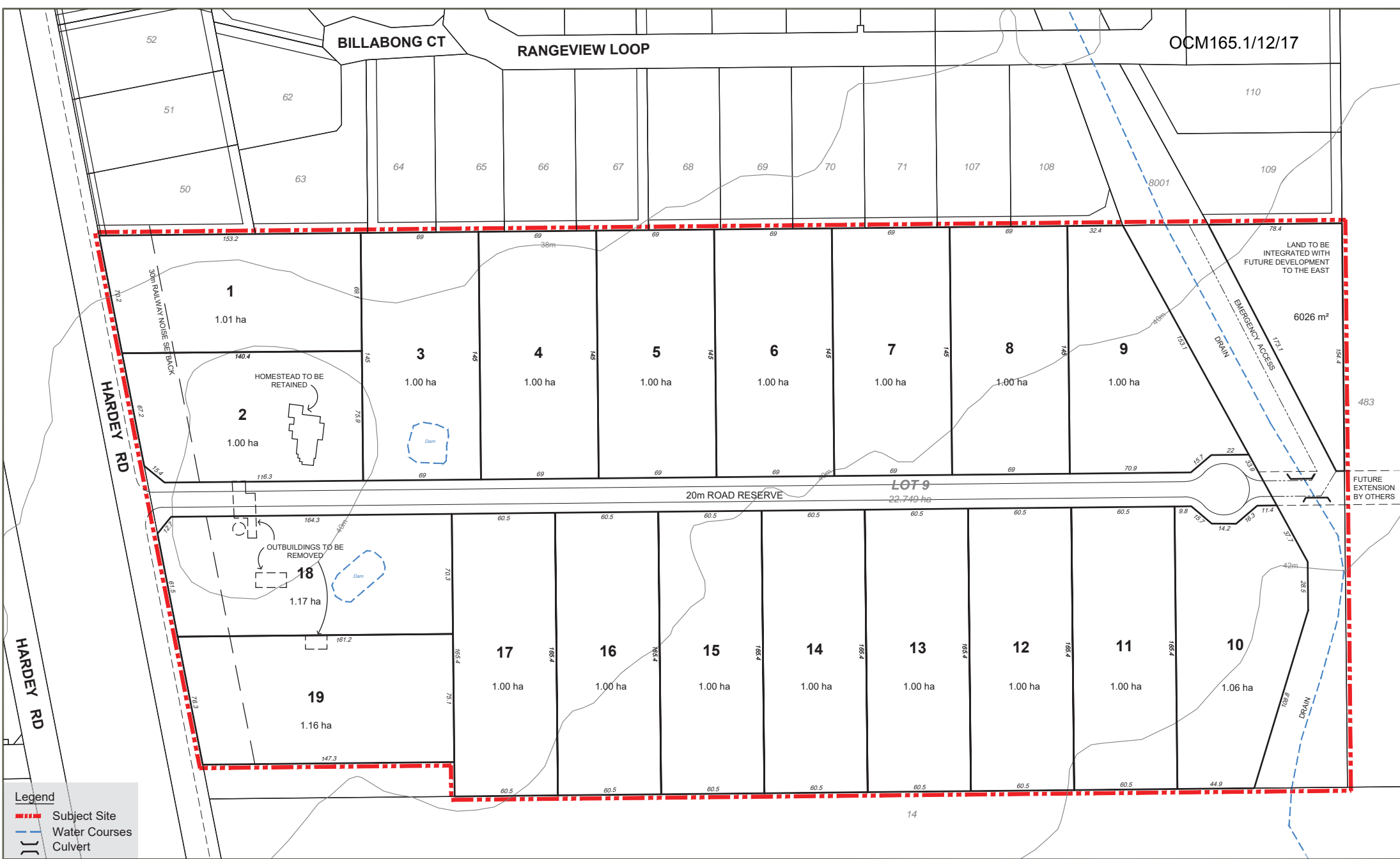


OCM 18 December 2017

Appendix A

Proposed Development Concept (Michael Glendinning 2017)



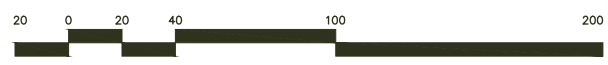


Legend

- Subject Site
- Water Courses
- Culvert



FIGURE 9 - SUBDIVISION GUIDE PLAN
 147 Hardey Road, Serpentine, 6125



Michael Glendinning
 Property

OCM 18 December 2017

Source of Information
 Site boundaries: Landgate
 Contours: DAFWA 2m Contours
 Projection: GDA94 MGA Zone 50 South

APEL 171702_Subdivision Guide Plan_1a_MGA00_147 Hardey Rd Serpentine_010817.dwg

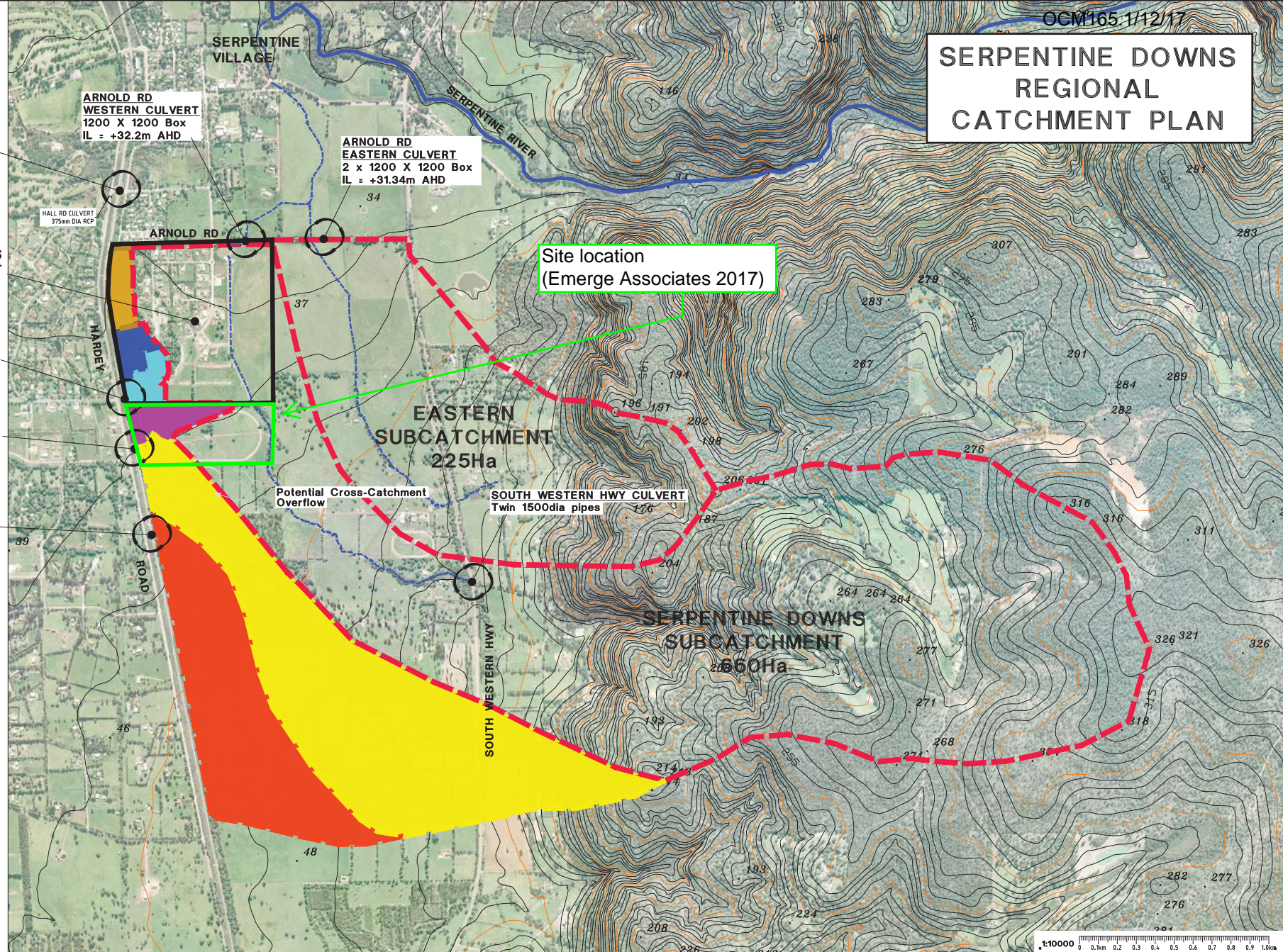
Appendix B

Regional Catchment Plan (Cardno 2013) with annotation by
Emerge Associates



OCM165-1/12/17

SERPENTINE DOWNS REGIONAL CATCHMENT PLAN



RAILWAY CULVERT
Quad 900's
Ch. 53.547Km

ARNOLD RD WESTERN CULVERT
1200 X 1200 Box
IL = +32.2m AHD

ARNOLD RD EASTERN CULVERT
2 x 1200 X 1200 Box
IL = +31.34m AHD

HALL RD CULVERT
375mm DIA RCP

SERPENTINE DOWNS PROJECT

RAILWAY CULVERT
Twin 900dia
IL = +36.89m AHD
Ch. 54.642Km

RAILWAY CULVERT
Quad 900dia
Ch. 54.904Km

RAILWAY CULVERT
Quad 900dia
Ch. 55.367Km








Site location
(Emerge Associates 2017)

EASTERN SUBCATCHMENT
225Ha

SOUTH WESTERN HWY CULVERT
Twin 1500dia pipes

SERPENTINE DOWNS SUBCATCHMENT
260Ha

LEGEND

-  CATCHMENT BOUNDARY
-  CATCHMENT DRAINING TO RAILWAY CULVERT Ch.53.5Km
-  CATCHMENT DRAINING TO HARDEY RD CROSSING CULVERT
-  CATCHMENT DRAINING TO HARDEY RD CROSSING CULVERT
-  CATCHMENT DRAINING TO RAILWAY CULVERT Ch. 54.6Km
-  CATCHMENT DRAINING TO RAILWAY CULVERT Ch. 54.9Km
-  CATCHMENT DRAINING TO RAILWAY CULVERT Ch. 55.6Km

DATE PLOTTED: 26 June, 2013 - 10:01am

USER: C:\projects\serpentine_downs\TERRACON\455814 CAD FILE: L:\2012\02004 - Serpentine USB-Drainage Report\Drawings\AuricAD\02004-005-SK1000 Regional Catchment Plan.dwg

Rev	Date	Description	Drawn	Appr.
D	25.06.13	ADDED CATCHMENT BOUNDARY	JYY	PSN
C	21.04.10	ADDED ARNOLD RD TWIN CELL CULVERT CATCHMENT BOUNDARY	JYY	PSN
B	12.11.09	ISSUED FOR INFORMATION	AMS	PSN
A	02.10.09	ISSUED FOR INFORMATION	BM	PSN

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CONSULTING ENGINEERS	Drawn	AMS	Date	02.10.09
TOWN PLANNERS	Designed	AJ	Date	02.10.09
PROJECT MANAGERS	Checked	AJ	Date	02.10.09
ENVIRONMENTAL CONSULTANTS	Reviewed	PSN	Date	02.10.09
BUILDING DESIGN	Approved	PSN	Date	02.10.09

Client	QUBE PTY LTD	Status	FOR APPROVAL
Project	SERPENTINE DOWNS ESTATE	Date	02.10.09
Scale	A.H.D.	Scale	1:10 000
File	REGIONAL CATCHMENT PLAN	Date	02.10.09
Revision	OCM 18 Dec 2017	Revision	005-SK100 D

Engineering Servicing Report
Lot 9 (147) Hardey Road, Serpentine



JDSi Reference
JDS171264

JDSi Consulting Engineers
October 2017

Revision History

Revision	Date	Description of Change	
A	28/07/2017	Draft	
0	7/08/2017	Final	
1	31/08/2017	Drainage updated and WaterCorp comments included	
2	3/10/2017	Modified for 1Ha lots	
3	5/10/2017	Final Layout Figure Included	
Author	MB	Reviewed By	JL
Signature		Signature	



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APPENDICES:

Appendix A – Water Corporation Comments



1. Key Objectives

This engineering servicing report has been prepared by JDSi as part of Serene Environs application for a Scheme Amendment request to the Shire of Serpentine Jarrahdale to rezone Lot 9 Hardey Road, Serpentine from 'Rural' to 'Rural Living A'. The key objectives of this report are to highlight:

- Existing infrastructure assets within the development area.
- Advise on infrastructure requirements for the planned development.
- Demonstrate the development can be serviced in the short to medium term.
- Advise on the implementation of key infrastructure requirements.
- Advise on earthwork requirements for the planned development.

This engineering report is based on a desktop study which covers the engineering infrastructure requirements to service the proposed development. The study incorporates reviews of earthworks, roads, stormwater drainage and utility services including sewer, water, power, telecommunications and gas.

The findings in this report are largely based on preliminary advice from relevant authorities, site investigations by Emerge Associates and the concept layout provided by Michael Glendinning Property as shown on Figure 2.2. The information is current as of July 2017.

2. Introduction

The subject site is located approximately 50km south east of the Perth CBD and is bounded by Hardey Road to the west, Serpentine Downs Estate to the north and rural land to the east and south, as shown on Figure 2.1:

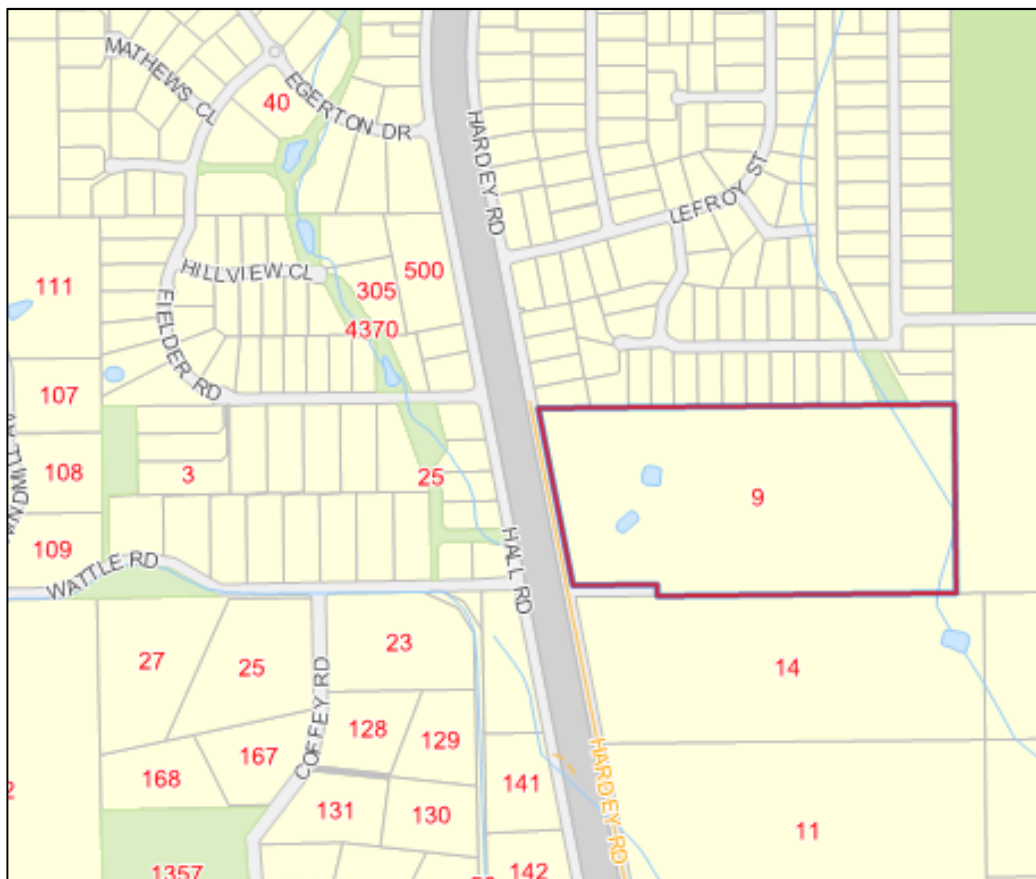


Figure 2.1: Site location (Shire of Serpentine Jarrahdale Intramaps, 2017)

The existing property contains a single dwelling and three sheds on elevated pads, two manmade dams and equine stabling and training facilities.

Lot 9 has an area of approximately 23 ha and is proposed to ultimately be subdivided into 19 one hectare (approximately) lots. The proposed layout is shown on Figure 2.2.

This report documents the existing and future servicing requirements to support the planned development. It has been based on JDSi's site observations, local experience gained from various projects and advice received from the various infrastructure stakeholders.

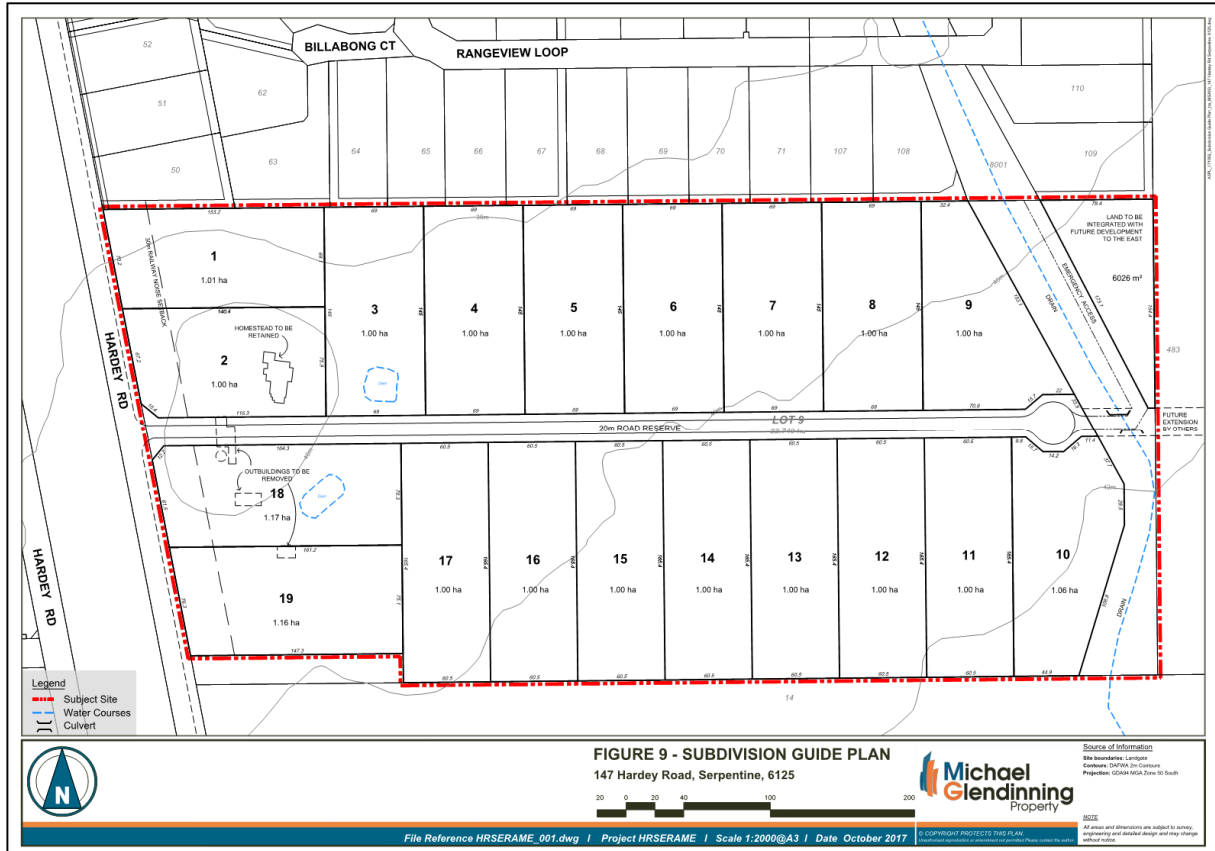


Figure 2.2: Subdivision plan (Michael Glendinning Property, 2017)

3. Site Characteristics

3.1. Topography

A detail feature survey is yet to be undertaken for the site. High level surface contours available in the Perth Groundwater Atlas indicate that the land has a gentle fall South East to North West. The survey data indicates existing levels across the site are generally flat, with elevations within the property ranging from approximately RL43m to RL38m AHD and shallow gradients generally in the order of 1%. The topography of the site is shown on Figure 3.2 with contour intervals of 1m.

The only significant topographical feature identifiable is the Arnold Road Main Drain at the eastern end of the property which flows north into the adjacent Serpentine Downs Estate.



Figure 3.2: Surface Contours (Perth Groundwater Atlas, 2017)

3.2. Groundwater

Emerge Associates undertook test-pitting of the site in November 2016 and observed that groundwater was encountered at depths ranging from 1.0m in the south-western portion of the site to 1.8m within the south-eastern portion of the site.

3.3. Geotechnical

Regional soil mapping by the Geological Survey of Western Australia shows the Cs (Sandy Clay) soil unit as occurring across the majority of the site.

Test-pitting undertaken by Emerge Associates in November 2016 recorded fairly consistent duplex soils across the site, generally comprising of silty sand up to 0.6m below ground level, over sandy clay and sandy gravelly clay from 0.5m to 2.6m (or the extent of the test pit).

3.4. Acid Sulphate Soils

No investigation to classify the actual risk of encountering Acid Sulphate Soils (ASS) on the site has been undertaken. Department of Water and Environmental Regulation Acid Sulphate Soils Risk Maps show the site as having a moderate to low risk of ASS occurring within 3m.

4. Earthworks

As the proposed development of the site will result in 1 hectare lots it is not feasible to undertake development wide earthworks. Apart from some localised earthworks associated with the demolition and removal of existing sheds, earthworks will likely be limited to provision of house pads at the time of dwelling construction.

Earthworks will need to be undertaken in accordance with the recommendations of a geotechnical investigation and Australian Standard AS3978-1996 "Earthworks for Residential and Commercial Developments".

5. Sewer

Water Corporation advises that the Serpentine Township sits outside the wastewater scheme planning area. As the land is to be developed as a rural subdivision no sewer services would be provided.

The proposed method of wastewater disposal will be via nutrient retentive Aerobic Treatment Units (ATU's) in accordance with Shire of Serpentine Jarrahdale requirements.

6. Water Supply

The Water Corporation owns and maintains the existing water reticulation system in Serpentine. An existing DN100 water main on the western side of Hardey Road terminates at the northern boundary of Lot 9 as shown on Figure 6.1.

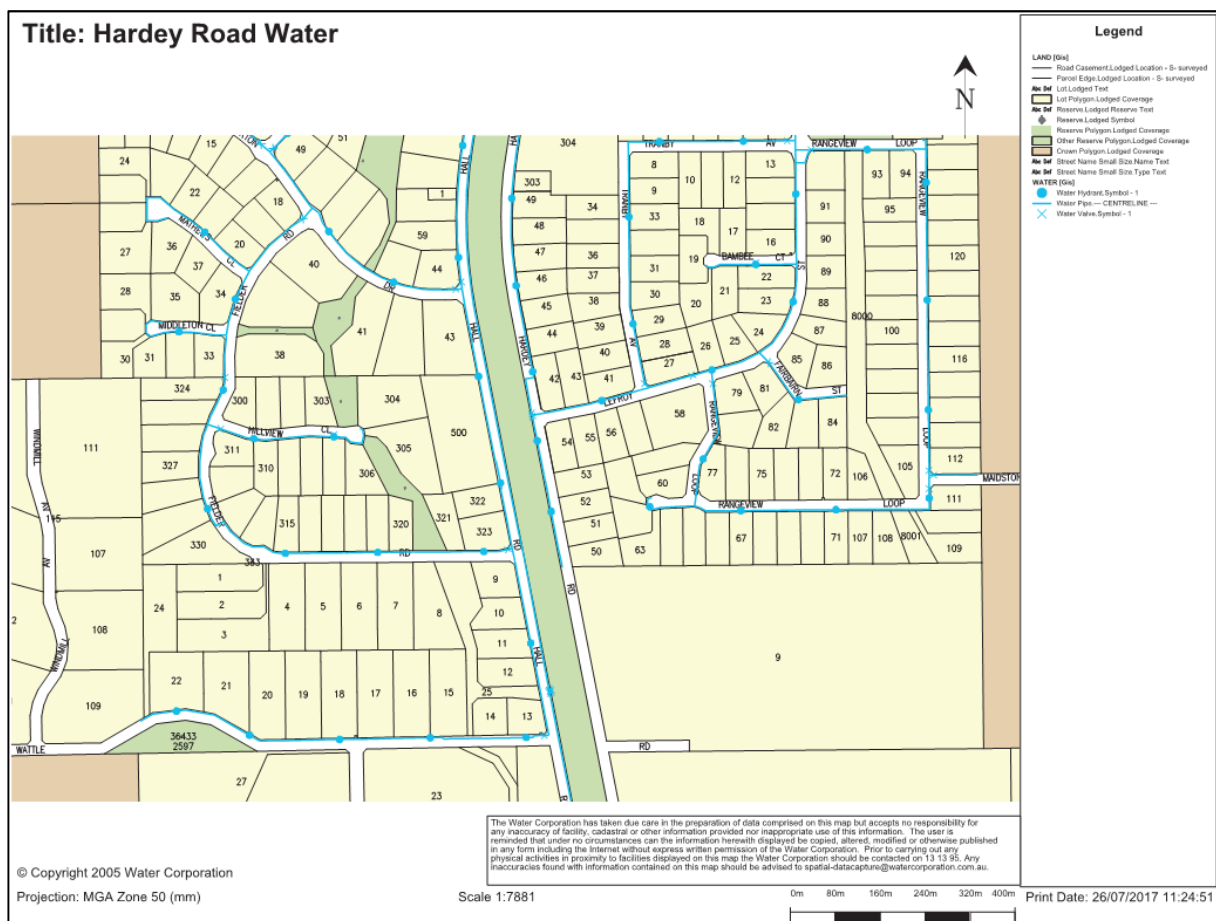


Figure 6.1: Water Corporation water reticulation assets (Water Corporation, July 2017)

The design of the water reticulation system would need to be approved by the Water Corporation and all construction will need to be undertaken in accordance with Water Corporation specifications.

7. Power Supply

Existing Western Power owned and operated 22,000/415V electricity distribution assets have been identified in the area of the proposed development at Lot 9 Hardey Rd, Serpentine.

These assets are supplied from the Western Power Byford Zone Substation via the 22,000 Volt Hardey Road (BYF 523.0 L4085 SUNRAYS ST) Feeder.

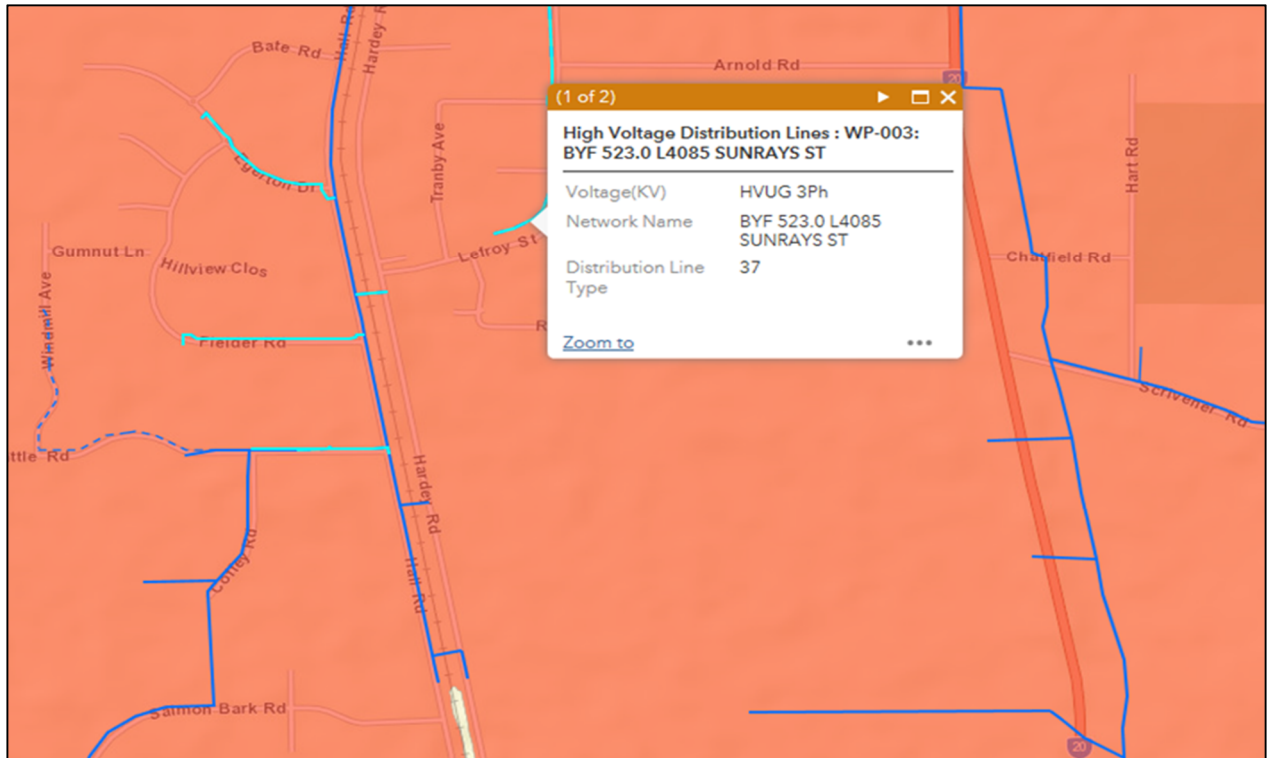


Figure 7.1: Electrical assets in vicinity

The estimated total power demand for the proposed development is 89kVA based on 4.7kVA per residential lot, as per the proposed yield of 19 lots. Based on the Western Power Network Capacity Mapping Tool, the available capacity within the area is approximately <5 MVA. Therefore we do not anticipate that there will be any power constraints to the development of this site.

As the development can potentially be supplied from the existing surrounding infrastructure, it is not foreseen that the supply of electrical power to this development is a major constraint. One 160kVA substation is proposed to service the development from the existing power distribution network.

The above advice is however based on desktop studies and information obtained from the Western Power NCMT online database.

8. Telecommunications

The subject site is serviced by existing telecommunications infrastructure owned and operated by Telstra, as indicated in the information provided by Telstra presented on Figure 8.1. The data indicates that there is a direct buried cable for property connections in the verge across the frontage of Lot 9.



Figure 8.1: Existing Telstra assets (Telstra, 2017)

A pit and pipe design to Tesltra/NBN standards would be installed within the development connecting to existing Telstra infrastructure in Hardey Road north of the site.

Serpentine currently has NBN access via fixed wireless service only. NBN Co. have advised that planning for the Serpentine area is set to commence in late 2017. Due to the number of lots proposed the developer can apply for NBN but it may be cost prohibitive in the short-term due to the Backhaul charges from the nearest NBN connection point.

9. Gas

Serpentine town site is not currently serviced with gas. Discussions with ATCO Gas indicate that there are no short to medium term plans to provide the area with gas. If gas is required, it will be bottled LPG supplied by the home owner.

10. Roads

Hardey Road is owned and maintained by the Shire of Serpentine Jarrahdale. Currently Hardey Road is sealed, rural standard to the northern boundary of the site after which it is unsealed.

On the basis of 8 trips per lot per day, the subdivision into 19 lots would generate an additional 152 vehicles per day on Hardey Road. This traffic would travel north of the Site as Hardey Road does not connect to the surrounding road network to the south.

The proposed development of the site will require the section of Hardy Road adjacent to Lot 9 to be upgraded. This upgrade will be required to match the existing cross section of Hardey Road to the north and will be a 7 metre wide asphalted road.



Figure 10.1: Hardey Road end of seal at northern boundary of Lot 9 (July 2017)

The internal road will be constructed to rural local road standard (unkerbed, 6m two coat seal and 1.2m wide shoulders) draining into roadside swales as is typical for local roads within the Serpentine Downs Estate to the north.



Figure 10.2: Rangeview Loop, Serpentine Downs Estate (Google Earth Streetview, October 2014)

The road will terminate at a culs-de-sac at the Arnold Road Main Drain reserve but will allow for a future extension to the east should that land be developed. An unsealed fire emergency track along the eastern side of the Drain reserve will be accessed from this point via a culvert crossing.

11. Drainage

The stormwater drainage for the development will need to be designed and constructed in accordance with Shire of Serpentine Jarrahdales' engineering guidelines and an approved LWMS.

Stormwater from lots will be disposed of on-site via infiltration. Road drainage will be retained and conveyed via roadside table drains to the existing drainage outlets in Hardey Road.

12. Disclaimer

JDSi has undertaken this assessment based on the information supplied and subsequently assumptions have been made which, if incorrect, have the potential to change costs. Major cost implications exist through factors which cannot be assured at this time including upgrading of utility services, WAPC conditions of development, ground conditions and timing of adjacent developments.

While JDSi has taken all care in the preparation of the likely development requirements and has noted key assumptions, JDSi accepts no responsibility for the accuracy of this report and provides it only as an indicative summary of engineering requirements.

If any further information is required or should you wish to clarify any issue, please contact our office

APPENDIX A: WATER CORPORATION COMMENTS



Mick Beaverstock

From: Ian Kininmonth <Ian.Kininmonth@watercorporation.com.au>
Sent: Thursday, 17 August 2017 12:07 PM
To: Mick Beaverstock
Subject: Service Feasibility Enquiry - 9, 147 Hardey Rd, Serpentine [Filed 17 Aug 2017 12:29]
Attachments: wate-corp-serv-hard-serp.pdf

Attention: Mick Beaverstock

I refer to your recent enquiry about Water Corporation services available to 9, 147 Hardey Rd, Serpentine to enable rezoning and subdivision to create 43 Rural Living lots and advise as follows:

Water

As indicated by the attached plan, reticulated water is available to the subject land. All water main extensions must be laid at the developers expense within existing and proposed road reserves, on the correct alignment and in accordance with the Utility Providers Code of Practice.

Wastewater

The subject area falls outside a planned sewerage catchment. As such Water Corporation sewerage services are not available to the subject land.

Drainage

The subject area falls within the Serpentine River Drainage Catchment in the Mundijong Drainage District, a rural drainage system. Developments within this catchment are required to contain the flows from a one in one hundred year storm event on site. Discharge to the Water Corporation drains must be compensated to pre-development levels. The developer of this land is advised to liaise with the Water Corporation at the preliminary planning stage to determine detailed planning requirements as this area could be prone to future flooding. At the time of development the developer may be required to provide calculations from a Consulting Engineer to demonstrate, to the satisfaction of the Water Corporation, that the runoff from the development has been restricted to pre development levels.

General Comments

The principle followed by the Water Corporation for the funding of subdivision or development is one of user pays. The developer is expected to provide all water reticulation if required. A contribution for water headworks may also be required. In addition the developer may be required to fund new works or the upgrading of existing works and protection of all works. Any temporary works needed are required to be fully funded by the developer. The Corporation may also require land being ceded free of cost for works.

For access to spatial information pertaining to Water Corporation infrastructure please access ESInet <https://www.watercorporation.com.au/home/builders-and-developers/subdividing/our-spatial-database>

For access to planned capital infrastructure please access the CIP planning layer <https://www.watercorporation.com.au/home/builders-and-developers/subdividing/access-our-scheme-planning/request-access-to-cip-planning-layer-on-slip>

Ian Kininmonth

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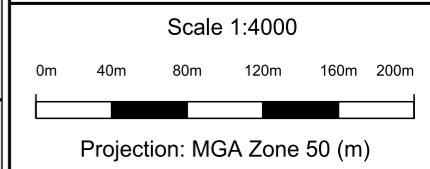
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- Land Matter Boundary, Boundary
- Land Matter Coverage, Coverage
- Drain Structure, Location - 16
- Drain Open Channel, Centreline
- Boundaries - Local Authority, Coverage
- Water Scour Fitting, Location (Trans) - Trans
- Water Access Chamber, Location (Trans) - Manhole
- Water Fitting, Location (Dist) - Connector
- Water Fitting, Location (Trans) - Change Point
- Water Fitting, Location (Trans) - Connector
- Water Fitting, Location (Trans) - Change Point
- Water Hydrant, Location (Dist) - Hydrant
- Water Pipe, Route (Dist) - Potable - Water Corporation
- Water Pipe, Route (Serv Design) - Potable - Water Corporation
- Water Pipe, Route (Serv) - Potable - Water Corporation
- Water Pipe, Route (Trans) - Potable - Water Corporation
- Water Valve, Location (Dist) - Open
- Water Valve, Location (Trans) - Open
- Water Pipe Section, Extent
- Service Point Location, Location (Serv) - Active
- Service Point Location, Location (Serv) - Inactive



Title:

Print Date: 17/08/2017 11:52:02



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18 December 2017
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Bushfire Management Plan

Lot 9 Hardey Road, Serpentine

Project No: EP17-071(03)

Prepared for Serene Environs Pty Ltd
October 2017

Bushfire Management Plan

Lot 9 Hardey Road, Serpentine



Document Control

Doc name:		Bushfire Management Plan Lot 9 Hardey Road, Serpentine			
Doc no.:		EP17-071(03)--003B ACW			
Version	Date	Author		Reviewer	
1	August 2017	Jessica Lisle	JHL	Kirsten Knox	KK
				Rohan Carboon	RC
Issued to client					
A	August 2017	Jessica Lisle	JHL	Anna Welker	ACW
				Update following client feedback	
B	October 2017	Jessica Lisle	JHL	Kirsten Knox	KK
				Revision based on revised subdivision plan	

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

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

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Executive Summary

Serene Environs Pty Ltd (the proponent) proposes to develop Lot 9 Hardey Road, Serpentine for residential land uses. This area is herein referred to as “the site” and is 22.8 ha in area, located approximately 47 km south-south-east of the Perth Central Business District within the Shire of Serpentine Jarrahdale, as shown in **Figure 1**. The site is bound by Hardey Road to the west and rural and rural residential land use to the east, south and north.

The site is currently zoned ‘Rural’ under the Metropolitan Region Scheme (MRS) and ‘Rural’ under the Shire of Serpentine Jarrahdale Town Planning Scheme No. 2 (TPS No. 2). Serene Environs Pty Ltd is proposing rezone the site under the Shire of Serpentine Jarrahdale’s TPS No. 2 to ‘Rural Residential’. This is to support the future subdivision of the site into multiple rural residential lots, public roads and drainage reserves.

The site is currently identified as a “Bushfire Prone Area” under the state-wide *Map of Bush Fire Prone Areas* released by the Office of Bushfire Risk Management (OBRM 2017). This Bushfire Management Plan (BMP) has been prepared to support the proposed re-zoning of the site to enable future rural residential development. It includes an assessment of bushfire hazard levels in the vicinity of the site (within 150 metres), in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015), the *Guidelines for Planning in Bushfire Prone Areas version 1.1* (the Guidelines) (WAPC and DFES 2017) and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009). This BMP has also been prepared to ensure that any bushfire risk is appropriately managed through future development planning and design process.

The vegetation within the site has been classified as predominately Grassland (Class G) vegetation associated with the cleared paddocks with some areas of Woodland (Class B), non-vegetated areas (Exclusion 2.2.3.2 (e)) and low-threat vegetation (Exclusion 2.2.3.2 (f)). Within 150 m of the site, Grassland (Class G) and Woodland (Class B) vegetation have been identified to the east, south and west, with low threat vegetation (Clause 2.2.3.2 (e)) identified to the north. The existing bushfire hazard of the site is moderate to extreme.

In the assumed post development scenario, the areas associated with future building envelopes and Asset Protection Zones (APZs) within lots will be maintained to achieve ‘low threat vegetation’ and will be excluded in accordance with Section 2.2.3.2 of AS 3959. Classified vegetation outside of APZs and identified outside the site boundary and east of the proposed drainage reserve (within the eastern portion of the site) is assumed to remain in its current state, and will therefore pose a long term bushfire hazard to the site.

This BMP demonstrates that as development progresses, an acceptable solution and/or performance based system of control can be adopted for the bushfire management issues outlined in the Guidelines. This includes:

- **Location:** future dwellings can be located in an area that will on completion be subject to an acceptable BAL rating (e.g. BAL-29 or below).

Bushfire Management Plan

Lot 9 Hardey Road, Serpentine



- **Siting and Design:** future dwellings can be sited so that they are not exposed to an unacceptable level of radiant flux (e.g. BAL-29 is not exceeded), with lots of an appropriate size to enable the provision of an APZ. Where required increased construction standards in accordance with AS 3959 and and/or APZs can be applied through the subdivision process.
- **Vehicular Access:** an interconnected network of roads and access ways can be provided within the development to facilitate the movement of people and emergency vehicles with access provided to Hardey Road, which is an existing public road, as well as future access to South Western Highway via future development to the east. Prior to the construction of the road through to South Western Highway, a cul-de-sac with a suitable turn-around area (a minimum 17.5 m diameter head) will be provided, In addition an emergency access way adjacent to the eastern boundary of the site will be provided, enabling secondary access to the existing public road network to the north.
- **Water:** the development can be provided with a permanent and reticulated water supply to support onsite firefighting requirements.

An updated Bushfire Management Plan, including detailed BAL assessment, will be prepared to support any future subdivision application for the site, and will outline how the detailed development design will manage bushfire hazards to address the requirements of SPP 3.7 and the Guidelines (WAPC and DFES 2017).

Bushfire Management Plan

Lot 9 Hardey Road, Serpentine



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Bushfire Management Plan

Lot 9 Hardey Road, Serpentine



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Appendices

Appendix A

Subdivision Guide Plan

Appendix B

Compliance Checklist

List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
AS	Australian Standard
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
EEP	Emergency Evacuation Plan
ESL	Emergency Services Levy
FDI	Fire Danger Index
FZ	Flame Zone

Table A2: Abbreviations – Organisations

Organisations	
BoM	Bureau of Meteorology
DoBCA	Department of Biodiversity Conservation and Attractions
DoW	Department of Water (now known as Department of Water and Environment Regulation)
DFES	Department of Fire and Emergency Services
DPaW	Department of Parks and Wildlife
OBRM	Office of Bushfire Risk Management
SES	State Emergency Services
WAPC	Western Australian Planning Commission

Table A3: Abbreviations – Legislation and policies

Legislation and policies	
AS 3959	Australian Standard 3959-2009 Construction of buildings in bushfire prone areas
Guidelines	<i>Guidelines for Planning in Bushfire Prone Areas version 1.2</i> (WAPC and DFES 2017)
SPP 3.7	<i>State Planning Policy 3.7 Planning in Bushfire Prone Areas</i> (WAPC 2015)

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Table A4: Abbreviations – Planning and building terms

Planning and building terms	
ESL	Emergency Services Levy
DPS	District Planning Scheme
MRS	Metropolitan Regional Scheme

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1 Introduction

Serene Environs Pty Ltd (the proponent) are seeking to amend the land use zoning of Lot 9 Hardey Road, Serpentine (herein referred to as “the site”), in order to allow for rural residential land uses. The site is 22.8 ha in area and is located approximately 47 km south-south-east of the Perth Central Business District within the Shire of Serpentine Jarrahdale, as shown in **Figure 1**.

The site is currently identified as a “Bushfire Prone Area” under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2017), as shown in **Plate 1** below. The identification of Bushfire Prone Areas within any portion of the site requires further assessment of the bushfire hazard implications on proposed development to be undertaken in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas version 1.1* (the Guidelines) (WAPC and DFES 2017).

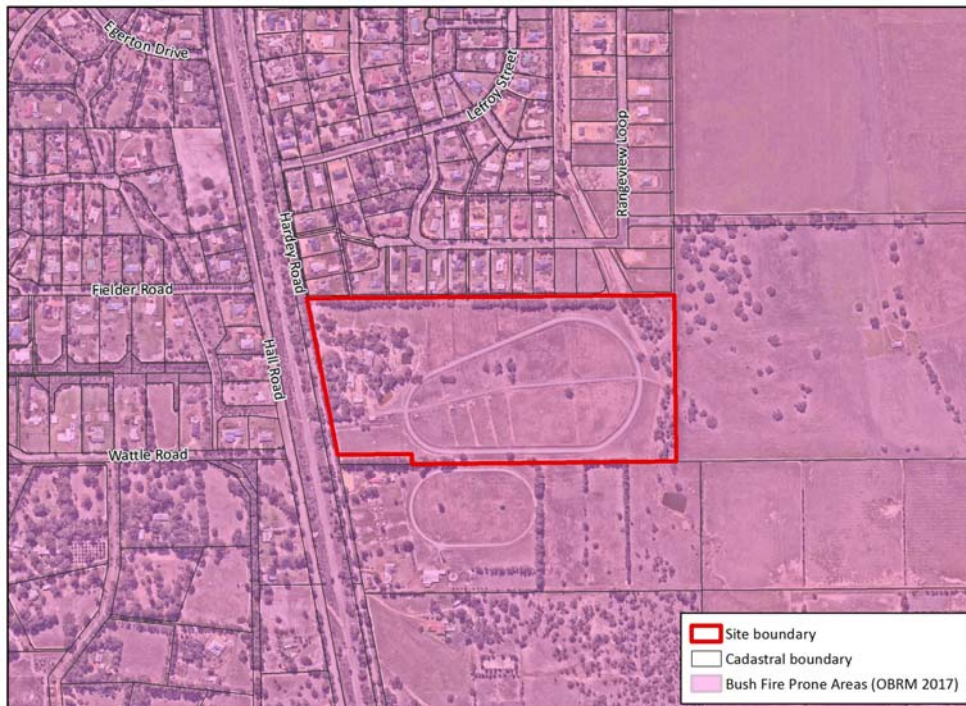


Plate 1: Areas within and surrounding the site identified as “Bushfire Prone Areas” (as indicated in purple) under the state-wide *Map of Bush Fire Prone Areas* (OBRM 2017).

1.1 Aim of this document

The aim of this Bushfire Management Plan (BMP) is to assess bushfire hazard levels within the site and nearby and ensure that the threat posed by any identified hazards can be appropriately mitigated and managed. It addresses the requirements of SPP 3.7 (WAPC 2015), the Guidelines (WAPC and DFES 2017) and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009) and provides a high level assessment of the general strategies to be considered as part of future planning and development stages.

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This BMP includes:

- An assessment of the existing classified vegetation and associated bushfire hazard levels in the vicinity of the site (within 150 m) and consideration of risks that will exist in the post development scenario.
- Commentary on how future development can achieve the performance principles of the Guidelines by ensuring:
 - Development can be located, sited and designed to ensure that any bushfire hazard does not present an unreasonable level of risk to life and property (i.e. BAL-29 is not exceeded).
 - Vehicular access to and egress from the development can be safely provided in the event of a bushfire.
 - A dedicated water supply can be made available to any future development, so that life and property can be protected from bushfire.
- An outline of the roles and responsibilities associated with implementing this BMP (see **Section 4**).

1.2 Accreditation

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

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

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

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

1.3 Statutory policy and framework

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

- *Fire and Emergency Services Act 1998*
- *Bush Fires Act 1954*
- Planning and Development (Local Planning Scheme Amendment) Regulations 2015
- Building Regulations 2012

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- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas version 1.1* (WAPC and DFES 2017)
- *Australian Standard AS 3959 – 2009 Construction of buildings in bushfire prone areas* (Standards Australia 2009)

1.4 Description of site and adjacent land uses

The site is zoned 'Rural' under the Metropolitan Region Scheme (MRS) (as shown in **Plate 2** below) and 'Rural' under the Shire of Serpentine Jarrahdale Town Planning Scheme No. 2 (TPS No. 2). The site is currently used for horse agistment purposes and contains a residential dwelling and associated outbuildings. The site is largely composed of cleared paddocks with a number of mature trees around the dwelling and lot boundary.

Natural topographical contours (DoW 2008) indicate that the site and surrounding area is generally flat, with elevation ranging from 43 metres Australian Height Datum (m AHD) in the south east portion of the site to approximately 38 m AHD in the north-west, as shown in **Figure 1**.

The site is bound by surrounding rural and rural residential land uses to the north, east and south and by Hardey Road to the west, which runs directly adjacent to the Australind Rail line.



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

2 Bushfire Hazard Assessment

2.1 Bushfire risk

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

Bushfire risk is determined by assessing:

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

It is not necessary to undertake a standalone site specific bushfire risk assessment in accordance with AS/NZS ISO 31000:2009 as part of this BMP, as risk has been appropriately considered in the specific context of the Guidelines (WAPC and DFES 2017), and future development will assess and respond to the bushfire risk based on a proposed development layout in accordance with Australian Standard AS 3959-2009 *Construction of buildings in bushfire prone areas* (AS 3959), as outlined future in **Section 3**.

2.2 Methodology and assumptions

The bushfire hazard assessment undertaken as part of this BMP has been informed by the following key restrictions and/or assumptions:

- A site assessment of the classified vegetation within and surrounding the site was undertaken on 19 June 2017.
- Vegetation within and surrounding the site was classified according to Table 2.3 of AS 3959, and the associated bushfire hazard levels determined using Appendix Two of the Guidelines (WAPC and DFES 2017). **Figure 2** and **Figure 3** reflect the existing vegetation and bushfire hazard conditions respectively for the site.

2.3 Vegetation classification and bushfire hazard assessment

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

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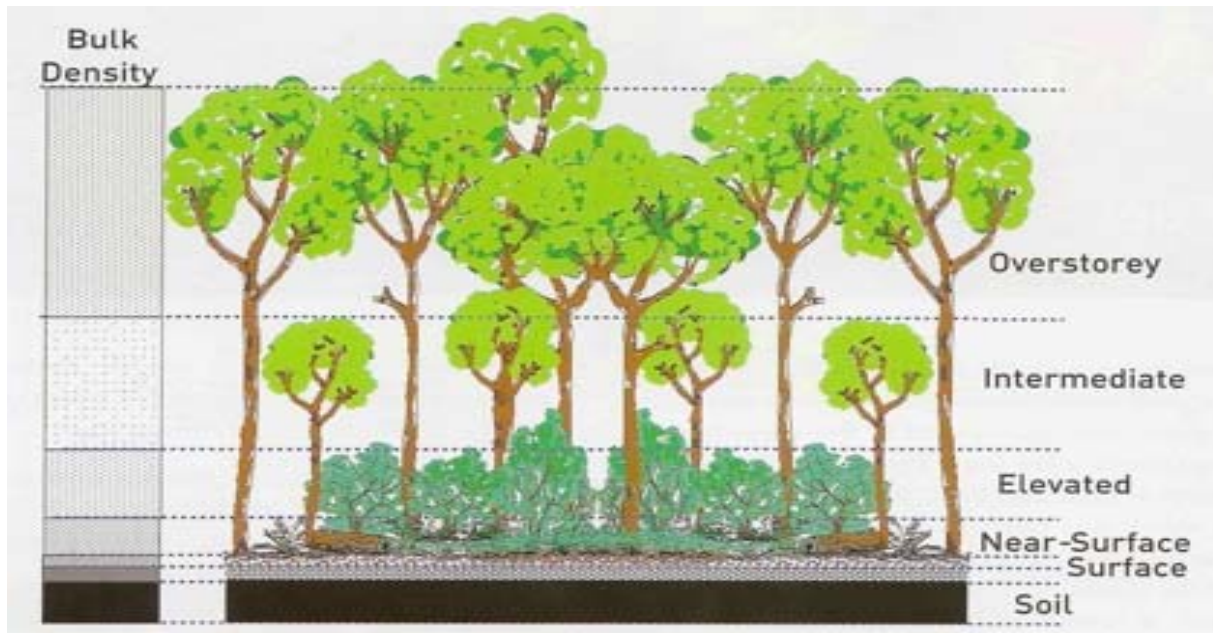


Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

The following sections outline the type of vegetation within and surrounding the site, classification of this vegetation in accordance with Section 2.2.3.2 and Table 2.3 of AS 3959, and its assumed post development condition. The bushfire hazard assessment levels have been determined using Appendix Two of the Guidelines (WAPC and DFES 2017).

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Table 1: Vegetation type and future management

Pre-development			Post-development		
Plot	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot	Post-development AS 3959 classification and assumptions	
Plot 1 and 2	Vegetation associated with the rural paddocks has been classified as Grassland. Due to the rural nature of land uses currently within the site, and in line with current guidance from the Department of Fire and Emergency Services (DFES), all grass fuels within the site are currently assumed to be unmanaged. AS 3959 classification: Grassland (Class G) (Figure 2) Bushfire hazard rating: Moderate (Figure 3)	 <p>Plate 4: Photo location 1</p>	 <p>Plate 6: Photo location 3</p>	Plot 1	Grassland vegetation located outside proposed building envelopes and APZs are assumed to remain in its current unmanaged state. AS 3959 classification: Grassland (Class G)
		 <p>Plate 5: Photo location 4</p>	 <p>Plate 7: Photo location 10</p>	Plot 2	Grassland in adjacent lots is assumed to remain in its current unmanaged state. AS 3959 classification: Grassland (Class G)
				Plot 5	Vegetation within the building envelopes and APZs will be managed to a low-threat standard in accordance with Clause 2.2.3.2(f). AS 3959 classification: Exclusion 2.2.3.2 (f)

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Table 1: Vegetation type and future management (continued)

Pre-development			Post-development	
Plot	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot	Post-development AS 3959 classification and assumptions
Plot 1 and 2	Continued	 <p>Plate 8: Photo location 11</p>		
Plot 3 and 4	<p>Vegetation associated with rows of trees located on lot boundaries, along the road and rail reserve to the west of the site as well as a small area of vegetation found adjacent to the southern boundary of the site has been classified as Woodland</p> <p>AS 3959 classification: Woodland (Class B) (Figure 2)</p> <p>Bushfire hazard rating: Extreme (Figure 3)</p>	 <p>Plate 9: Photo location 2</p>	 <p>Plate 10: Photo location 5</p>	<p>Plot 3</p> <p>Woodland vegetation located outside proposed building envelopes and APZs are assumed to remain in its current unmanaged state.</p> <p>AS 3959 classification: Woodland (Class B)</p>

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Table 1: Vegetation type and future management (continued)




Pre-development			Post-development	
Plot	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot	Post-development AS 3959 classification and assumptions
Plot 3 and 4	Continued	 <p>Plate 11: Photo location 6</p>	Plot 4	Woodland vegetation in adjacent lots is assumed to remain in its current unmanaged state. AS 3959 classification: Woodland (Class B)
		 <p>Plate 13: Photo location 13</p>		Plot 5
		 <p>Plate 12: Photo location 12</p>		

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Table 1: Vegetation type and future management (continued)

Pre-development			Post-development (see Figure 4)	
Plot	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot	Post-development AS 3959 classification and assumptions
Plot 5	<p>Areas associated with well-reticulated and managed private gardens have been excluded under Clause 2.2.3.2(f).</p> <p>Vegetation in established rural residential lots that occur to the north of the site have been excluded under Clause 2.2.3.2(f). These areas have been classified as low threat vegetation and are considered managed in accordance with the requirements of the Shire of Serpentine Jarrahdale Firebreak notice for management of lots less than 4047m².</p> <p>AS 3959 classification (Figure 2): Exclusion 2.2.3.2 (f)</p> <p>Bushfire hazard rating (Figure 3): Low, however where this plot occurs within 100 m of moderate or extreme hazards, a moderate hazard applies.</p>	 <p>Plate 14: Photo location 7</p>  <p>Plate 15: Photo location 6</p>	 <p>Plate 16: Photo location 8</p>	<p>Plot 5</p> <p>It is assumed that these areas will be maintained in their existing condition in accordance with the requirements of the Shire of Serpentine Jarrahdale Firebreak notice and remain excluded in accordance with Clause 2.2.3.2 (e) of AS 3959.</p> <p>AS 3959 classification: Exclusion 2.2.3.2 (f)</p>

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Table 1: Vegetation type and future management (continued)

Pre-development			Post-development	
Plot	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot	Post-development AS 3959 classification and assumptions
Plot 6	<p>Non-vegetation areas (Exclusion 2.2.3.2(e)) such as homes, driveways and the agistment tracks.</p> <p>AS 3959 classification: Exclusion 2.2.3.2(e) (Figure 2)</p> <p>Bushfire hazard rating: Low, however area falls within 100 m of moderate/extreme hazards, therefore moderate hazard applies (see Figure 3).</p>	Refer to Photo 7 and 12	Plot 6	<p>It is assumed that these areas will be maintained in their existing condition and remain excluded in accordance with Clause 2.2.3.2 (e) of AS 3959.</p> <p>AS 3959 classification: Exclusion 2.2.3.2 (e)</p>

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2.4 Effective slope

The effective slope under areas of classified vegetation has been determined based on an analysis of the topographic contours and was determined to be effectively flat/upslope beneath classified vegetation within the site and surrounds, as shown in **Figure 4**. Effective slope will be reviewed in further detail as part of future Bushfire Management Plans prepared to support subdivision of the site.

3 Bushfire mitigation strategy

3.1 Bushfire risk management

In line with the requirements of SPP 3.7 (WAPC 2015), this BMP provides an assessment of bushfire hazards within and nearby to the site and provides an outline of how future development can address the bushfire protection criteria, as detailed within Appendix Four of the Guidelines.

As previously discussed, it will not be necessary to undertake a standalone risk assessment as per AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines* to support future development within the site. Land use planning bushfire risk mitigation and building control strategies are detailed in the following sections and provide commentary on how the bushfire protection performance criteria (as outlined in Appendix Four of the Guidelines (WAPC and DFES 2017)) can be addressed as part of future planning and development stages.

Appendix Four of the Guidelines (WAPC and DFES 2017) requires the following bushfire risk management issues to be addressed as part of any future development:

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

3.2 Bushfire protection criteria

The following sections discuss the mitigation strategies that are likely to be implemented as part of future development within the site, to address the bushfire risk management issues outlined in Appendix Four of the Guidelines (WAPC and DFES 2017). These mitigation measures will be refined and finalised as part of the subdivision process.

A compliance checklist for the bushfire protection criteria is provided in **Appendix B**.

3.2.1 Element 1: Location

3.2.1.1 Intent

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

3.2.1.2 Mitigation strategies

The development can be sited and designed to manage or mitigate the bushfire hazards identified within or nearby to the site to ensure that future dwellings will not be exposed to an unacceptable level of radiant heat flux (i.e. BAL-29 is not exceeded). This will be achieved through:

- Siting and design of development within the site, including the provision of building envelopes and associated Asset Protection Zones (APZs) to ensure dwellings are located in areas subject to moderate or low bushfire hazards, and where required increased building construction standards in accordance with AS 3959.
- Two vehicle access routes to and from the site, including provision of an emergency access way to the existing public road network to the north of the site.
- Adequate water supply to enable life and property to be defended against bushfire

These measures are considered further in the following sections.

3.2.2 Element 2: Siting and design of development

3.2.2.1 Intent

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

3.2.2.2 Mitigation strategies

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

The categories of BALs have been summarised in **Table 2** below.

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

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

The Guidelines indicate that to achieve this bushfire protection criterion, buildings must be located so that BAL-29 is not exceeded, with the asset protection zone (APZ) sized appropriately to facilitate this outcome. The APZ is a low fuel area immediately surrounding a building. Non-flammable features such as irrigated landscapes, gardens, driveways and roads can form parts of an APZ. The intention of an APZ is to:

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

At this stage in the planning process, a BAL assessment (to determine applicable BAL ratings based on nearby classified vegetation) has not been completed for the proposed development within the site given the specific location of building envelopes and associated dwellings is unknown, and therefore the location of fuel managed areas has not been determined. An indicative Subdivision Guide Plan has been provided in **Appendix A**.

However, based on the classified vegetation identified within and adjacent to the site, and in consideration of Table 2.4.3 of AS 3959, **Table 3** provides a summary of the minimum setback distances that will be required to ensure BAL-29 is not exceeded and siting and design of development can be appropriately addressed in accordance with the Guidelines in the future development stages.

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Table 3: Summary of likely minimum setback distance required to achieve BAL-29 or less

Vegetation classification	Likely minimum setback required to achieve BAL-29, based on Table 2.4.3 of AS 3959	
	Effective slope	Distance (m)
Woodland (Class B)	Flat / upslope	14 m
Grassland (Class G)	Flat / upslope	8 m

The proposed future lots are sufficiently sized to enable appropriate setbacks (as per the requirements of the Guidelines) to nearby classified vegetation to be accommodated through APZs. An example of an APZ, to demonstrate how this would apply to a future dwelling has been provided in **Plate 17** below. In addition to the APZ, it is likely that building construction standards may need to increase (in accordance with AS 3959), depending on the determined BAL rating. This will be outlined as part of the subdivision and/or development process and will be based on the location of building envelopes (and/or dwellings) and nearby classified vegetation.

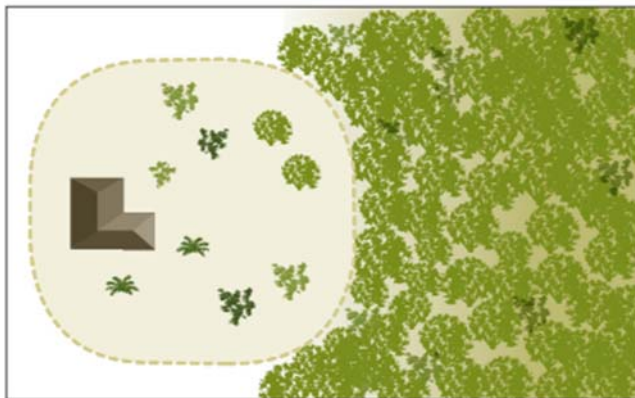


Plate 17: Indicative Asset Protection Zone example (WAPC and DFES 2017)

The Shire of Serpentine Jarrahdale *Firebreak Notice and Fuel Hazard Reduction Notice* require a minimum 20 m-wide APZ be provided adjacent to dwellings and outbuildings. An APZ of this width will ensure that BAL-29 is not exceeded, however this distance can be varied in accordance with the *Firebreak Notice and Fuel Hazard Reduction Notice*. Therefore, the specific location and width of any APZs will be determined as part of a detailed BAL assessment however as a minimum will ensure BAL-29 is not exceeded. This will be outlined as part of the BMP prepared to support future subdivision applications and/or development.

3.2.3 Element 3: Vehicular access

3.2.3.1 Intent

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

3.2.3.2 Mitigation strategies

The site currently abuts Hardey Road, a public road servicing existing residents, as shown **Figure 1**. Vehicular access to Hardey Road will be maintained as part of the proposed development, through the provision of a public road through the central portion of the site. Hardey Road connects with the broader public road network, enable safe egress to the north. In the future, it is intended that the site will connect with South Western Highway to the east, through future rural-residential development. Given the timing for the development to the east is currently unknown, the site also proposes to provide an emergency access way adjacent to the drainage reserve, to enable future residents' secondary access from the site. This emergency access way will connect to the existing public road network north of the site, through and existing drainage reserve (with an emergency access way).

On this basis, the proposed development is able to achieve the requirements of the Guidelines with regard to vehicular access. As part of the subdivision and development process, the following mitigation measures will be addressed:

- Acceptable solution A3.1: Two access routes. Future development within the site will include the provision of an internal road network, which will link with Hardey Road, an existing public road, and South Western Highway. An emergency access way will also be accommodated within the site to facilitate secondary access in the eastern portion of the site.
- Acceptable solution A3.2: Public roads. All public will comply with the minimum standards outlined in Appendix Four of the Guidelines.
- Acceptable solution A3.3: Cul-de-sacs. Prior to the construction of the public road connection to South Western Highway (via future development to the east), a cul-de-sac with a suitable turn-around area (a minimum 17.5 m diameter head) will be provided.
- Acceptable solution A3.5: Private driveway longer than 50 metres. The ultimate location and length of private driveways will be specified as part of subdivision-level BMP/s, however where private driveways are longer than 50 m in length, the minimum standards outlined in Appendix Four of the Guidelines will be met.
- Acceptable solution A3.6: Emergency access way. An emergency access way is proposed to provide an alternative link to the public road network during emergencies. The emergency access way is proposed to connect the cul-de-sac head in the eastern portion of the site to a drainage reserve and existing emergency access way to the north, which then connects with nearby public roads. Emergency access ways will be comply with the minimum standards outlined in Appendix Four of the Guidelines.
- Acceptable solution A3.8: Firebreak width - Lots greater than 4047 m² will be required to have an internal perimeter firebreak of a minimum width of three metres in accordance with the Shire of Serpentine Jarrahdale's Firebreak Notice. Given the minimum size of the proposed lots is 1 ha, this requirement is likely to apply to all proposed lots within the site.

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3.2.4 Element 4: Water

3.2.4.1 Intent

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

3.2.4.2 Mitigation strategies

Future rural residential development within the site will be provided with a reticulated water supply, and will include fire hydrants installed by the developer/s to meet the standard specifications of Water Corporation and DFES.

The minimum standards for water supply as outlined in Appendix Four of the Guidelines (WAPC and DFES 2017) can be met as part of future rural residential development.

3.3 Public education

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

The Shire of Serpentine Jarrahdale provides bushfire safety advice to residents available from their website (<http://www.sjshire.wa.gov.au/what-we-do/emergency-services/fire/>). Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high risk areas.

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

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4 Implementing the Bushfire Management Plan

Following approval of the scheme amendment, it is likely that development within the site will be progressed through the subdivision approval process, and will need to be supported by an updated BMP addressing the specific management measures outlined within this document.

Table 4 outlines the future responsibilities of the developer regarding future subdivision of the site, and the associated bushfire risk mitigation measures. These responsibilities will need to be considered as part of the subsequent planning process. Additional bushfire mitigation responsibilities will be outlined as part of future updates to this BMP undertaken as part of subdivision, including responsibilities for future owners/occupiers of lots within the site, as well as the Shire of Serpentine Jarrahdale and will include an outline of ongoing mitigation or management actions.

Table 4: Responsibilities for the implementation of the BMP at subdivision application

Management action	Timing
Developer	
Update the BMP in accordance with SPP 3.7, the Guidelines and AS 3959 to support the subdivision application, based on the proposed layout.	To support the subdivision application
Undertake a BAL assessment for any proposed subdivision area that is designated as a bushfire prone area within the <i>Map of Bush Fire Prone Areas</i> , with assessment results to be included within the updated BMP.	To support the subdivision application
Where required, and based on the outcomes of the BAL assessment, make spatial provision within the subdivision layout to accommodate any applicable building envelopes and APZs. This may include ensuring lots are of an adequate depth or width to accommodate the relevant setback distance, or through the provision of public roads and / or managed public open space.	To support the subdivision application
Make spatial provision for the following to be installed to the standards outlined in the Guidelines: <ul style="list-style-type: none"> • Public roads • Cul-de-sacs • Private driveways greater than 50 m in length (where relevant) • Emergency access ways. 	To support the subdivision application
Make spatial provision for two access ways (either formal public roads and/or temporary or permanent emergency access ways) are provided at all times for each subdivision stage.	
Where applicable, easements for the emergency access ways should be created/accommodated as part of the subdivision process.	To support each future subdivision application, and as part of subdivision clearance process
Where required, make spatial provision to ensure an adequate water supply can be provided to the site, as outlined in Section 3.2.4 .	To support the subdivision application
Consider management requirements for temporary bushfire hazards located within 150 m of the subdivision application area (where within the developer landholding) to reduce bushfire hazard to future titled lots. Any such management requirements should be specified in the associated future BMP.	To support each future subdivision application
Comply with the Shire of Serpentine Jarrahdale Firebreak Notice and Fuel Hazard Reduction Notice as published.	Ongoing, where applicable.

5 Summary of bushfire management

The site is located within an area identified as bushfire prone within the state *Map of Bush Fire Prone Areas* (OBRM 2017). This BMP has been prepared in accordance with the requirements of SPP 3.7 and Appendix Four of the Guidelines (WAPC and DFES 2017) to support the proposed rezoning of the site and demonstrates that, as development progresses, the risk from bushfire can be managed in accordance with the bushfire performance criteria outlined in the Guidelines. This has been summarised below:

- **Location:** future dwellings can be located in an area that will on completion be subject to an acceptable BAL rating (e.g. BAL-29 or below).
- **Siting and Design:** future dwellings can be sited so that they are not exposed to an unacceptable level of radiant flux (e.g. BAL-29 is not exceeded) with lots of an appropriate size to enable the provision of an APZ. Where required increased construction standards in accordance with AS 3959 can be applied through the subdivision process.
- **Vehicular Access:** an interconnected network of roads and access ways can be provided within the development to facilitate the movement of people and emergency vehicles with access provided to Hardey Road, which is an existing public road, as well as future access to South Western Highway via future development to the east. Prior to the construction of the road through to South Western Highway, a cul-de-sac with a suitable turn-around area (a minimum 17.5 m diameter head) will be provided. In addition, an emergency access way adjacent to the eastern boundary of the site will be provided, enabling secondary access to the existing public road network to the north,
- **Water:** the development can be provided with a permanent and reticulated water supply to support onsite firefighting requirements.

An updated BMP, including detailed BAL assessment, will be prepared to support any future subdivision application for the site and will outline the ultimate mitigation strategies proposed to support rural residential development, including the provision or requirement for APZs and increased construction standards for dwellings.

Ongoing consultation will be undertaken with the Shire of Serpentine Jarrahdale, DFES and the WAPC to ensure suitable bushfire hazard mitigation measures are designed and implemented as part of the proposed development.

Bushfire Management Plan
Lot 9 Hardey Road, Serpentine



6 Applicant Declaration

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

SIGNATURE:

A handwritten signature in blue ink, appearing to be 'Kirsten Knox', written over a horizontal line.

Name: Kirsten Knox

Company: Emerge Associates

Date: 5 October 2017

SIGNATURE:

A handwritten signature in blue ink, appearing to be 'Rohan Carboon', written over a horizontal line.

Name: Rohan Carboon

Company: Bushfire Safety Consulting

Date: 5 October 2017

7 References

7.1 General references

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

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

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

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas version 1.1*, Perth.

7.2 Online references

Department of Water 2008, *LIDAR derived 1 m elevation contours* dataset, Government of Western Australia.

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

Bushfire Management Plan

Lot 9 Hardey Road, Serpentine



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Figures



Figure 1: Assessment Area and Topographic Contours

Figure 2: Existing Site Conditions – AS 3959 Vegetation Classification

Figure 3: Existing Site Conditions – Bushfire Hazard Assessment

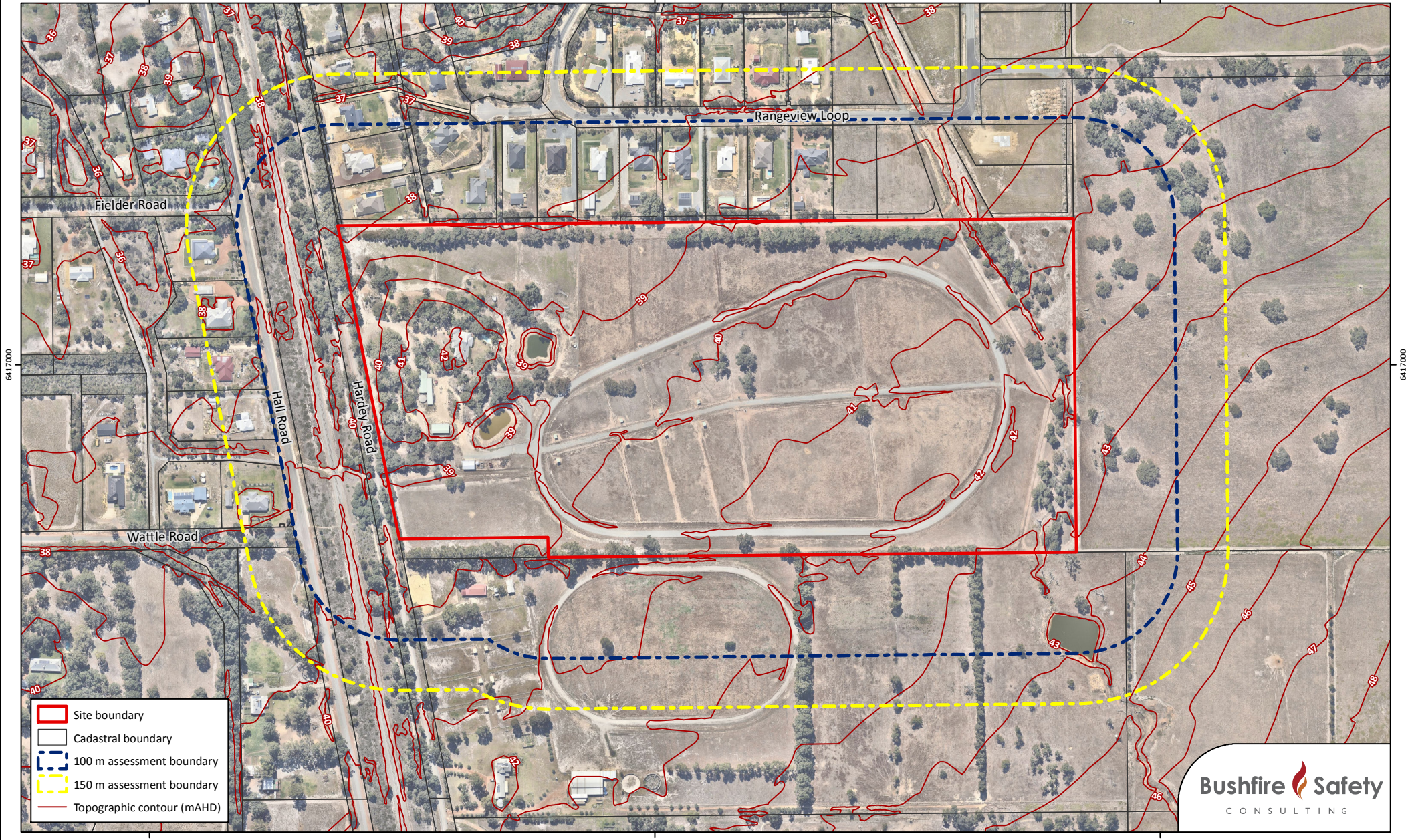
Figure 4: Effective Slope

403500

404000

404500

OCM165.1/12/17



- Site boundary
- Cadastral boundary
- 100 m assessment boundary
- 150 m assessment boundary
- Topographic contour (mAHD)

403500

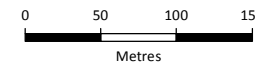
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Figure 1: Assessment Area and Topographic Contours

Project: Bushfire Management Plan
 Lot 9 Hardey Road, Serpentine
Client: Serene Environs

Plan Number:
 EP17-071(03)--F04
Drawn: KNM
Date: 31/07/2017
Checked: JHL
Approved: KK
Date: 04/08/2017

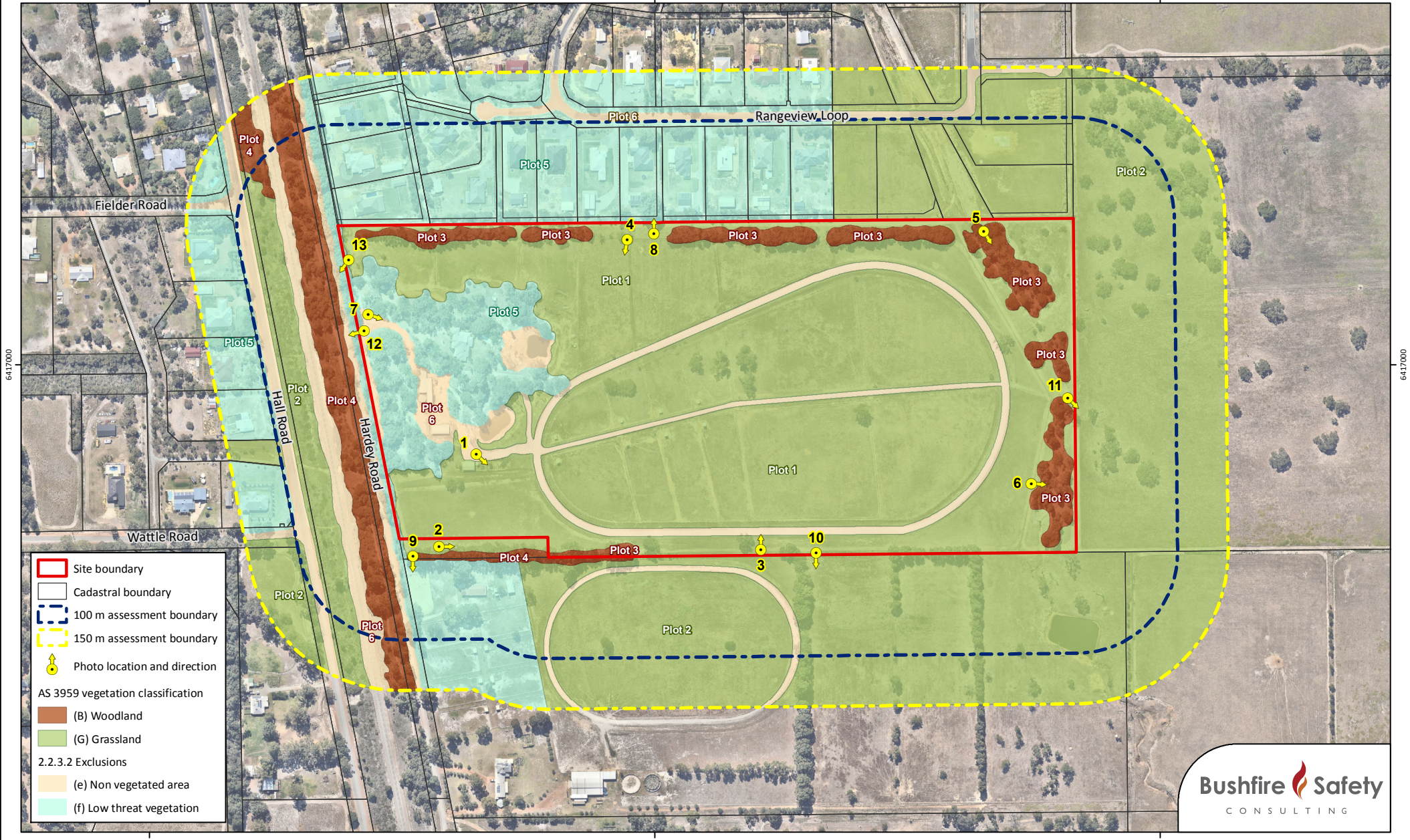


Scale: 1:5,000@A4
 GDA 1994 MGA Zone 50



OCM 18 December 2017

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



- Site boundary
- Cadastral boundary
- 100 m assessment boundary
- 150 m assessment boundary
- Photo location and direction
- AS 3959 vegetation classification
- (B) Woodland
- (G) Grassland
- 2.2.3.2 Exclusions
- (e) Non vegetated area
- (f) Low threat vegetation

Bushfire Safety
CONSULTING

Figure 2: Existing Site Conditions – AS 3959 Vegetation Classification

Project: Bushfire Management Plan
Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
EP17-071(03)-F05a

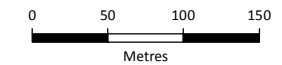
Drawn: KNM

Date: 05/10/2017

Checked: JHL

Approved: KK

Date: 05/10/2017



Scale: 1:5,000@A4
GDA 1994 MGA Zone 50



OCM 18 December 2017

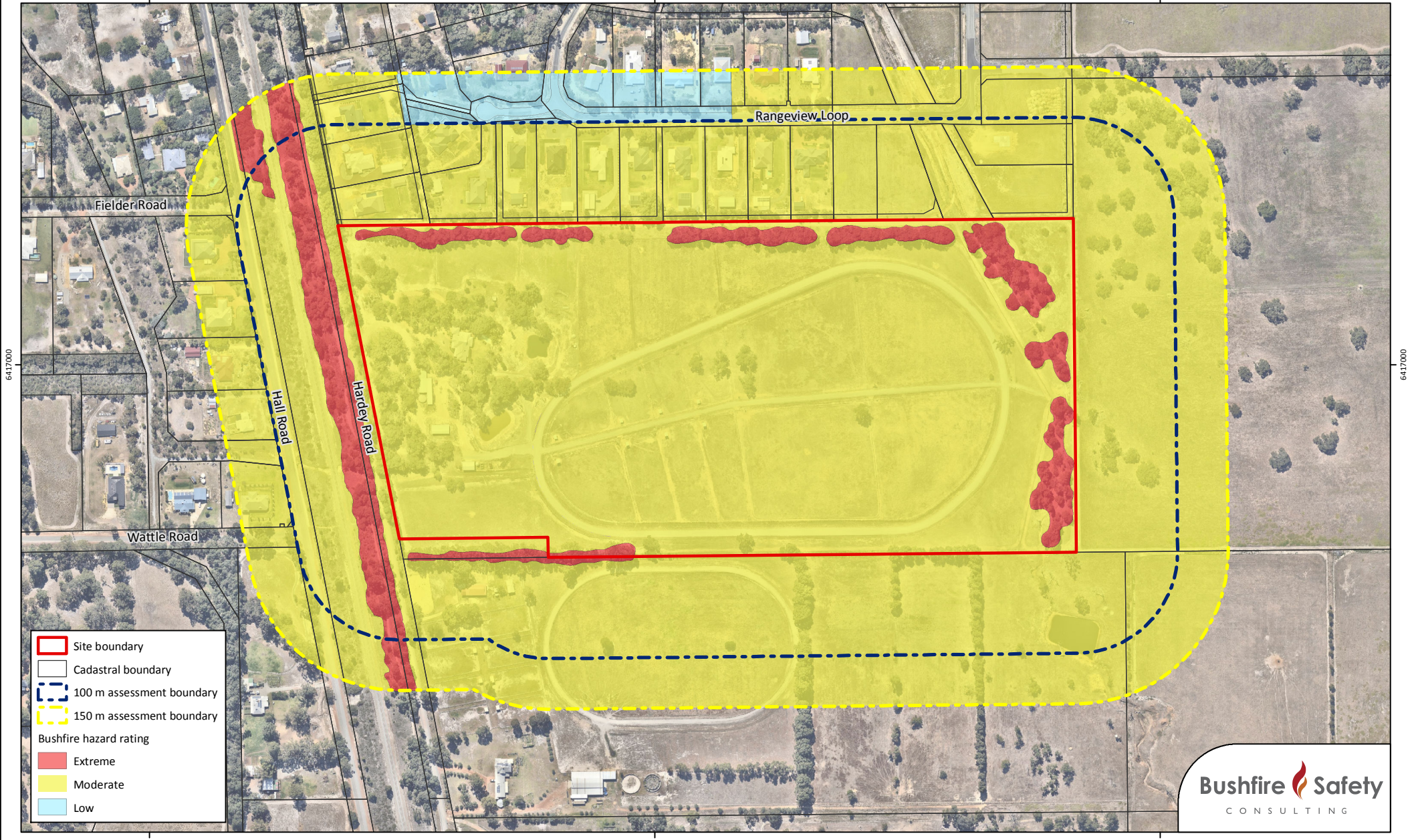
While Emmerge Associates makes every attempt to ensure the accuracy and completeness of data, Emmerge accepts no responsibility for externally sourced data used

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OCM165.1/12/17



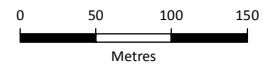
- Site boundary
- Cadastral boundary
- 100 m assessment boundary
- 150 m assessment boundary
- Bushfire hazard rating
- Extreme
- Moderate
- Low



Figure 3: Existing Site Conditions – Bushfire Hazard Rating

Project: Bushfire Management Plan
 Lot 9 Hardey Road, Serpentine
Client: Serene Environs

Plan Number:
 EP17-071(03)-F06a
Drawn: KNM
Date: 05/10/2017
Checked: JHL
Approved: KK
Date: 05/10/2017

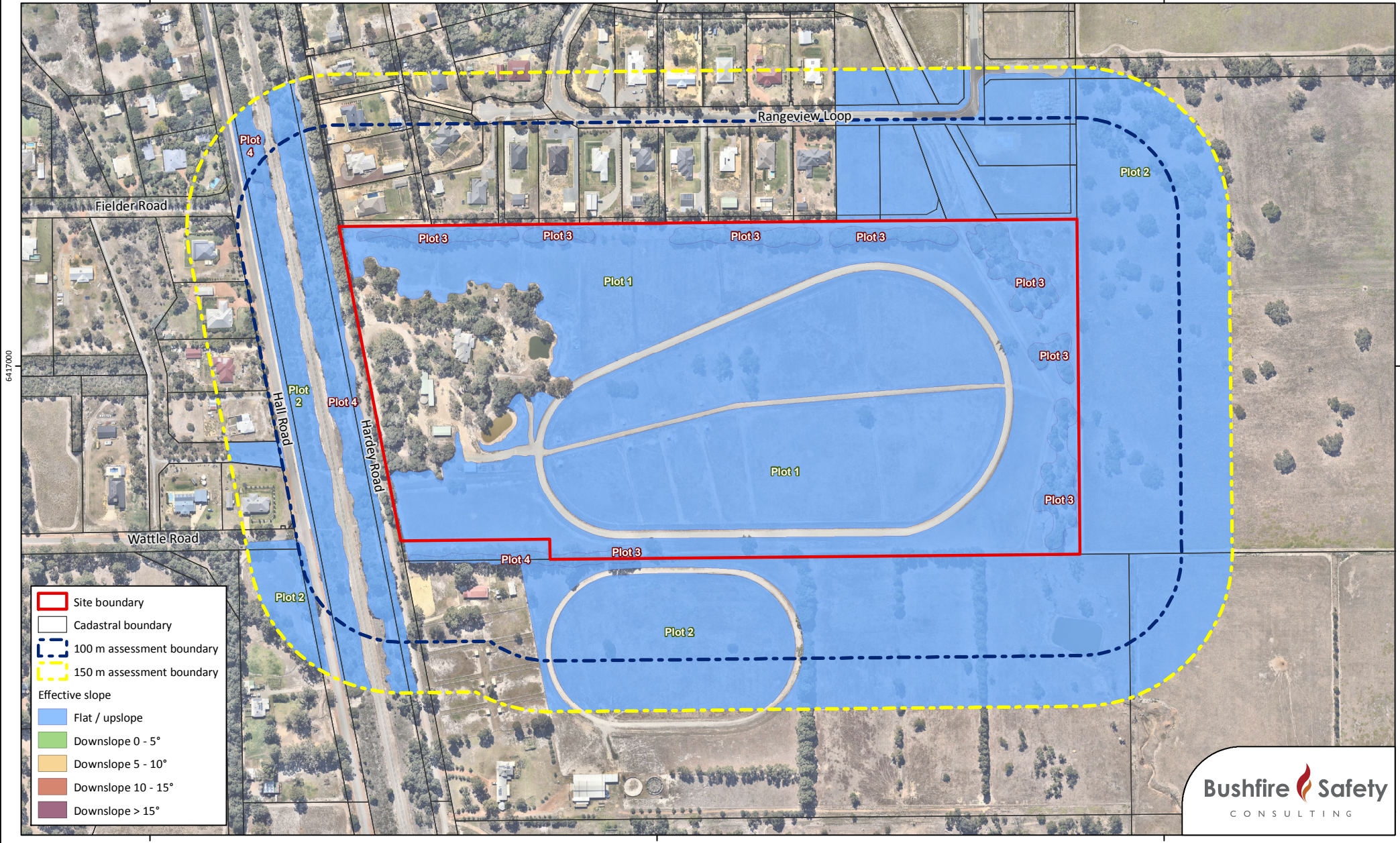


Scale: 1:5,000@A4
 GDA 1994 MGA Zone 50



OCM 18 December 2017

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



Site boundary
 Cadastral boundary
 100 m assessment boundary
 150 m assessment boundary

Effective slope

- Flat / upslope
- Downslope 0 - 5°
- Downslope 5 - 10°
- Downslope 10 - 15°
- Downslope > 15°



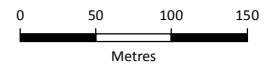
Figure 4: Effective Slope

Project: Bushfire Management Plan
 Lot 9 Hardey Road, Serpentine

Client: Serene Environs

Plan Number:
 EP17-071(03)-F19

Drawn: KNM
 Date: 05/10/2017
 Checked: JHL
 Approved: KK
 Date: 05/10/2017



Scale: 1:5,000@A4
 GDA 1994 MGA Zone 50



OCM 18 December 2017

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

Appendix A

Subdivision Guide Plan



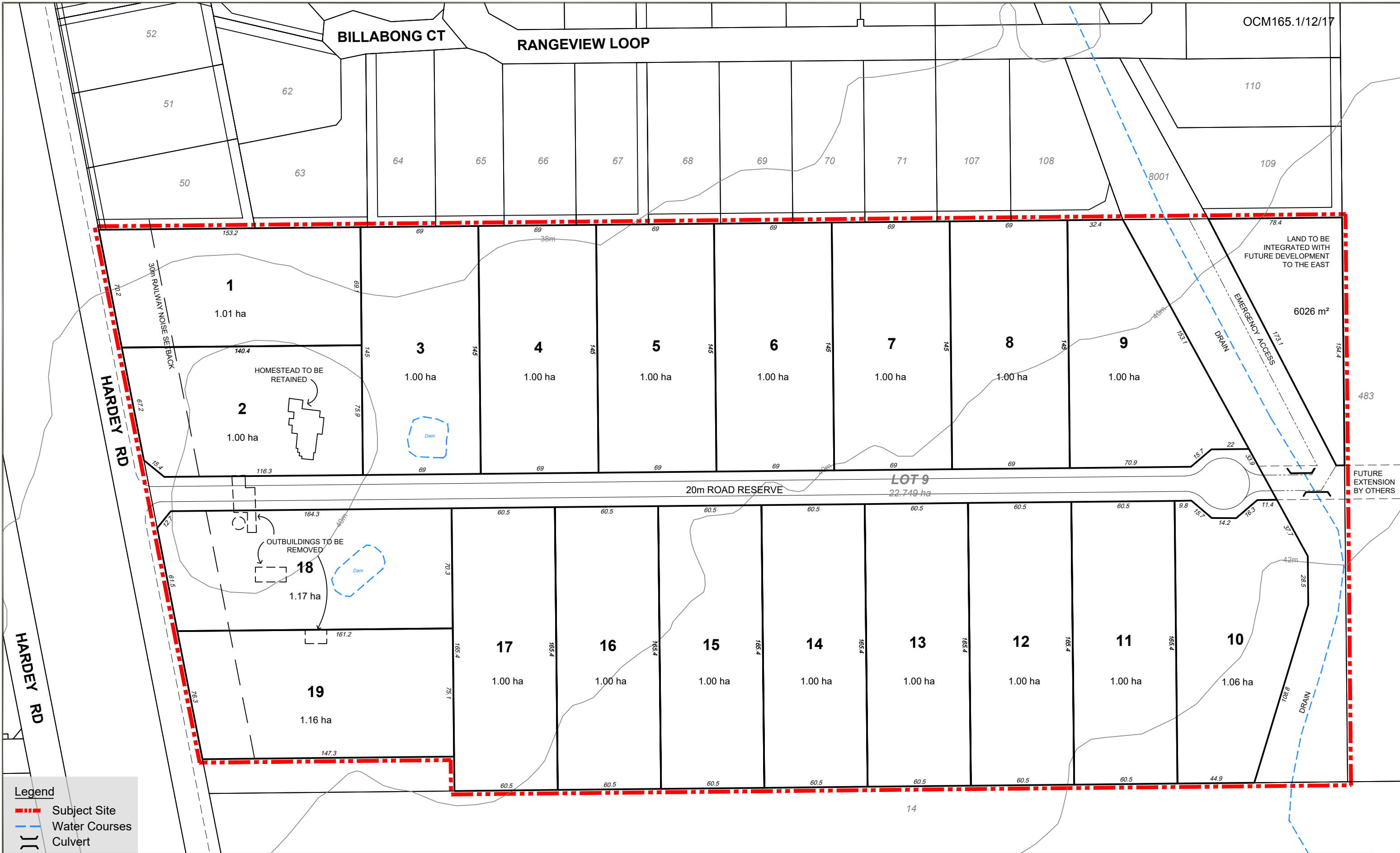


FIGURE 9 - SUBDIVISION GUIDE PLAN
 147 Hardey Road, Serpentine, 6125



Source of Information
 Site boundaries: Landgate
 Contours: DAFWA 2m Contours
 Projection: GDA94 MGA Zone 50 South

NOTE
 This plan is a guide only and is subject to survey, engineering and detailed design and may change without notice.

ASP_171002_Subdivision Guide Plan_1a_MGA94_147 Hardey Rd Serpentine_6125.dwg

Appendix B

Compliance Checklist



Appendix B: Compliance Checklist

Element/Question	Response	Applicable section of BMP
1: Location		
Does the proposal comply with the performance criteria by applying acceptable solution A1.1 (development location)?	Yes. Any new dwellings within the site can be located to ensure BAL-29 is not exceed.	Section 3.2.1
2: Siting and design of the Development		
Does the proposal comply with the performance criteria by applying acceptable solution A2.1 (asset protection zone)?	Yes. New dwellings can be located so that BAL-29 is not exceeded.	Section 3.2.2
3: Vehicular access		
Does the proposal comply with the performance criteria by applying acceptable solution A3.1 (two access routes)?	Yes. The site will include two vehicular access routes, including one to Hardey Road, an existing public road, and one to South Western Highway (as part of proposed future development).	Section 3.2.3
Does the proposal comply with the performance criteria by applying acceptable solution A3.2 (public road)?	Yes. All roads will be able to achieve the minimum standards outlined in the Guidelines.	Section 3.2.3
Does the proposal comply with the performance criteria by applying acceptable solution A3.3 (cul-de-sac)?	Yes. Prior to the construction of the public road through to South Western Highway, a cul-de-sac with a suitable turn-around area (a minimum 17.5 m diameter head) will be provided	Section 3.2.3
Does the proposal comply with the performance criteria by applying acceptable solution A3.4 (battle-axe)?	N/A	N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.5 (private driveway longer than 50 m)?	Yes. Where applicable, private driveways longer than 50 m in length will be required to meet the minimum standards outlined in Appendix Four of the Guidelines.	Section 3.2.3
Does the proposal comply with the performance criteria by applying acceptable solution A3.6 (emergency access way)?	Yes. An emergency access way will be provided on the eastern boundary of the site, connecting to the existing road network to the north.	Section 3.2.3
Does the proposal comply with the performance criteria by applying acceptable solution A3.7 (fire services access routes)?	N/A	N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.8 (firebreak width)?	Yes. The lots can be appropriately sized to accommodate a firebreak and/or the lot can be managed to a 'low threat' standard, as per the Shire of Serpentine Jarrahdale Firebreak Notice and Fuel Hazard Reduction Notice.	Section 3.2.3

Bushfire Management Plan

Lot 9 Hardey Road, Serpentine



Appendix B: Compliance Checklist (continued)

Element/Question	Response	Applicable section of BMP
4: Water		
Does the proposal comply with the performance criteria by applying acceptable solution A4.1 (reticulated areas)?	Yes. A reticulated public water supply will be available to development within the site.	Section 3.2.4
Does the proposal comply with the performance criteria by applying acceptable solution A4.2 (non-reticulated areas)?	N/A	N/A
Does the proposal comply with the performance criteria by applying acceptable solution A4.3 (individual lots within non-reticulated areas)?	N/A	N/A