COTERRA ENVIRONMENT



Baseline Environmental Report

Keralup Landholdings – Site 4

Draft A April 2021

CALIBRE | COMMITMENT | COLLABORATION

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Executive Summary

This report has been prepared to inform contractual agreements for the development two land parcels with a total land area of 267 ha, of which 216 ha may potentially be utilised for future activities, within 320 Gull Road, Keralup.

It is proposed to develop this site as a composting facility, also containing a large buffer around the development to mitigate dust impacts from site activities.

Review of the existing environmental condition of the site has identified the following key constraints and opportunities to development:

Environmental aspect	General Description	Further investigations/management
Acid sulfate soils	Moderate to low risk based on DWER mapping. Monitoring has indicated that groundwater is acidic with limited buffering capacity due to the presence of ASS.	Further investigation, reporting (ASS Assessment and Dewatering Management Plan) and management during construction may be required.
Groundwater	High groundwater levels present at the site. Elevated nutrient concentrations present in groundwater. Groundwater pH is acidic.	Nutrient and Irrigation Management Plan (NIMP) may be required. Groundwater monitoring to be undertaken. Approval to abstract groundwater required if groundwater abstraction is proposed.
Wetlands	Conservation, Resource Enhancement and Multiple Use wetland areas are mapped within the site. Existing wetland condition mapping may not be accurate.	The preferred location of future development areas would be outside of mapped Conservation and Resource Enhancement category wetland areas and associated buffer zones. If this cannot be avoided, consultation with the Shire of Murray and DBCA would be required to discuss the ecological condition of the proposed development locations to seek approval for development within this area. As such further investigation and/or assessment is likely to be required if Conservation or Resource Enhancement category wetland areas are proposed for development.
Vegetation and flora	Vegetation condition 'Completely Degraded' to 'Very Good-Excellent'. No significant flora. No Threatened Ecological Communities.	Areas of vegetation in 'Very Good' and higher condition should be prioritised for retention, where possible. Areas of retained native vegetation should be managed to avoid further reduction in the botanical condition and values. A Native Vegetation Clearing Permit (NVCP) may be required if clearing of vegetation is necessary for the proposed site development. A Vegetation Management Strategy may be required to support a NVCP application to retain and manage vegetation on site.
Fauna	Some significant species recorded in the area but based on site conditions Site 4 appears to provide limited fauna habitat values.	Fauna Management and Relocation Plan may be required as part of clearing works.

Environmental aspect	General Description	Further investigations/management
	Mosquitoes are known to occur in this area. The mosquito populations identified onsite are similar to surrounding off-site location.	Minimising mosquito habitat creation and attractants should form part of the site planning and design. Mosquito management, including a review of mosquito habitat mapping and monitoring, may need to be addressed in the Shire of Murray approval process to minimise risk to people involved in site development
Contamination	No contamination sources / potentially contaminating activities were identified to have occurred at Site 4. Sampling results indicated some guidance exceedances are present in the groundwater likely to be related to the historical agricultural use of the site and surrounds. Appendix 3 provides the detailed contamination investigation findings and documents the baseline conditions as required to address the contract requirements	No further investigation appears likely to be required
Cultural Heritage	No indigenous heritage site or non-indigenous heritage site recorded on site.	No further investigations appear likely to be required.
Noise, dust and odour	No known issues onsite.	Studies may be required to support a Works Approval and Licence for the site operation as a composting facility.

The recommended EPA separation distance between sensitive land uses and composting facilities ranges from 150 m – 1000 m. The closest sensitive premise (residential dwelling) to this site is located approximately 2 km southwest of the site.

The following environmental approvals may be required to progress development of a composting facility at the site:

- DWER Works Approval and Licence
- Environmental documentation to support a Shire of Murray Development Application
- DWER Native Vegetation Clearing Permit
- DWER bore construction and groundwater abstraction licence
- EPBC Act referral

1 Introduction

The State government Keralup landholding is approximately 4,000 hectares (ha) in size and is located approximately 60km south of the Perth CBD (Figure 1). The landholding is located in the Shire of Murray (Figure 1). The landholding, located at 320 Gull Road, Keralup WA 6182, has been portioned into five sites (Figure 2) to facilitate various land uses. including:

- Site 1: 374 ha site proposed for use as 'production facility'
- Site 2: 336 ha site proposed for use as 'plantation'
- Site 3: 508 ha site proposed for use as 'solar farm'
- Site 4: 267 ha site proposed for use as 'composting facility' and 'composting facility buffer'
- Site 5: 97 ha site proposed for use as a 'cemetery'.

Site 4, the subject of this report, comprises two land parcels with a total land area of 267 ha, of which 216 ha may potentially be utilised for future activities (Figure 3). This site is proposed to be developed as a composting facility and maintains a buffer around the development for mitigation of dust impacts from site activities. Historically, this site has been subject to clearing for rural purposes. As such, the land is generally degraded due to grazing, habitat loss and weed invasion.

1.1 Planning

1.1.1 Current Zoning

The whole Keralup landholding is zoned 'Rural' under the Peel Region Scheme (PRS) (WAPC, 2013) and the Shire of Murray Local Planning Scheme No. 4 (LPS) (DPLH, 1989) (Figure 4).

1.1.2 Historical Town Planning Overview

To facilitate the previous urban development proposal for the site, a scheme amendment was required to rezone the land from 'Rural' to 'Urban Deferred' under both the PRS and Shire of Murray LPS.

The Keralup District Structure Plan (DSP) was prepared and submitted to the Department of Planning in July 2010 as a pre-curser to a potential scheme amendment. Revisions to the DSP were submitted to the Western Australian Planning Commission (WAPC) and local authorities for consideration and endorsement in late 2012.

The DSP was developed on the basis of the Keralup Master Plan, which was approved for release by State Cabinet in mid-2007.

The environmental studies which were undertaken to inform the rezoning and DSP processes have been referenced in this report, where relevant.

1.2 Environmental Approvals History

1.2.1 Previous Approval (1998)

The original proposal to develop the Keralup landholdings (formally known as Amarillo Farm), was referred to the Environmental Protection Authority (EPA) for assessment and approval to undertake residential development and drainage works in 1995. The EPA set the level of assessment as 'Public Environmental Review' (PER). A PER was subsequently prepared by the proponent and assessed by the EPA in 1996. As a result, the EPA determined that the proposal could be managed to meet the EPA's objectives, subject to the implementation of a set of conditions. The conditions recommended by the EPA pertained to surface water management, wetlands, vegetation, noise, odour, groundwater and mosquitoes. On this basis of this advice

the Minister for the Environment approved the proposal in 1998, with conditions as outlined within Ministerial Statement 473.

However, following receipt of this environmental approval, the development was not commenced and the approval subsequently expired in 2005.

1.2.2 Section 16e Advice (2008)

A Master Plan for the development was prepared in 2007. In order to ensure the Masterplan appropriately addressed the sites key environmental features and to identify any further environmental investigations required the Minister for Housing requested that the Minister for the Environment/EPA provide strategic advice under Section 16(e) of the *Environmental Protection Act 1986* (EP Act). Through this process the EPA identified a number of key environmental constraints relating to the proposed urban development of Keralup and identified the need for additional environmental investigations and liaison with relevant technical agencies. The EPA's Section 16(e) advice was published in March 2008 (EPA Bulletin 1281) and identified the following environmental constraints:

1. Surface and Groundwater
2. Wetlands
3. Remnant Vegetation
4. Soil and Groundwater
5. Significant Fauna
6. Noise
7. Odour
8. Mosquitoes.

The Department of Housing (DoH) responded to the Section 16(e) advice by preparing an Environmental Scoping document, which was referred to the EPA with a request that the proposal be assessed as a Strategic Environmental Assessment (SEA) under Section 37B (2) of EP Act. The SEA was subsequently put on hold, due to a change in project strategy.

1.2.3 District Water Management Strategy (2013)

In accordance with the requirements of the Department of Water's (DoW's) Better Urban Water Management (BUWM) Guidelines (DoW, 2008), a District Water Management Strategy (DWMS) was prepared for the project to accompany the DSP (Emerson Stewart, 2013). The DWMS in general outlined the principles and objectives for best practice water management across the site and aimed to demonstrate how these objectives could be achieved.

The DWMS also described how water resources should be considered at each urban development planning stage which is then built upon at subsequent planning stages.

In general, the DWMS provided the following:

- Design objectives relevant to the urban development scenario (i. e. qualitative and quantitative objectives to guide subsequent water management decisions)
- Identification of existing site characteristics such as geology, hydrogeology and groundwater characteristics using the findings from previous investigations and the findings from additional investigations undertaken as part of this study
- Conceptual urban water management strategies associated with the proposal urban development.

The DWMS was assessed and approved by the DoW in 2013.

1.3 Contractual Lease Arrangements

The sites will be leased to the future operators by the State government. The lease contract requires the preparation of a Baseline Environmental Report. This is defined as:

- Baseline Environmental Report – means a report, prepared by a Contaminated Sites Assessor nominated by the Landlord, setting out a baseline environmental assessment of the Land and which must include reference to the surface and groundwater and the flora and fauna present on the Premises.

The contractual requirements in relation to the Baseline Environmental Report include:

- The Landlord will, before the Commencement Date, instruct the Contaminated Sites Assessor to prepare the Baseline Environmental Report in draft and to provide a copy to both the Landlord and the Tenant. The parties will work together with the Contaminated Sites Assessor to finalise the Baseline Environmental Report; and
- The Baseline Environmental Report will be for the benefit of the Landlord (and any successors in title to the Landlord) and the Tenant. The Contaminated Sites Assessor will provide the Landlord and the Tenant with a copy of the finalised Baseline Environmental Report before the Commencement Date.

1.4 Purpose of this Report

This report is being prepared to fulfil the lease contract (Section 1.3) and to identify environmental opportunities and constraints regarding the development of Site 4 as proposed, and to identify potential future environmental approval requirements.

2 Key Policies and Guidance Documents

The following policies and guidance documents are relevant to development and approvals in this location. A brief description of the policies and guidance documents are provided below, with further reference in the following sections of this report, where relevant.

2.1 Town Planning

2.1.1 Peel Region Scheme

The PRS is the key land use planning document for the region. The PRS establishes zoning and reservations to guide land uses and development at a regional level. Associated with the PRS are a range of policies that address key issues for the region (WAPC, 2013). These associated policies include:

2.1.1.1 Floodplain Management Policy

The PRS Floodplain Management Policy (WAPC, 2002) is designed to formalise the consideration of floodplain management requirements by responsible authorities when preparing Town Planning Schemes, scheme amendments, and when considering subdivision and development applications.

The policy applies to land:

- within the 1 in 100-year floodplains
- adjacent to the floodplains, up to 0.5 m above the 1 in 100-year flood level
- adjacent to the Peel Inlet – Harvey Estuary and below 2.2 mAHD
- generally, within 200 m of watercourses or sections of watercourses where a floodplain has not been defined, but where WAPC or local government consider there is likely to be floodplain management requirements.

The policy requires that development applications within the flood fringe will be subject to a minimum habitable floor level of 0.5m above the 1 in 100-year flood level.

2.1.2 Shire of Murray Town Planning Scheme No. 4

The Shire of Murray's Town Planning Scheme No. 4 (TPS4) provides for the orderly and properly planned use and development of land within the Shire. TPS4 is consistent with the PRS and provides detail on acceptable activities within each zoning.

Rural Industry is a land use defined under TPS4 as "an industry handling, treating, processing or packing primary products grown, reared or produced in the locality, and a workshop, servicing plant or equipment used for rural purposes in the locality" (DPLH, 1989).

These industries require approval by the Shire of Murray in a 'Rural' zoned area.

2.1.3 Shire of Murray Local Planning Policies

The Shire of Murray has developed a number of Local Planning Policies which may have relevance to development at the site. Specific policies are discussed below.

2.1.3.1 Biodiversity Protection

This policy applies to all planning proposals that are likely to impact on local natural areas (Section 3.6.5) within the Shire of Murray (Shire of Murray, 2016a).

All proposals for clearing of local natural areas require planning approval prior to the commencement of works. Where approval is required applicants will need to clearly demonstrate that their proposal meets the objectives and requirements of this policy and any other requirement of the Shire's planning framework.

The objectives of the policy are:

- To protect, maintain and enhance the viability of habitats, ecological communities, flora and fauna, and biodiversity
- To ensure that any land use or development in close proximity to or containing a natural area is compatible with the long-term maintenance and conservation of that natural area, and will not have detrimental impacts on biodiversity
- To assist in achieving the Specific Biodiversity Feature Targets and Precinct Protection Targets established in the Shire of Murray Local Biodiversity Strategy (Ironbark Environmental, 2013).

2.1.3.2 Mosquitoes

The Shire of Murray is in an area that has high populations of mosquitoes and breeding areas associated with salt marshes around the Peel-Harvey Estuary. These mosquitoes are known vectors of the Ross River Virus and the Barmah Forest Virus (Shire of Murray, 2017).

In response to this the Shire has development a Mosquito Local Planning Policy (Shire of Murray, 2017). This policy identifies that mosquito management should be employed to minimise the impact of mosquitoes on development, rather than eliminating them (Shire of Murray, 2017).

The objective of the Policy is to reduce the impact of mosquitoes on developments, and the Policy is applicable to rezoning, structure plan, subdivision and development proposals in any areas (new residential and other development) that may be sensitive to the impact of mosquitoes and are within 5 km of mosquito breeding areas (Shire of Murray, 2017).

2.2 Land Use Planning

2.2.1 EPA Guidance Statement No. 33 – Environmental Guidance for Planning and Development

This guidance statement provides an overview of environmental protection processes and information, to assist land use planning and development in Western Australia. It provides specific information on (EPA, 2008):

- Environmental protection processes in Western Australia including referral and environmental impact assessment procedures that apply to land use planning and development under the *Environmental Protection Act 1986*
- EPA's advice on protecting a range of biophysical factors, to assist land use planning
- EPA's advice on managing potential pollutants, waste and water (pollution management factors), to assist land use planning
- EPA's advice on protecting aspects of the biophysical environment of cultural and social significance to the community (social surroundings factors), and the EPA's position on risk.

2.2.2 EPA Guidance statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses

This document provides advice on the use of generic separation distances (buffers) between industrial and sensitive land uses to avoid conflicts between incompatible land uses. It takes into account protection of the environment as defined by the *Environmental Protection Act 1986* with a focus on protecting sensitive land uses from unacceptable impacts on amenity that may result from industrial activities, emissions and infrastructure (EPA, 2005).

"Industrial land use" as used in this document encompasses a range of industrial, commercial and rural activities, and infrastructure, associated with off-site emissions that may affect adversely the amenity of sensitive land uses (EPA, 2005).

Land uses considered to be potentially sensitive to emissions from industry and infrastructure include residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child care facilities, shopping centres, playgrounds, and some public buildings. Some commercial, institutional and industrial land uses which require high levels of amenity or are sensitive to particular emissions may also be considered "sensitive land uses" (EPA, 2005).

2.2.3 State Planning Policy 2.5 – Rural Planning

State Planning Policy 2.5 – Rural Planning (SPP 2.5) (WAPC, 2016a) has been prepared to both protect and facilitate development of rural land for rural purposes, including primary production, basic raw materials, regional facilities and protection of biodiversity and landscape (WAPC, 2016a).

SPP 2.5 aims to support rural-zoned development under the State and local government planning frameworks for scheme amendments, structure plans and subdivision/development proposals on rural-zoned land (WAPC, 2016a).

The objectives of SPP 2.5, relevant to this site, are to:

- support existing, expanded and future primary production through the protection of rural land, particularly priority agricultural land and land required for animal premises and/or the production of food
- provide investment security for existing, expanded and future primary production and promote economic growth and regional development on rural land for rural land uses
- provide a planning framework that comprehensively considers rural land and land uses, and facilitates consistent and timely decision-making
- avoid and minimise land use conflicts
- promote sustainable settlement in, and adjacent to, existing urban areas
- protect and sustainably manage environmental, landscape and water resource assets.

State Planning Policy 2.5 – Rural Planning Guidelines (SPP 2.5 Guidelines) (WAPC, 2016b) and Development Control Planning Policy 3.4 (DC 3.4) – Subdivision of Rural Land (WAPC, 2016c) have been prepared to guide the implementation of State Planning Policy 2.5 – Rural Planning.

SPP 2.5 Guidelines detail planning requirements for rural-zoned land, and what to consider in respect of potential land use, and development controls associated with mixed land uses allowed within rural-zoned land, such that differing uses can be accommodated in accordance with region and local scheme requirements.

DC 3.4 details appropriate standards for rural subdivisions being planned for other purposes (i.e. not rural living purposes), including, but not limited to, the use of land for processing works and buffers, public utilities and rehabilitation of degraded land.

2.2.4 Swan Bioplan – Peel Regionally Significant Natural Areas

In 2013, the EPA released advice on the Swan Bioplan – Peel Regionally Significant Natural Areas (Peel RSNA's). Identification of the Peel RSNA's were based on review of 2009 aerial photography and the natural values that represent the range of landscapes, habitats, vegetation and flora found in the areas (Section 3.6.5).

The Advice (EPA, 2013) states that any development proposals in the Peel Sector of the Swan Bioplan area will be considered on their merits. However, those impacting on regionally significant natural areas will be subjected to higher scrutiny.

Proposals that may impact on Peel RSNAs will require site specific flora and vegetation surveys to be undertaken compliant with Level 2 survey standards as outlined in Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016a). Proponents may also need to undertake other environmental surveys consistent with EPA guidance, e.g. fauna surveys consistent with Technical Guidance – Terrestrial Fauna Surveys (EPA, 2016b) as required (EPA, 2013).

Depending upon the outcome of these studies, Peel RSNAs may not be suitable for development.

2.2.5 Shire of Murray Local Biodiversity Strategy

The Shire of Murray Local Biodiversity Strategy is aimed at protecting bushland, wetlands and rivers. This was prepared in 2013 as the Shire prepared to enter a significant growth phase. The strategy establishes the Shire's natural area protection and retention objectives incorporating State and Federal government requirements (SoM, 2013).

The Strategy focuses on identifying Local Natural Areas (LNAs). These are areas of bushland and wetland outside of lands managed by the DBCA. They include local reserves, private lands and bushland managed by other State government agencies. They are the areas of bushland over which the Shire has some level of influence as development is planned and designed (SoM, 2013).

As with Peel RSNAs, LNA areas should be subject to ecological assessment, and depending upon the finding of these studies may not be suitable for development.

Following the development of the Local Biodiversity Strategy, the Shire prepared the Biodiversity Protection Local Planning Policy (Section 2.1.3.1), to facilitate the implementation of the strategy.

2.2.6 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation which commenced 16 July 2000. The EPBC Act focuses Australian Government interests on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance.

Key Matters of National Environmental Significance (MNES) which may be relevant to development within this area, depending on the specific site features and facility design include:

- Peel-Yalgorup Ramsar system, which includes the Peel Inlet-Harvey Estuary
- Threatened black cockatoo species (i.e. Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo)
- Banksia Woodlands of the Swan Coastal Plain ecological community.

Is it noted that the above list is not exhaustive, and other MNES may be relevant to development of the site. An initial assessment of other MNES has been undertaken using the Protected Matters Search Tool on the EPBC Act website (Appendix 1).

Referrals of projects under this act is proponent driven, as there are no third-party referral mechanisms under this legislation.

2.2.7 Guideline: Better Practice Composting

The Department of Water and Environmental Regulation (DWER) released "Guideline: Better Practice Composting" in 2020 to provide advice on the operation and management of composting facilities covered by Category 67A of Schedule 1 of the *Environmental Protection Regulations 1987* (Section 6.1). The guideline defines:

- Environmental performance objectives in relation to the following:
  - Air emissions
  - Dust
  - Environmental siting
  - Fires
  - Land and water
  - Litter and debris
  - Odour
  - Vectors
  - Feedstocks
- Product quality
- Record keeping and reporting
- Additional approvals.

2.3 Water Management

2.3.1 Murray Drainage and Water Management Plan

The Department of Water (DoW) prepared the Murray Drainage and Water Management Plan (DWMP) which provides guidance on how water quality and quantity can be managed to minimise any adverse impacts on the environment and to ensure sustainable development (DoW, 2011).

The Murray DWMP contains information regarding principles and strategies to manage catchments, minimise changes in hydrology, maintain or improve water quality, manage and restore waterways and wetlands and protect water resources. This plan outlines the DoW's direction on how water in the plan area should be managed, in response to the development proposed in the South Metropolitan-Peel sub-regional planning framework (DPLH, 2018). This plan aims to facilitate developments that embrace total water-cycle management principles, and water sensitive urban design (WSUD) best-management practices. It also provides a framework for future planning and development proposals and their associated (subsequent) site-specific water management strategies and plans (DoW, 2011).

2.3.2 Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992

The site is located within the Swan Coastal Plain Catchment of the Peel Inlet - Harvey Estuary, which has a history of poor water quality. The objective of the *Environmental Protection (Peel Inlet – Harvey Estuary) Policy 1992* (Peel-Harvey EPP) is to reduce the input of nutrients, particularly phosphorus, into the Peel Inlet – Harvey Estuary through a number of means, which include appropriate land management by landowners in the policy area.

The policy may trigger the requirement for preparation of a nutrient budget or appropriate management plans for proposed land uses.

2.3.3 State Planning Policy 2.1 – Peel-Harvey Coastal Plain Catchment

State Planning Policy 2.1 – The Peel-Harvey Coastal Plain Catchment (WAPC, 2003b) has been prepared to ensure land use changes within the Peel-Harvey Estuarine System likely to cause environmental damage are brought under planning control. The policy applies to all residential, commercial, industrial, rural and recreation land uses. The objectives of the policy are:

- To improve the social, economic, ecological, aesthetic, and recreational potential of the Peel-Harvey Coastal Plain Catchment
- To ensure that changes to land use within the Catchment to the Peel-Harvey Estuarine system are controlled so as to avoid and minimise environmental damage
- To balance environmental protection with the economic viability of the primary sector
- To increase high water-using vegetation cover within the Peel-Harvey Coastal Plain Catchment
- To reflect the environmental objectives in the Draft *Environmental Protection Policy (Peel-Harvey Estuarine System) 1992*
- To prevent land uses likely to result in excessive nutrient export into the drainage system.

2.3.4 Water Quality Improvement Plan for the Rivers and Estuary of the Peel-Harvey System – Phosphorus Management

The Water Quality Improvement Plan for the Rivers and Estuary of the Peel – Harvey System – Phosphorus Management (WQIP) was released by the EPA in November 2008 (EPA, 2008b). The WQIP aims to improve water quality in the Peel-Harvey Estuarine System by reducing phosphorus discharges from the catchment through land use planning and changes to urban and agricultural practices to ultimately limit the level of phosphorus reaching the Peel-Harvey waterways. The Plan identifies the current status of phosphorus loads; identifies the environmental values of water bodies, and the water quality objectives that will protect the environmental values. The water quality objectives in the plan reflect those of the Peel-Harvey EPP (Section 2.3.2).

3 Existing Environment

3.1 Climate

Keralup is located within the Swan Coastal Plain (SCP) which is characterised by a Mediterranean climate, defined as having cool wet winters and warm dry summers.

The nearest rainfall monitoring station is located in Hopelands, north of Keralup, which has recorded mean annual rainfall of 745 mm, largely between May and August (BoM, 2021).

Temperature data for the region has been obtained from the Karnet monitoring station, indicating a mean temperature of 22. 6° Celsius (BoM, 2021).

3.2 Topography, Landform and Soils

3.2.1 Topography

The site is generally low lying, ranging in elevation from approximately 10 metres Australian Height Datum (mAHD) in the west to 20 mAHD at the highest point located in the eastern end of the site (Figure 5).

3.2.2 Landform and soils

The site comprises soils from the Bassendean System, described as an Aeolian deposit consisting of sandplains with low dunes and occasional swamps with iron or humus podzols (Churchward and McArthur, 1980) (Figure 5). Specifically, soils comprise:

- Bassendean B1 Phase – extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant
- Bassendean B2 Phase – flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan at 1-2 metres
- Bassendean B3 Phase – closed depressions and poorly defined stream channels with moderately, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam
- Bassendean B4 Phase – broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1. 5 m by clay or less frequently a strong iron-organic hardpan (van Gool et al, 2005).

3.3 Acid Sulfate Soils

The site is mapped as having a 'moderate to low risk' of acid sulfate soils (ASS) being present (DWER, 2017; Figure 5). A small portion of the site in the south eastern corner is mapped as having a 'high to moderate risk' of containing ASS (DWER, 2017; Figure 5). Previous preliminary investigations across the whole Keralup site by Coffey Environments (2009a) have confirmed:

- The majority of soils at the site comprise light grey to grey, loose coarse sands grading to darker iron-stained coarse-grained sands and bands of weakly cemented, dark grey to black medium sands (coffee rock)
- Surface soils were dark due to the presence of organic matter
- 358 samples from 54 locations (approximately 50% from each sample location) across the whole Keralup site were analysed via the Chromium Suite (S_{CR}) method

- 92 samples (approximately 26% of all analysed samples) from 39 locations across the whole Keralup site indicated the presence of ASS within 4 m of the surface.

The outcome of the Coffey investigation was to identify areas where additional ASS investigation are recommended. The location of the recommended additional investigation areas (i.e. Stage 2 Investigation Required) is provided in Appendix 2. This mapping indicates that additional ASS investigations are recommended within parts of Site 4.

3.4 Hydrology

3.4.1 Surface water

The site is located within the Serpentine sub-catchment of the Peel-Harvey Catchment. Surface drainage across Keralup and throughout the surrounding region is collected in numerous shallow agricultural drains which have been constructed to alleviate water-logging of the land. Several open agricultural drains traverse Keralup, some of them arising on neighbouring land (Figure 6).

Drainage waters from Wandalup Farms piggery, south of the site, drain northward towards Keralup in an unnamed drain, and westward along part of the southern boundary in the Gull Road Drain (Peck and Davies, 1993). The Gull Road Drain has a catchment of approximately 7km^2.

Site 4 is not located within the floodplain of the Serpentine River.

3.4.2 Wetlands

A wetland assessment was undertaken by Coffey Environments (2010) to assess the status of existing wetlands on the site. Following this assessment, a number of wetlands onsite were re-classified by the (then) Department of Environment and Conservation (DEC) (now Department of Biodiversity, Conservation and Attractions (DBCA)). A number of these reclassified wetlands appeared to have an elevated classification, which was raised with DEC by the Department of Housing (including submission of further technical information prepared by PGV Environmental (2012), but further assessment and consultation was not progressed at this time.

The current DBCA wetland locations and classifications are shown on Figure 6 with information relating to these wetlands summarised on Table 1. The wetland management category definitions are provided in Table 2.

Table 1: Wetlands identification details

Wetland (UFI)	Landform	Wetland Type	Management Category	Total area of wetland (ha)	Area on site (ha)
15856	Flat	Palusplain	CCW	43.83	17.87
15857	Flat	Palusplain	CCW	18.35	7.60
15853	Flat	Palusplain	REW	258.97	111.99
16021	Flat	Palusplain	MUW	27,602	10.78
15849	Flat	Sumpland	REW	9.31	6.91

Table 2: Wetland management categories

Management Category	General Description	Management Objective
Conservation	Wetlands which support a high level of attributes and functions	Highest priority wetlands. Objective is to preserve and protect the existing conservation values of the wetlands through various mechanisms including: • reservation in national parks, crown reserves and State-owned land, • protection under Environmental Protection Policies, and • wetland covenanting by landowners. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.
Resource Enhancement	Wetlands which may have been partially modified but still support substantial ecological attributes and functions	Priority wetlands. Ultimate objective is to manage, restore and protect towards improving their conservation value. These wetlands have the potential to be restored to Conservation category. This can be achieved by restoring wetland function, structure and biodiversity. Protection is recommended through a number of mechanisms.
Multiple Use	Wetlands with few remaining important attributes and functions	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through landcare.

Source: EPA (2008)

The Department of Communities assessment of the potential developable extent of each site, as shown on Figure 2, is based on the extent of the site which contains quality wetland values as identified during the 2010 and 2012 wetland assessments.

As such further consultation and/or assessment may be required to confirm and seek approval for the site-specific development footprints.

3.5 Hydrogeology

The dominant regional groundwater features surrounding the Keralup study area include the regional superficial sand aquifer which is underlain by the deep aquifers of the Leederville system, and Yarragadee Aquifer (Emerson Stewart, 2013).

A partial aquitard, defined as a layer of low permeability soil which retards groundwater flow between adjoining (relatively high permeability) aquifers, underlies a significant portion of the site at shallow depth (generally < 3 mBGL), with much of the site experiencing extended periods of waterlogging during winter months (Emerson Stewart, 2013).

3.5.1 Groundwater

Regional groundwater flows in a westerly direction across the study area towards the Serpentine River. Typically, groundwater in the general Keralup area contains high levels of nutrients, based on historical land uses practices in the broader catchment (Emerson Stewart, 2013).

Groundwater monitoring has identified that groundwater quality varies across the broader region, reflecting the soil variability, current and historical land uses practices and concentrations of mineral sands (Emerson Stewart, 2013).

Peak groundwater levels typically occurred between August and September with minimum groundwater levels recorded during May (Emerson Stewart, 2013). The Average Annual Maximum Groundwater Level

(AAMGL) in the vicinity of Site 4 varied from approximately 0 to 7 m below ground level (mBGL), dependent upon topographic elevations (Emerson Stewart, 2013).

Western Environmental (2021) undertook a groundwater assessment as part of preliminary contamination investigations (Section 3.8, Appendix 3). Selected parameters measured across the investigation area indicate the following:

- pH ranged from 3.9 – 6 indicating groundwater is acidic
- Electrical conductivity (EC) ranged from 93 µs/cm – 150 µs/cm indicating groundwater is fresh
- Groundwater depths were measured from 3.125 – 3.545 m below ground level (mBGL).

Further groundwater laboratory analyses in relation to potential contamination are detailed in Section 3.8.

3.6 Vegetation and Flora

Across Australia, regions have been identified based on climate, geology, landforms and characteristic vegetation and fauna, under the Interim Biogeographic Regionalisation of Australia (IBRA) (Commonwealth of Australia, 2013). The site is located in the Perth subregion of the Swan Coastal Plain IBRA region, described as a low lying plain covered with woodlands dominated by Banksia or Tuart on sandy soils (Mitchell et al, 2002).

3.6.1 Vegetation Associations and Complexes

According to Beard (1990), the vegetation of the subject land is located within the Bassendean 1000 – Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree (*Melaleuca* spp.) association (FVC, 2020).

Further, the site is being contained within the Bassendean Complex – Central and South (Figure 7), described as *Eucalyptus marginata* (Jarrah) – *Allocasuarina fraseriana* (Sheoak) – *Banksia* species to low woodland of *Melaleuca* species and sedgelands on the moister sites (Heddle et al, 1980).

3.6.2 Vegetation Type and Condition

A vegetation review and field assessment of the southern portion of Keralup was undertaken by Focused Vision Consulting with field work undertaken in November 2017 and September 2019 (FVC, 2020).

11 vegetation units were identified at Site 4 (

Table 3), including large areas (~49%) of cleared pasture (Figure 7). None of the mapped vegetation units were identified to be of conservation significance (FVC, 2020).

Vegetation on the site ranged in condition from 'Completely Degraded' (~46.5%) to 'Very Good-Excellent' (~2%) (FVC, 2020; Figure 8).

FVC (2020) also assessed the extent of plantation vegetation onsite. Only a small portion of native remnant vegetation (~5%) remains on site (Figure 9) with the site containing a large portion of native regrowth (~48%) and cleared land (~47%). Although native vegetation is regenerating in areas previously cleared for rural activities, the native growth does not represent endemic (locally native) species, and instead typically represent novel assemblages, dominated by one or two species (particularly *Kunzea glabrescens* or *Astartea scoparia*) (FVC, 2020).

3.6.3 Flora

3.6.3.1 Threatened and Priority Flora

No threatened or priority flora were identified within the site during targeted and opportunistic searches (FVC, 2020; Figure 10).

3.6.3.2 Weeds

One Declared Pest plant (weed) species listed by the Department of Primary Industries and Regional Development (DPIRD), **Moraea flaccida* (Cape Tulip), was located on the site (Figure 10), within vegetation unit KgTOS (Section 3.6.2). The species has become well established in the broader area of Keralup, occurring in dense infestations, and was also observed to be common in areas adjacent to the site (FVC, 2020).

3.6.4 Threatened and Priority Ecological Communities

One Commonwealth listed Threatened Ecological Community (TEC) is identified based on regional scale mapping as potentially occurring within the site – Banksia Woodlands of the Swan Coastal Plain/Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region. This TEC is listed as 'Endangered' under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and is Priority 3 under Western Australian Conservation codes (FVC, 2020; Figure 10).

This TEC was not found to occur within the study area, i. e. no *Banksia spp*. were recorded on the site (FVC, 2020).

3.6.5 Peel Regionally Significant Natural Areas and Shire of Murray Local Natural Areas

The EPA released the Swan Bioplan – Peel Regional Significant Natural Areas (Peel RSNAs) information to guide development in 2010 (EPA, 2013). These RSNAs were identified on the basis of aerial photography and the identification of natural values (i.e. vegetation, wetlands etc) at the time (2009). No RSNAs were identified on Site 4 as part of this assessment.

The purpose of identifying RSNAs is to guide development to areas of cleared land in preference to un-cleared land (EPA, 2013) and to prompt detailed evaluation of natural features and values prior to any development in these areas.

Following the release of the Peel RSNAs, the Shire of Murray identified their own Local Natural Areas (LNAs) outside of regional open space (Ironbark Environmental, 2013).

The site contains LNAs, associated with the mapped geomorphic wetlands and presence of native vegetation.

Table 3: Vegetation units

Vegetation Unit	Vegetation Description	Area (ha)	% of site
AsKgTS	*Astartea scoparia* and *Kunzea glabrescens* Closed Tall Scrub to 3 m over *Juncus pallidus* Very Open Sedgeland to 1. 4 m over **Lotus subbiflorus* Very Open Herbland to 0. 15 m.	33. 38	12. 55
AsTSJpOS	*Astartea scoparia* Tall Shrubland to 2. 1 m over *Juncus pallidus* Open Sedgeland to 2 m over **Hypochaeris glabra, *Ornithopus pinnatus* and **Lotus subbiflorus* Open Herbland to 0. 4 m over **Anthoxanthum odoratum* Very Open Grassland to 0. 35 m.	0. 2	0. 07
CcOF(D)	*Corymbia calophylla* Open Forest to 12 m over *Melaleuca preissiana* Low Woodland to 7 m over *Regelia ciliata* Closed Tall Scrub to 3. 5 m over *Xanthorrhoea preissii, Hypocalymma angustifolium* and *Acacia pulchella* Open Shrubland to 1. 2 m over *Dasypogon bromeliifolius* Very Open Herbland to 0. 4 m.	1. 88	0. 71
EmLOF	*Eucalyptus marginata subsp. marginata (*with *Hardenbergia comptoniana*) and *Xylomelum occidentale* Low Open Forest to 8 m over *Xanthorrhoea preissii* Open Shrubland to 1 m over *Hibbertia hypericoides* Low Open Shrubland to 0. 8 m over**Briza maxima* and **Vulpia myuros* Open Grassland to 0. 3 m.	2. 59	0. 97

Vegetation Unit	Vegetation Description	Area (ha)	% of site
ErMpLCF	*Eucalyptus rudis* and *Melaleuca preissiana* Low Closed Forest to 8 m over *Astartea scoparia* Tall Open Shrubland to 2. 5 m over *Juncus pallidus* and *Lepidosperma longitudinale* Sedgeland to 1. 2 m over **Lotus subbiflorus* and **Hypochaeris glabra* Very Open Herbland to 0. 3 m over **Vulpia* sp. and **Bromus* diandrus Very Open Grassland to 0. 3 m.	5. 35	2. 01
ErMpW	*Eucalyptus rudis* and *Melaleuca preissiana* Woodland to 13 m over *Melaleuca rhaphiophylla* Low Open Woodland to 6 m *over Kunzea glabrescens* and *Astartea scoparia* Tall Shrubland to 5 m over *Juncus pallidus* Sedgeland to 1 m over **Isolepis prolifera* and *Azolla* sp. Herbland to 0. 4 m.	4. 05	1. 52
JpSAs	*Juncus pallidus* Sedgeland to 1. 8 m over **Lotus subbiflorus* and **Moraea flaccida* Open Herbland to 0. 5 m over **Cynodon dactylon* and **Cenchrus clandestinus* Open Grassland to 0. 15 m with occasional *Astartea scoparia* to 1. 5 m.	19. 6	7. 37
JpSAsMp	*Juncus pallidus* Sedgeland to 1. 8 m over **Lotus subbiflorus* and **Moraea flaccida* Open Herbland to 0. 5 m over **Cynodon dactylon* and **Cenchrus clandestinus* Open Grassland to 0. 15 m with occasional *Astartea scoparia* to 2. 2 m and scattered *Melaleuca preissiana* to 10 m.	6. 13	2. 3
KgTOS	*Kunzea glabrescens* Tall Open Shrubland to 2. 6 m over *Astartea scoparia* Open Heath to 2 m over *Juncus pallidus* Open Sedgeland to 2 m over **Ornithopus pinnatus* and **Hypochaeris glabra* Very Open Herbland to 0. 35 m and scattered *Melaleuca preissiana* to 10 m.	51. 64	19. 41
MpLOF/MpLOF(D)	*Melaleuca preissiana* Low Open Forest to 6 m over *Astartea scoparia* tall Open Scrub to 2. 8 m over *Juncus pallidus* Very Open Sedgeland to 2 m over **Ornithopus pinnatus* and **Hypochaeris glabra* Herbland to 0. 5 m.	5. 22	1. 96
MpWAsS	*Melaleuca preissiana* Woodland to 10 m over *Astartea scoparia* Shrubland to 2 m over *Juncus pallidus* Open Sedgeland to 1. 8 m over **Vulpia sp.* Open Grassland to 0. 15 m over **Lotus subbiflorus* and **Romulea rosea* Open Herbland to 0. 2 m.	5. 27	1. 98
Cleared Pasture		130. 76	49. 14

Source: FVC, 2020

3.7 Fauna and Habitat

3.7.1 Fauna Habitats

A comprehensive fauna assessment was undertaken at the site in 2009 (Coffey Environments, 2009b).

The site is largely cleared paddock, with two fauna habitats identified within the site (Figure 11) as follows:

- Open paddock with *Juncus pallidus* (*Juncus pallidus* in paddock with occasional *Astartea scoparia*, often on edge of wetland area)
- *Melaleuca* remnant woodland with wetland understorey (woodland dominated by *Melaleuca* and Flooded Gums, with moist, dense understorey).

3.7.2 Fauna Occurrence

A range of surveys were undertaken to define avifauna, nocturnal reptiles, mammals and bats that utilise the Keralup site. Multiple fauna species were recorded through trapping, direct observation, spotlighting and bat echolocation (Coffey Environments, 2009b). Targeted surveys were also undertaken for visible tree hollows that may be utilised by Black Cockatoo species.

Survey results indicated the fauna assemblage was typical of fauna species that occur on the Swan Coastal Plain (Coffey Environments, 2009b).

Of the 134 recorded species, 6 conservation significant species were observed on the Keralup site (Table 4 and Section 3.7.3).

Table 4: Number and type of fauna recorded at Keralup

Family	Number of Species Present	Conservation-significant species recorded
Amphibians	8	0
Mammals	10	1 (Refer to Table 5)
Bats	6	0
Reptiles	21	0
Avifauna	89	5 (Refer to Table 5)
TOTAL	*134*	*6*

3.7.3 Threatened and Priority Fauna

A search of the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) Protected Matters Search Tool identified multiple species that may occur in the area (Appendix 1). Of those species identified in this search, Coffey Environments (2009b) determined the likelihood of some significant species occurring on the Keralup site (Table 5).

Table 5: Significant fauna species recorded on the Keralup site

Species	EPBC Act Conservation Status	Biodiversity Conservation Act Status	Type of Presence	Potential to be found in Project Area*
Birds				
Actitus hypoleucos (Common Sandpiper)	Migratory		Species or species habitat known to occur within area	
Apus pacificus (Fork-tailed Swift)	Migratory	Migratory	Species or species habitat likely to occur within area	
Ardea alba (Great Egret)	Migratory		Breeding known to occur within area	Recorded on site
Botaurus poiciloptilus (Australian Bittern)	Endangered		Species or species habitat likely to occur within area	
Calidris acuminata (Sharp-tailed Sandpiper	Migratory	Migratory	Species or species habitat known to occur within area	Possible
Calidris canutus (Red Knot, Knot)	Endangered	Endangered	Species or species habitat known to occur within area	
Calidris ferruginea (Curlew Sandpiper)	Critically Endangered		Species or species habitat may occur on site	Possible
Calidris melanotus (Pectoral Sandpiper)	Migratory		Species or species habitat known to occur within area	
Calidris ruficollis (Red-necked Stint)	Migratory	Migratory		Possible

Species	EPBC Act Conservation Status	Biodiversity Conservation Act Status	Type of Presence	Potential to be found in Project Area*
Calyptorhynchus banksii naso (Forest Red-tailed Black Cockatoo)	Vulnerable	Vulnerable	Species or species habitat likely to occur within area	Recorded on site – feeding
Calyptorhynchus baudinii (Baudin's Black Cockatoo)	Endangered		Species or species habitat likely to occur within area	Unlikely
Calyptorhynchus latirostris (Carnaby's Black Cockatoo)	Endangered	Endangered	Breeding likely to occur within area	Likely (foraging)
Motacilla cinerea (Grey Wagtail)	Migratory	Migratory	Species or species habitat may occur on site	
Merops ornatus (Rainbow Bee-eater)	Migratory			Recorded on site
Numenius madagascariensis (Eastern Curlew)	Critically Endangered	Critically Endangered	Species or species habitat may occur within area	Possible
Pandion haliaetus (Osprey)	Migratory	Migratory	Species or species habitat likely to occur within area	
Phaps elegans (Brush Bronzewing)		Priority 4		Recorded on site
Pluvialis squatarola (Grey Plover)	Migratory	Migratory		Possible
Rostratula australis (Australian Painted Stripe)	Endangered		Species or species habitat likely to occur within area	
Sternula nereis nereis (Australian Fairy Tern)	Vulnerable		Species or species habitat may occur within area	
Thinornis rubricollis (Hooded Plover)		Priority 4		Possible
Tringa nebularia (Common Greenshank)	Migratory	Migratory	Species or species habitat likely to occur within area	Recorded on site
Tringa stagnatilis (Marsh Sandpiper)	Migratory	Migratory		Possible
Mammals				
Dasyurus geoffroi (Chuditch,Western Quoll)	Vulnerable	Priority 4	Species or species habitat likely occur within area	Unlikely
Falsistrellus mackenziei (Western False Pipistrelle)		Priority 4		Possible
Hydromys chrysogaster (Water –rat, Rakali)		Priority 4		Possible
Isoodon fusciventer (Southwestern Brown Bandicoot)		Priority 4		Recorded on site
Notamacropus irma (Western Brush Wallaby)		Priority 4		Unlikely

Species	EPBC Act Conservation Status	Biodiversity Conservation Act Status	Type of Presence	Potential to be found in Project Area*
Phascogale tapatafa wambenger (Brush-tailed Phascogale		Conservation Dependent		Possible
Pseudocheirus occidentalis (Western Ringtail Possum)	Critically Endangered		Species or species habitat likely occur within area	Unlikely
Reptiles				
Lerista lineata (Lined Skink)		Priority 3		Possible
Neelaps calonotus (Black-striped Snake)		Priority 3		Possible

Source: Coffey Environments, 2009b

Based on previous fauna studies, existing degraded nature of fauna habitat and a review of conservation-significant species that could occur in the area, Site 4 provides limited fauna value (Coffey Environments, 2009b). In particular, habitat for Black Cockatoos is generally limited to the Eucalypt woodland areas which mostly occur along the Serpentine River, to the west of the site.

3.7.4 Mosquitoes

Based on the prevalence of mosquitoes in the Keralup area, Rankine Mosquito Management undertook a larval and adult mosquito monitoring program for several years over the broader Keralup area from 2008 – 2014.

The mosquito species present in the area are diverse, and the dominant mosquito species present are *Aedes camptorhynchus* and *A. vigilax*, both of which are known disease vector bearing species (Rankine Mosquito Management, 2017).

The numbers of mosquitoes identified at monitoring sites is considered high, but also similar to surrounding off-site locations (Rankine Mosquito Management, 2017).

3.8 Potential Contamination

Preliminary contamination investigations have been undertaken in accordance with relevant guidance, by Western Environmental (2021). These investigations provide information on the baseline condition of the site and identify key considerations. A summary of the investigation undertaken, and key findings are provided below, with a full copy of the contamination investigation report provided in Appendix 3.

3.8.1 Historical Land Uses

Based on a review of historical land uses, the site has been largely undisturbed for many years (since 1965). It appears that the site has been used for low-intensity agriculture since approximately 1983 when constructed dams are visible (WEPL, 2021). No changes appear evident to site use since 2008 (WEPL, 2021).

3.8.2 Contamination Investigations

A limited soil and groundwater assessment was undertaken to determine the baseline environmental condition of the site on the basis of historical land uses (WEPL, 2021). Nine soil sampling locations within Site 4 were analysed for a suite of potential contaminants, including:

- Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)
- Total recoverable hydrocarbons (TRH) with and without silica gel clean-up

- Benzene/toluene/ethylbenzene/xylenes (BTEX).

Three existing groundwater bores (B07, B09 and B11) were used for analysis of the following suite to assess existing groundwater quality:

- Dissolved Metals (Al, As, Be, Bo, Cd, Cr, Cu, Fe, Pb, Mn Hg, Ni, Se, Zn)
- TRH with and without silica gel clean-up
- BTEX
- Polycyclic aromatic hydrocarbons (PAHs)
- Organochlorine/organophosphate pesticides (OC/OPs)
- DWER ASS Suite (total Al & Fe, acidity, alkalinity, speciated and total nitrogen, Cl, conductivity, pH, phosphate, filterable reactive phosphorous, sulphate (as S), total dissolved solids (TDS)
- Per- and polyfluoroalkyl substances (PFAS).

3.8.3 Laboratory Analytical Results

3.8.3.1 Soil results

Soil results have been compared to "commercial/industrial" health investigation levels (HIL-D) as per the *National Environmental Protection (Assessment of Site Contamination) Measure* (NEPC, 2013) and the *Assessment and Management of Contaminated Sites* (DER, 2014). The use of this criteria is deemed the most conservative measure for development, in recognition that the site will not actually be developed as "industrial/commercial" premises.

The results are summarised as follows:

- All metals results were below the laboratory limit of reporting (LOR) and adopted assessment criteria
- All OC/OP results were below the laboratory LOR and adopted assessment criteria
- All BTEX and TRH compounds (both before and after silica gel clean-up) were below LOR and adopted assessment criteria
- All PAH compounds were below LOR and adopted assessment criteria
- All PFAS compounds were below LOR and adopted assessment criteria.

3.8.3.2 Groundwater results

Groundwater results have been compared to the following criteria as per the *National Environmental Protection (Assessment of Site Contamination) Measure* (NEPC, 2013) and the *Assessment and Management of Contaminated Sites* (DER, 2014):

- Fresh Water Guidelines (FWG) for slightly-moderately disturbed systems
- Drinking Water Guidelines (DWG)
- Long-term Irrigation Water Guidelines (LIWG)
- Non-potable Groundwater Use Guidelines (NPUG) (Department of Health, 2014)
- ASS Indicator Guideline Criteria (DER, 2015a and 2015b).

3.8.3.2.1 Physiochemical and ASS Parameters

Physiochemical and ASS parameters were below adopted assessment criteria except for the following:

- pH ranged from 3.9 – 6, which exceeds the FWG and DWG guideline range of 6.5 – 8.5 at all locations (B07, B09, B11). pH also exceeded the ASS Indicator guideline (<5) at B07, B09 and B11

- EC values ranged from 93 – 150 µs/cm, which exceeds the FWG guideline range of 300 – 1500 µs/cm at B07, B09 and B11
- Chloride concentrations ranged from 17 – 39 mg/L, which exceeds the LIWG guideline range of 350 – 700 mg/L
- Dissolved sodium concentrations ranged from 13 – 25 mg/L, which exceeds the LIWG guideline range of 230 – 460 mg/L
- Exceedances of the alkalinity:sulphate ASS ratio guideline of <5 were observed at all locations (B07, B09, B11). Where alkalinity or sulphate values were below LOR, a value of half the LOR was adopted to calculate the ratio (value of 4 adopted at B07, B09, B11)
- Exceedances of the acidity:alkalinity ASS ratio guideline of 1 were observed at all locations except B03. Values ranged from 1.5 – 3.7 at B07, B09 and B11
- Total phosphorous concentrations ranged from 0.22 – 0.44 mg/L, which exceeds the LIWG guideline value (0.05 mg/L) and FWG guideline value of 0.1 mg/L at all locations (B07, B09, B11)
- Total nitrogen concentrations ranged from 1.1 – 3.19 mg/L, which exceeds the FWG guideline value of 1 mg/L at all locations (B07, B09, B11)
- NOx-N [Nitrate & Nitrite (as N)] concentrations ranged from < 0.5 – 2.4 mg/L, which exceeds the FWG guideline value of 0.1 mg/L at locations B09 (2.4 mg/L) and B11 (0.69 mg/L)
- Ammonia (as NH3-N) ranged from < 0.01 – 0.59 mg/L, which exceeds the DWG guideline of 0.5 mg/L at B07.

3.8.3.2.2 Metals

Dissolved and total metals concentrations were below the adopted assessment criteria with the exception of the following:

- Dissolved aluminium ranged from 0.34 – 0.47 mg/L in all bores (B07, B09, B11), which exceeds the NUPG guideline value of 0.2 mg/L
- Dissolved copper concentrations ranged < 0.001 – 0.005 mg/L, and B09 (0.005 mg/L) exceeds the FWG guideline value of 0.0014 mg/L
- Dissolved iron concentrations ranged from 0.09 – 0.86 mg/L, and B07 (0.86 mg/L) exceeds the NPUG guideline criteria of 0.3 mg/L and DWG criteria of 0.3 mg/L
- Dissolved zinc ranged from 0.008 – 0.01 mg/L, and B09 (0.014 mg/L) and B11 (0.01 mg/L) exceeds the FWG guideline criteria of 0.008 mg/L
- Total aluminium ranged from 0.38 0 4 mg/L, and exceeds the ASS Indicator criteria of 0.15 mg/L
- Total iron ranged from 0.14 – 0.87 mg/L, and exceeds the NPUG guideline criteria of 0.3 mg/L.

3.8.3.2.3 Others

All OC/OP results were below the laboratory LOR and adopted assessment criteria.

All BTEX, TRH and TPH compounds (both before and after silica gel clean-up) were below LOR and adopted assessment criteria.

All PAH compounds were below LOR and adopted assessment criteria.

All PFAS compounds were below LOR and adopted assessment criteria.

3.8.3.3 Conclusion

There were no exceedances of soil quality guidelines in the samples analysed.

Based on the limited investigation sampling, widespread shallow soil contamination is not apparent (WEPL, 2021).

Groundwater results identified that current conditions are similar in nature to conditions observed in the wide scale preliminary ASS investigation undertaken in 2008 (Coffey, 2009a) (WEPL, 2021).

3.9 Cultural Heritage

3.9.1 Indigenous Heritage

A search of the Aboriginal Heritage Enquiry System (DPLH, 2021) indicates that no indigenous heritage sites occur within Site 4.

3.9.2 Non-indigenous Heritage

A search was undertaken of the State Heritage database (State Heritage Office, 2021) and Heritage – Australian Heritage Database (DAWE, 2020). No areas of non-indigenous heritage significance have been recorded within Site 4.

3.10 Surrounding Land Uses

The site is predominantly surrounded by rural landholdings to the north, east and south, which includes a piggery and a mushroom farm to the south of the site. The piggery (Lots 89 and 109 on Plan 741) is classified as "Contaminated – restricted use" under the *Contaminated Sites Act 2003* on the basis of former land uses at the site, which have attributed to metals, pathogens, nutrient and hydrocarbons remaining present in the soil and groundwater.

The Serpentine River runs in a north-south direction, approximately 3 km west of the site. Special rural, and rural-zoned lots are located between the Serpentine River and the Kwinana Freeway, which runs parallel to the western boundary of the landholding. Paganoni Swamp Nature Reserve and predominantly rural residential landholdings are present further west.

The Parmelia Gas Pipeline corridor is located to the east of Site 4 (it traverses the Keralup landholdings to the north of Site 4). The Dampier to Bunbury Natural Gas Pipeline (DBNGP) is also located further east of the site. An ATCO Australia gas pipeline is located south of the Keralup landholdings, which is a connection to the DBNGP.

Twin 330Kv high voltage overhead transmission lines are located along the eastern boundary of the Keralup landholdings. The transmission lines are contained within two easements in the favour of Western Power. This easement is located within Site 4. There may be implications for land use planning on Site 4 within the vicinity of the transmission line easements.

The closest sensitive land use (i.e. residential dwelling) to Site 4 is located approximately 2 km southwest of the site on Redheads Road, Keralup.

4 Environmental Opportunities, Constraints and Further Investigation Considerations

4.1 Acid Sulfate Soils

The site has been found to contain ASS, however the full extent has not yet been defined through investigations (Section 3.3). Mapping has been produced by Coffey Environments (2009a) identifying the broad location of areas requiring further investigation to determine the extent of natural acidity in surface and subsurface soils within this site (Appendix 2).

Groundwater monitoring results from the 2021 investigation showed exceedances of ASS parameters in most groundwater monitoring bores, with groundwater being acidic with limited buffering capacity (WEPL, 2021).

4.1.1 Opportunities and Constraints

Given the nature of ASS, disturbance of these soils can generate leaching of sulfuric acid and contaminants. Flushing of these contaminants into groundwater and surface water can cause:

- Ecological damage to aquatic and riparian ecosystems
- Contamination of groundwater with various metals (arsenic, aluminium etc)
- Damage to infrastructure through the corrosion of concrete, steel and other sub-surface assets.

These potential impacts can be caused through oxidation of ASS by:

- Dewatering operations
- Excavation or other soil disturbance
- Groundwater abstraction for private or commercial water supplies
- Groundwater level control by drainage
- Dredging operations
- Land use changes which alter the water balance.

Disturbance of ASS, without proper treatment and/or management, could result in the site being classified under the *Contaminated Sites Act 2003*.

4.1.2 Further Investigations

Further ASS investigations within the mapped Stage 2 investigation areas (Appendix 2), should this area be likely to be disturbed as part of the site development, are recommended to further delineate areas of high natural acidity (Coffey Environments, 2009a). Groundwater monitoring may also be warranted to determine the likelihood of groundwater being affected by sulfide oxidation if use or disturbance of groundwater is proposed.

Developments and construction programs that involve excavations or dewatering will also likely require the preparation of an Acid Sulfate Soil and Dewatering Management Plan prior to works commencing onsite (Section 6.2).

4.2 Water Management

Groundwater and surface water hydrology should be managed to enable development at the site to proceed with minimal impact to the surrounding environment.

4.2.1 Opportunities and Constraints

Elevated nutrient concentrations in groundwater are a key characteristic of this location. Future development should aim to reduce nutrient inputs and avoid mobilisation of existing nutrients the soil profile, where possible. Specialist hydrological advice may be required at the detailed design stage for future land uses to enable best practice design initiatives and management to be implemented.

Any future groundwater abstraction should ensure that impacts to the site hydrology or disturbance to ASS is avoided.

The Department of Water has also undertaken modelling studies to identify the impact of sea-level rise on land development projects in the Murray and Lower Serpentine catchments (Hall et al 2010, Marillier et al, 2015). The site falls within the Lower Serpentine catchment, and there may be some level of consideration required as to the impact of potential changes in groundwater levels associated with sea-level rise on the basis of future climate scenarios. Technical expertise may be required to assess the Marillier et al (2015) report in the local context of the site.

4.2.2 Further Investigations

Specialist hydrological advice should be sought at the site design stage to allow incorporation of best practice drainage initiatives and management to be implemented, as well as ensuring the requirements of the relevant drainage management policies and guidance area addressed.

A Nutrient and Irrigation Management Plan (or similar) may be required by the Shire of Murray to support a future Development Application (DA) for the site.

Given the proposed use of Site 4, groundwater monitoring (up and down gradient of the composting facility) is likely to be required prior to and during operation of the facility.

4.3 Wetlands

4.3.1 Opportunities and Constraints

Potential risks and pressures to wetlands and waterways from development include:

- Development may increase nutrient loading to the sites surface and groundwater, influencing wetland nutrient balancing and ecology
- Clearing of vegetation associated with wetlands and/or wetland buffers may impact on wetland values
- Potential risk of ASS-related impacts to groundwater regime, if not managed appropriately during construction
- Downstream impacts to the Peel-Harvey system though an increase in pollution entering the Serpentine River is a potential concern if water runoff and nutrient application is not managed and controlled.

As noted in Section 3.4.2, the site contains wetland areas mapped as Conservation, Resource Enhancement and Multiple Use management categories, although the appropriateness of these categories in some locations is disputed by the Department of Communities.

The preferred location of future development areas would be outside of mapped Conservation and Resource Enhancement category wetland areas and associated buffer zones (assume a 50 m zone would be requested by the regulatory authorities). If this cannot be avoided, consultation with the Shire of Murray and DBCA would be required to discuss the ecological condition of the proposed development locations to seek approval for development within this area.

4.3.2 Further Investigations

As noted above, consultation with the Shire of Murray and DBCA specifically related to wetland condition and future use/development will be required should development within mapped CCW or REW areas and their associated buffer zones be desired. Further studies may be required on the basis of this agency consultation.

4.4 Vegetation and Flora

The site is largely cleared and contains small portions of remnant vegetation and plantation vegetation. None of the vegetation on site has been identified to have conservation significance (Section 3.6). Although vegetation is degraded, there is still some value of existing vegetation in terms of providing fauna habitat (Section 3.7 and Section 4.5).

4.4.1 Opportunities and Constraints

Potential impacts to vegetation and flora will result from land clearing for development. Any areas of vegetation that are retained within the site may be impacted due to adjacent construction activities, and in-direct impacts resulting from development and human disturbance. Some of these impacts may include:

- Loss or changes in vegetation community structure and biodiversity
- Further fragmentation of existing fauna habitats
- Spread of weeds and pathogens (e. g. *Phytophthora* Dieback).

Areas of vegetation in 'Very Good' and higher condition should be prioritised for retention, where possible.

Areas of retained native vegetation should be managed to avoid further reduction in the botanical condition and values. This may include fencing to avoid disturbance, weed management to avoid further weed spread into these areas etc.

Approval to clear native vegetation will be required from the Department of Water and Environmental Regulation under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, unless a valid exemption is applicable. In order to obtain a Native Vegetation Clearing Permit (NVCP), there may be a requirement to commit to management of retained vegetation areas, or revegetation of some portions of the site.

4.4.2 Further Investigations

As noted above, a NVCP application may be required to gain approval for clearing of native vegetation should this be required to facilitate development of the site. The vegetation and flora surveys undertaken in 2017 and 2019 would assist to support the application preparation.

If a vegetation management strategy is required as part of the NVCP application, or as part of the Shire of Murray Development Application (DA) process it is recommended that this strategy be prepared in accordance with the Shire of Murray's Local Planning Policy – Vegetation Management (2018), and should address:

- Revegetation methodology, including species selection, planting location, site preparation works
- Completion criteria
- Monitoring and maintenance regime.

4.5 Fauna and Habitat

Based on the largely degraded state of vegetation at the site, the quality of fauna habitat appears limited (Section 3.7). With the exception of wetland birds, the species of fauna present, or likely to visit the Keralup

site, would also be present in areas of better-quality vegetation in the region (Coffey Environments, 2009b). Given the proximity of the site to the Serpentine River, it is likely that fauna abundance and diversity would be higher within the areas of regional open space associated with the river.

4.5.1 Opportunities and Constraints

Of those conservation-significant fauna species identified at the Keralup site (Section 3.7.3), it is possible that development may impact some fauna species, due to disturbance of fauna habitat, despite the limited availability of fauna habitat on site.

Potential impacts to fauna during vegetation clearing, if required, should be considered and managed. A Fauna Management and Relocation Plan can be undertaken as part of the clearing work to minimise impacts to resident fauna populations. Clearing outside of the main avifauna breeding season is also recommended, if possible.

If development has the potential to cause a significant impact on any fauna species listed under the EPBC Act, the development proposal should be referred to the Federal Department of Agriculture, Water and the Environment.

Given the high number of mosquitoes known to occur at the site (Section 3.7.4), and that identified species are known to carry human health risks (Ross River Virus and Barmah Forest Virus), mosquito management is likely to be a consideration of future development approvals and site management. The SoM Mosquito LPP seeks to limit the impacts of mosquitoes associated with new developments. This may be potentially achieved through initiative such as:

- Construction practices to avoid the creation of new mosquito breeding sites, including from wheel ruts, depressions, or blocking drainage lines with spoil materials
- Stormwater management, including filling or levelling of low-lying areas where practical and ensuring infiltration drainage areas discharge within 96 hours
- Drainage and water holding infrastructure to be maintained in good condition to minimise breeding opportunities
- Avoid creating thick vegetation belts which assist mosquito harbourage and movement
- Lighting design to avoid attracting mosquitoes
- Employee notification and education regarding mosquito protection practices such as wearing clothing which covers arms and legs, use of repellents etc.

4.5.2 Further Investigations

Preparation of a Fauna Management and Relocation Plan may be a requirement of the Shire of Murray as part of the project approvals.

As noted above, if the proposed site development appears to potentially have a significant impact on a fauna species protected under the EPBC Act, referral of the project under this legislation should be undertaken.

Mosquito management, including a review of mosquito habitat mapping and monitoring, may need to be addressed in the Shire of Murray approval process to minimise risk to people involved in site development.

4.6 Contamination

Preliminary investigations have been conducted on site to determine the presence of contamination on the basis of historical land uses (Section 3.8).

4.6.1 Opportunities and Constraints

Failure to detect and remediate contamination from historical site activities may exacerbate the impacts to soil and groundwater following development. Contaminants may eventually leak into sensitive environments such as the Serpentine River.

4.6.2 Further Investigations

Based on results of a limited contamination assessment, no further contamination assessment appears necessary for Site 4.

5 Land Use Separation Requirements

EPA guidance on Separation Distances to Sensitive Land Uses (EPA, 2005) provides recommended setback distances to a variety of industry types and agricultural land uses. For composting facilities, a buffer distance ranges from 150 m – 1000 m, to limit impacts associated with noise, dust and odour (Table 6).

Table 6: Separation Distances between Industrial and Sensitive Land Uses

Land Use	Description	Impacts	Buffer Distance
Composting facility	Outdoor uncovered, regularly turned windrows	Noise, dust, odour	1000 m for manures, mixed food/ putrescible & vegetative food waste; 500 m for biosolids & 150 m for green waste
	Outdoor covered, turned windrows	Noise, dust, odour	750 m for manures, mixed food/ putrescible & vegetative food waste; 250 m for biosolids & 150 m for green waste
	Outdoor covered windrows with continuous aeration	Noise, dust, odour	500 m for manures, mixed food/ putrescible & vegetative food waste; 250 m for biosolids & 150 m for green waste
	Enclosed windrows with odour control	Noise, dust, odour	250 m for manures, mixed food/ putrescible & vegetative food waste; 150 m for biosolids
	In-vessel composting with odour control	Noise, dust, odour	150 m for manures, mixed food/ putrescible & vegetative food waste; 150 m for biosolids

As noted in Section 3.10, the closest sensitive premise (residential dwelling) to this site is located approximately 2 km southwest of the site.

6 Potential Environmental Approvals

6.1 DWER Works Approval and Licence

Industrial premises with potential to cause emissions and discharges to air, land or water are known as 'prescribed premises' and trigger regulation under the *Environmental Protection Act 1986*.

The *Environmental Protection Act 1986* requires an occupier of a premises who carries out work (constructs or alters infrastructure) which causes the premises to become a prescribed premises, to only do so in accordance with a Works Approval. A Works Approval authorises the construction of a prescribed premises and may also authorise emissions and discharges that occur during construction and commissioning.

The *Environmental Protection Act 1986* makes it offence for occupiers of prescribed premises to cause an emission from a prescribed premises, unless they hold a Licence for that premises. Licences contain conditions to protect the environment or public health from emissions from the premises.

The prescribed premises category 67A (as listed in Schedule 1 of the *Environmental Protection Regulations 1987*) is likely to be relevant to the composting facility (Table 7).

Table 7: Prescribed Premises Categories – Composting facility operations

Category Number	Description of Category	Production of Design Capacity
67A	Compost manufacturing and soil blending: premises on which organic material (excluding silage) or waste is stored pending processing, mixing, drying or composting to produce commercial quantities of compost or blended soils.	1000 tonnes or more per year

The composting facility will only trigger a prescribed premise category if it produces 1000 tonnes or more per year.

A works approval and licence is likely be required, including potential supporting studies in relation to noise, dust and odour, depending on the scale of the operation and proximity to sensitive receptors. In addition, reference should be made to "Guideline – Better Practice Composting" (DWER, 2020) in the development of the composting facility.

6.2 Shire of Murray Development Application – supporting environmental documentation

The Shire of Murray will likely require an assessment of the potential environmental impacts and proposed design and management strategies to address these impacts as part of the Development Application documentation package. As such, preparation of an Environmental Assessment Report (EAR) is likely to be required. In order to inform the EAR, the following studies may need to be progressed:

- Review of native vegetation clearing requirements and potential fauna impacts
- Review of wetland and hydrological impacts of the proposed development

Some or all of the following additional tasks may also be required as a condition of approval, if not requested up-front:

- ASS Investigation and possibly an ASS and Dewatering Management Plan
- Nutrient and Irrigation Management Plan
- Vegetation Management Strategy

- Fauna Management and Relocation Plan
- Mosquito Management Plan/commitments.

6.3 DWER Native Vegetation Clearing Permit

If native vegetation is required to be cleared for the construction or operation of the facility an application for a Native Vegetation Clearing Permit (NVCP) would be required to be submitted to DWER for assessment and approval, unless a valid exemption exists.

As part of the NVCP assessment process, DWER may ask for ecological survey information relevant to the site and for future vegetation management commitments or offset comments to be made.

6.4 DWER approvals for Groundwater Abstraction

If groundwater abstraction is required for the future operation of the site, an approval to construct a bore as well as a licence to take water will be required from DWER.

6.5 EPBC Act Referral

If the proposed development and operation of the site appears likely to have a significant impact on Matters of National Environmental Significance listed under the EPBC Act, referral of the project under this legislation would be recommended.

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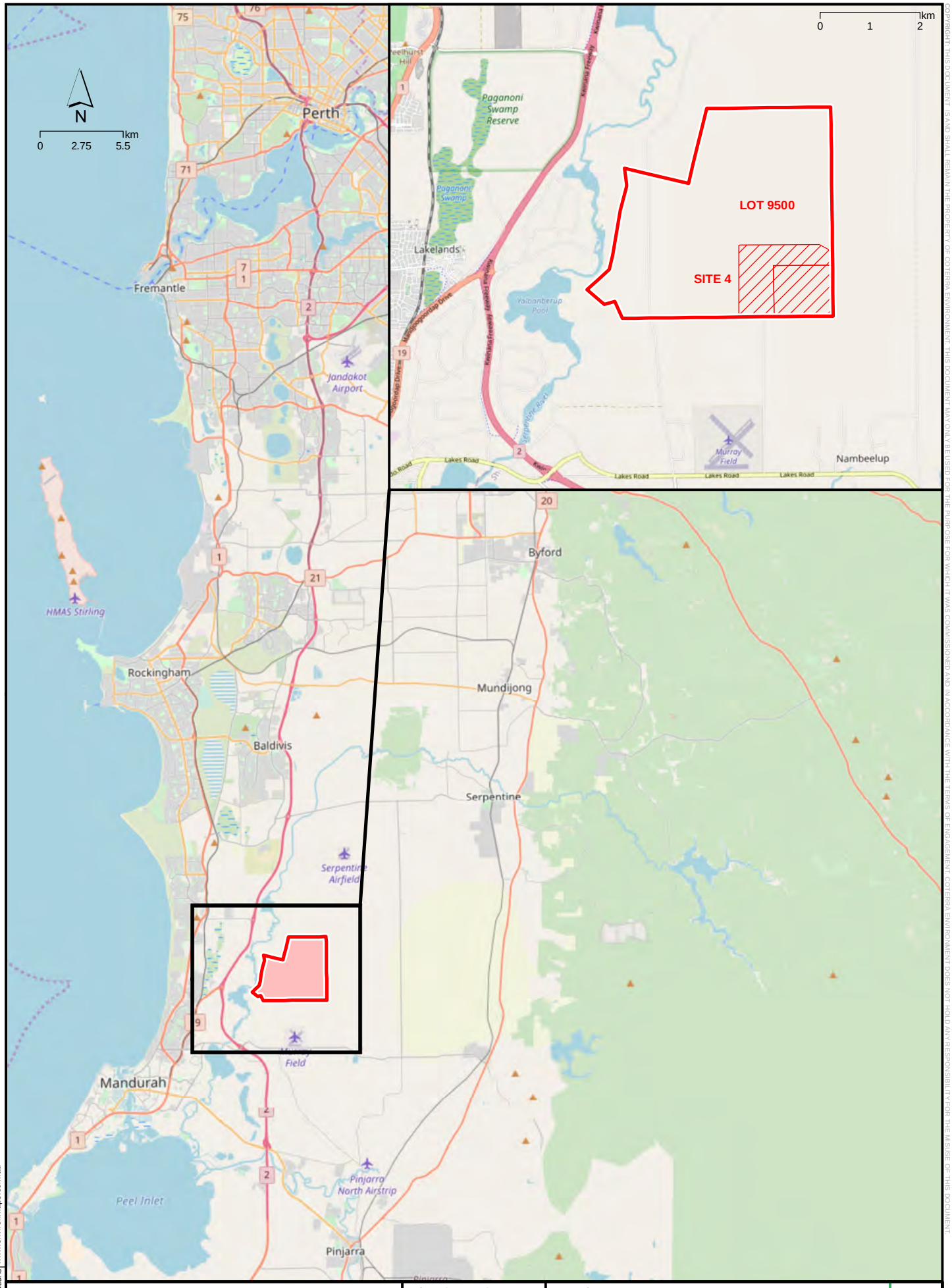
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Figures



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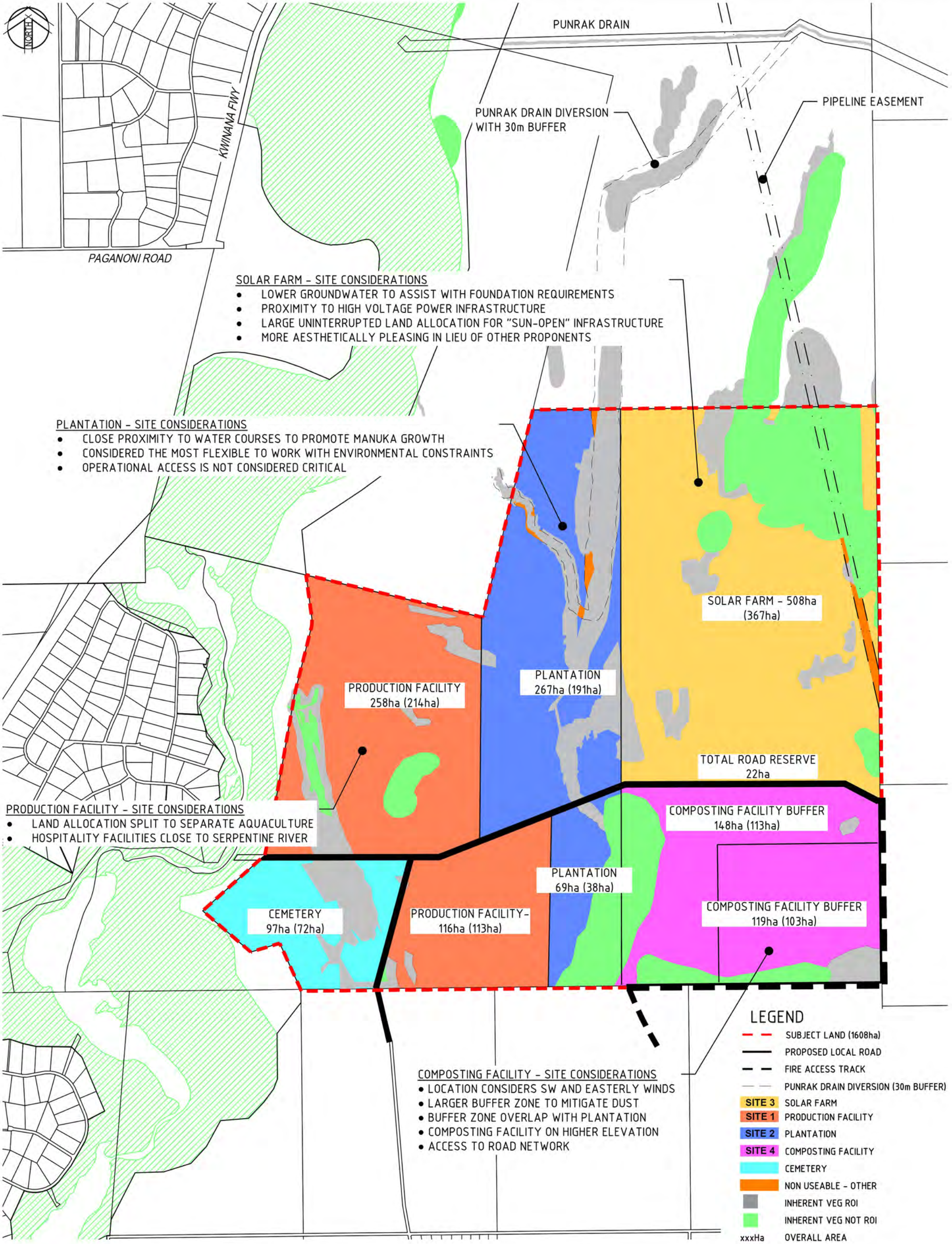
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Development WA
BASELINE ENVIRONMENTAL REPORT
320 GULL ROAD, KERALUP W.A. 6182

SITE LOCATION

Figure 1

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SCALE 1:25000m @A3

Source: Cardno, 01.02.20

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DEVELOPMENT SITE CONFIGURATION

Figure 2

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LEGEND

- Lot 9500
- Site 4
- Cadastre

N

0 125 250 500 750 1,000 m

Scale: 1:20,000 @ A3
GDA 1994 MGA Zone 50

KARNUP
KEYSBROOK
STAKE HILL
NAMBEELUP
LOT 9500
SITE 4
SITE 4
Kwinana Fwy
Guanarnup Pool
Summerhill Dr
Evergreen Loop
SERPENTINE RIVER
Lymon Rd
Serpentine Wy
Ibis Rtt
Yalbanberup Pool
Riverlands
Gull Rd
Yangedi Rd

Source: Cadastre - Landgate, 2021
Orthophoto - NearMaps, 04.01.21

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AERIAL PHOTOGRAPH

Figure 2

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LOCAL STRUCTURE PLAN

METROPOLITAN REGION SCHEME

LEGEND
- Lot 9500
- Site 4
- Cadastre

N

0 125 250 500 750 1,000 m

Scale: 1:30,000 @ A3
GDA 1994 MGA Zone 50

SPECIAL RURAL

Guanarnup Pool

SERPENTINE RIVER

SPECIAL RURAL

RURAL

SITE 4

SITE 4

SECONDARY ROAD

URBAN DEFERRED

PRIMARY ROAD

BUSH FOREVER

REGIONAL OPEN

RURAL

SITE 4

SITE 4

INDUSTRIAL

SPECIAL USE
KENNEL

SPECIAL USE VARIOUS
Landgate / SLIP

Source: MRS/LPS - DLPH
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 04.01.21

ENVIRONMAPS | t: 0406 590 006
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COTERRA ENVIRONMENT
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SITE LAND USE ZONING

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LEGEND

- Lot 9500
- Site 4
- Cadastre
- Contour (mAHD)

Acid Sulphate Soil Risk Mapping

- High to moderate risk
- Moderate to low risk

Soil Landscape Systems

- Bassendean System: Swan Coastal Plain from Busselton to Jurien. Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths.
- Pinjarra System: Swan Coastal Plain from Perth to Capel. Poorly drained coastal plain with variable alluvial and aeolian soils. Variable vegetation includes Jarrah, marri, wandoo, paperbark sheoaks and rudis.
- Spearwood System: Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/brown shallow sands.
- Vasse System: Poorly drained estuarine flats, of the Swan Coastal Plain. Tidal flat soil, saline wet soil and pale deep sand. Samphire, sedges and paperbark woodland.

N

0 125 250 500 750 1,000 m

Scale: 1:20,000 @ A3
GDA 1994 MGA Zone 50

LOT 9500

SITE 4

SITE 4

Bassendean System

Pinjarra System

Vasse System

Spearwood System

Guanarnup Pool

Yalbanberup Pool

SERPENTINE RIVER

KARNUP

STAKE HILL

NAMBEELUP

Kwinana Fwy

Summerhill Dr

Everglade Loop

Lymon Rd

Serpentine Wy

Ibis Rise

Gull Rd

Langedi Rd

Source: ASS Mapping - DWER
Contours - DPIRD
Cadastre - Landgate, 2021
Soil Landscape -Sytems DAFWA
Orthophoto - NearMaps, 04.01.21

ENVIRONMAPS | t: 0406 590 006
Environmental Mapping Solutions | www.environmaps.com.au

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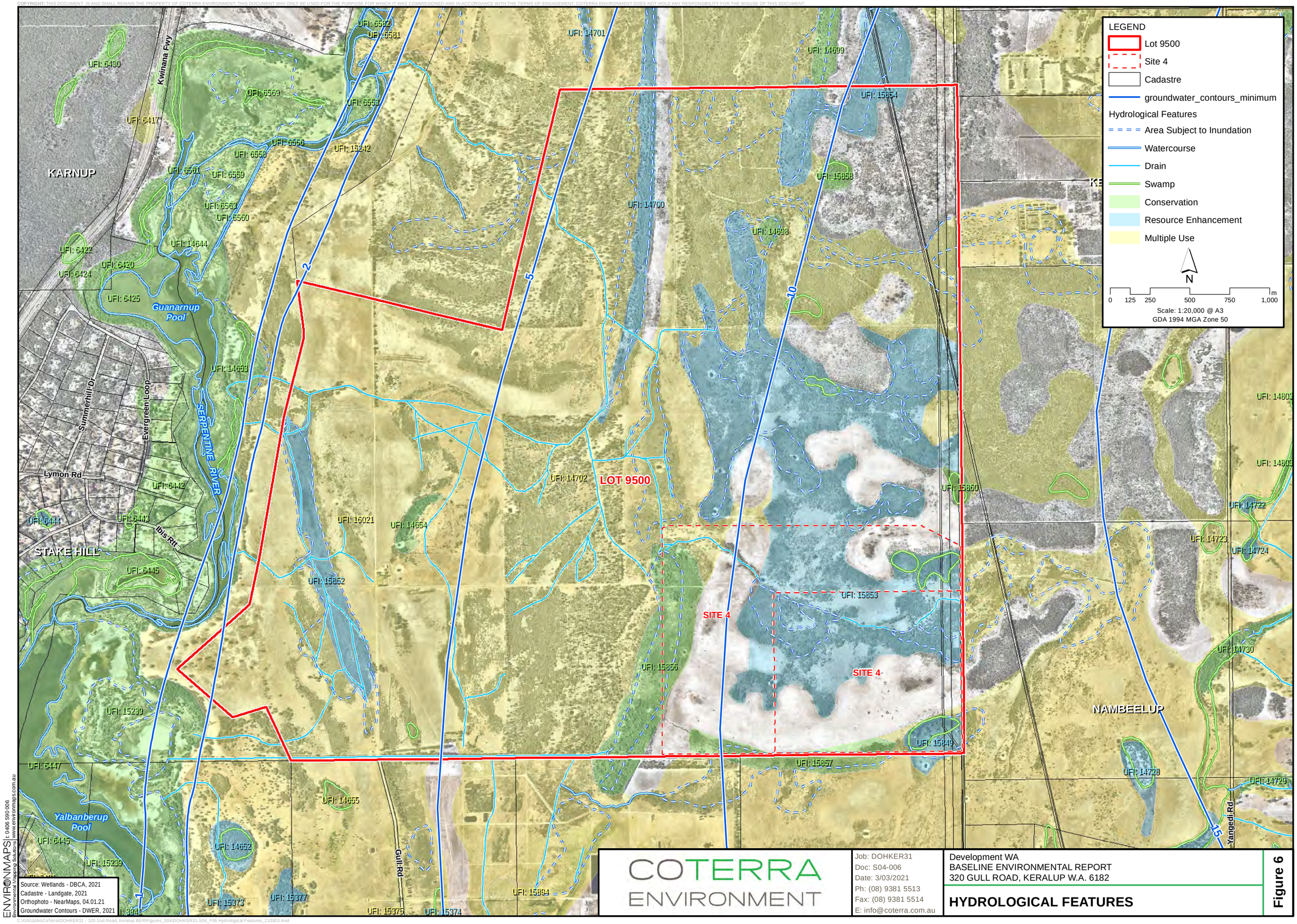
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TOPOGRAPHY, LANDFORM AND SOILS

Figure 5

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Source: Wetlands - DBCA, 2021
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 04.01.21
Groundwater Contours - DWER, 2021

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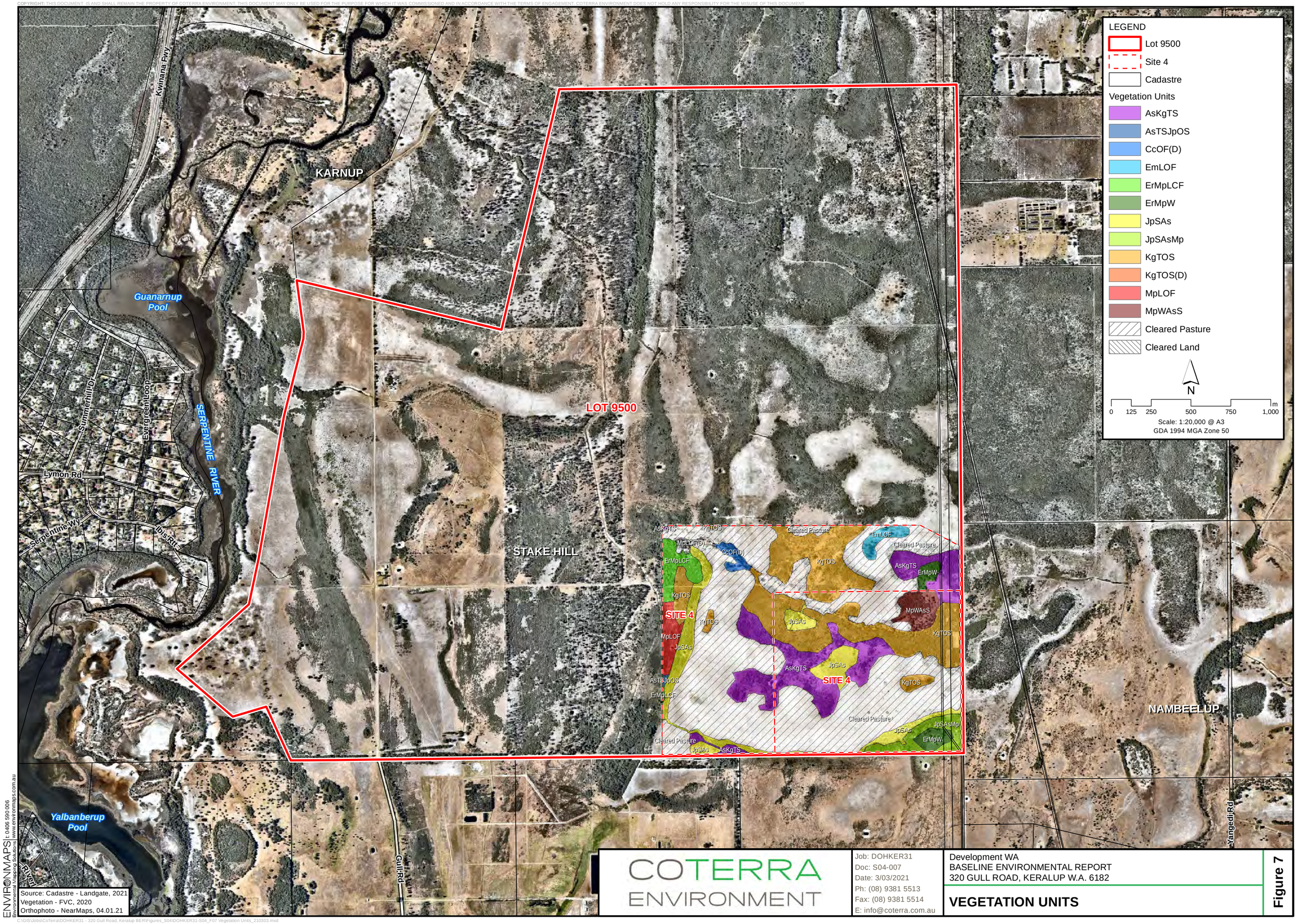
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HYDROLOGICAL FEATURES

Figure 6

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Source: Cadastre - Landgate, 2021
Vegetation - FVC, 2020
Orthophoto - NearMaps, 04.01.21

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Environmental Mapping Solutions | www.environmaps.com.au

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VEGETATION UNITS

Figure 7

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LOT 9500

SITE 4

SITE 4

Kwinana Fwy

Guanarnup Pool

Summerhill Dr

Evergreen Loop

SERPENTINE RIVER

Lymon Rd

Serpentine Wy

Ibis Rtt

Yalbanberup Pool

Gull Rd

Yangedi Rd

LEGEND

- Lot 9500
- Site 4
- Cadastre

Vegetation Condition

- VG-Ex
- (G-VG) Good to Very Good
- (G) Good
- (D-G) Degraded to Good
- (D) Degraded
- (D-CD) Degraded to Completely Degraded
- (CD) Completely Degraded

N

0 125 250 500 750 1,000 m

Scale: 1:20,000 @ A3
GDA 1994 MGA Zone 50

Source: Cadastre - Landgate, 2021
Vegetation - FVC, 2020
Orthophoto - NearMaps, 04.01.21

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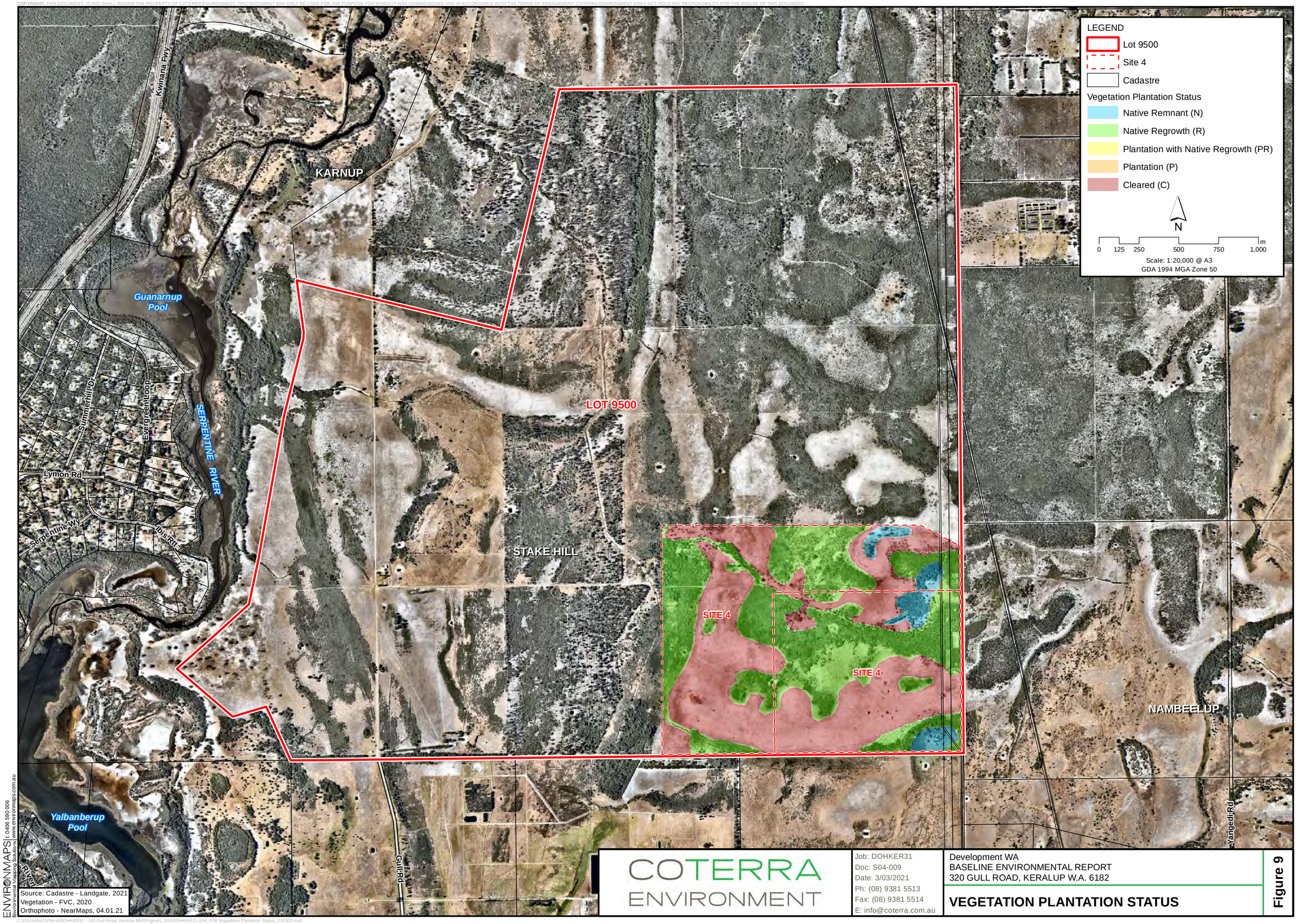
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VEGETATION CONDITION

Figure 8

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Source: Cadastre - Landgate, 2021
Vegetation - FVC, 2020
Orthophoto - NearMaps, 04.01.21

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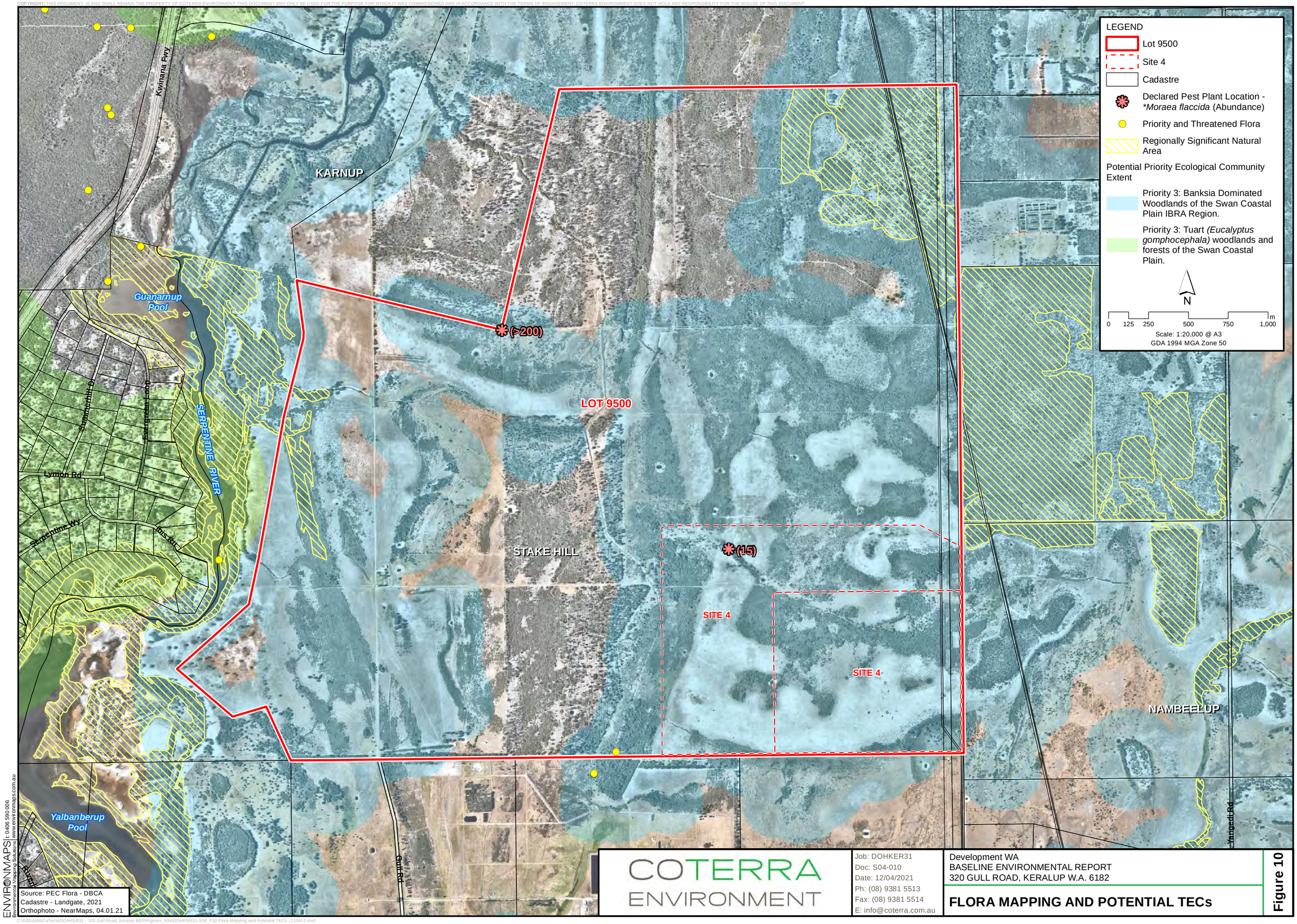
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VEGETATION PLANTATION STATUS

Figure 9

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Source: PEC Flora - DBCA
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 04.01.21

ENVIRONMAPS | 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

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FLORA MAPPING AND POTENTIAL TECs

Figure 10

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LEGEND

- Lot 9500
- Site 4
- Cadastre

Fauna Habitat

- Eucalypt woodland dry
- Eucalypt woodland wet
- *Eucalyptus globulus* plantation
- Melaleuca wetland
- Shrubland
- Paddock with *Juncus pallidus*
- Cleared paddock

N

0 125 250 500 750 1,000 m

Scale: 1:20,000 @ A3
GDA 1994 MGA Zone 50

LOT 9500

SITE 4

SITE 4

Kwinana Fwy

Guanarnup Pool

SERPENTINE RIVER

Summerhill Dr

Evergreen Loop

Lyndon Rd

Serpentine Rd

Ibis Bend

Yalbanberup Pool

Gull Rd

Bramley Rd

Yangedi Rd

Source: Cadastre - Landgate, 2021
Orthophoto - NearMaps, 04.01.21

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Environmental Mapping Solutions | www.environmaps.com.au

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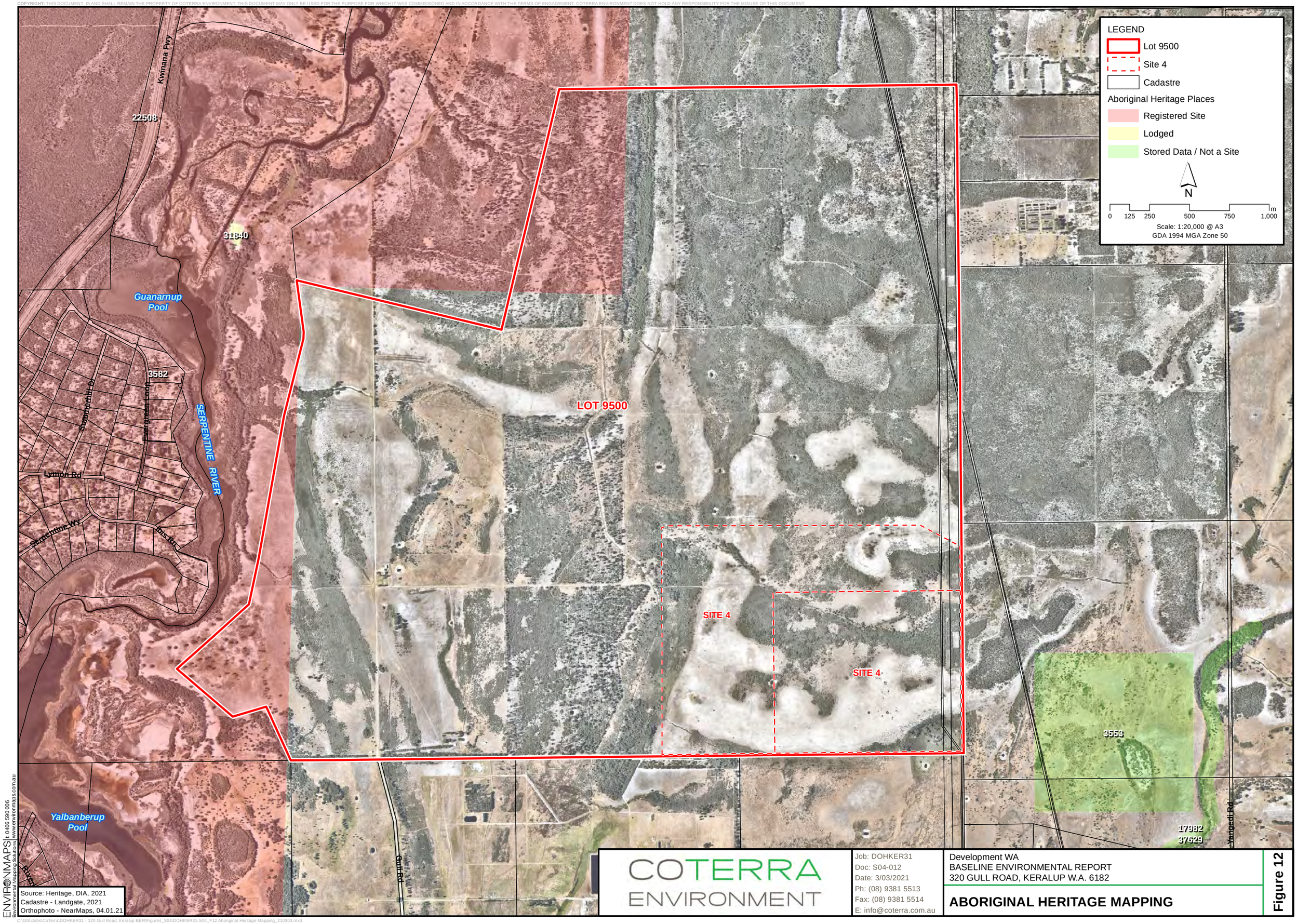
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FAUNA HABITAT

Figure 11

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Source: Heritage, DIA, 2021
Cadastre - Landgate, 2021
Orthophoto - NearMaps, 04.01.21

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Environmental Mapping Solutions | www.environmaps.com.au

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ABORIGINAL HERITAGE MAPPING

Figure 12

Appendix 1 EPBC Act Protected Matters Search Results

Australian Government

Department of Agriculture, Water and the Environment

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.

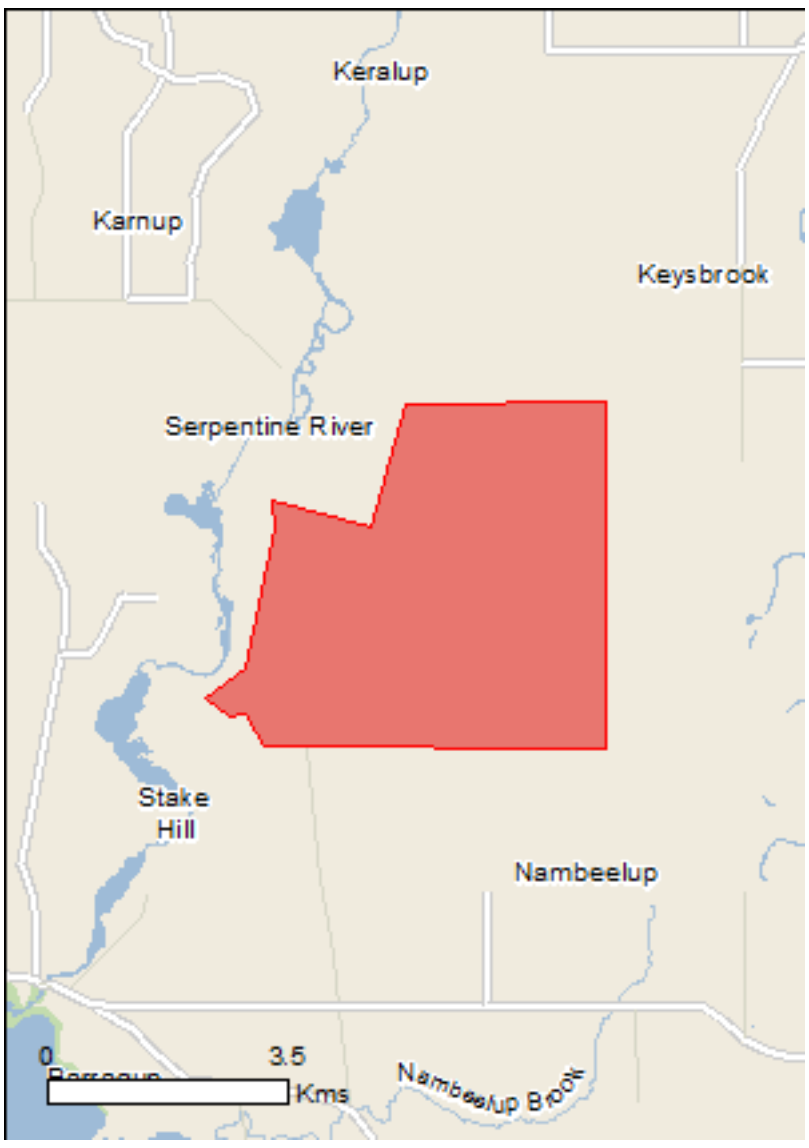
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/02/21 15:46:00

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

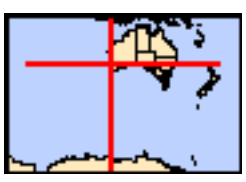
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

Buffer: 0.0Km



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:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	21
Listed Migratory Species:	10

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:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	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:	None
Regional Forest Agreements:	None
Invasive Species:	33
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Peel-yalgorup system	10 - 20km 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
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
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 likely to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	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
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sternula nereis nereis		
Australian Fairy Tern [82950]	Vulnerable	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
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area
Diuris drummondii		
Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely 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-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696)		
Selena's Synaphea [82881]	Critically Endangered	Species or species habitat may occur within area
Synaphea sp. Serpentine (G.R. Brand 103)		
[86879]	Critically 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 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 known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to 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 known to 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 likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

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 known to 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]		Breeding known 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 known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to 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 known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
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 likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

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 Resouces 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
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

Name	Status	Type of Presence
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
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
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

Name	Status	Type of Presence
		area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		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
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
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		
Hemidactylus frenatus 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

-32.444501 115.858095,-32.444646 115.857924,-32.482593 115.857924,-32.482449 115.813463,-32.478684 115.811232,-32.478973 115.809172,-32.476946 115.80591,-32.473905 115.811232,-32.458263 115.814837,-32.455366 115.814665,-32.458263 115.827539,-32.444646 115.831831,-32.444501 115.858095

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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Appendix 2 Acid sulfate soil investigation areas (extract from Coffey (2009a))

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

STAGE 1 OF THE PRELIMINARY ACID SULFATE SOIL INVESTIGATION - KERALUP

INTERPRETED SURFACE DISTRIBUTION OF ASS

FIGURE 4

RIVER ROAD
HENDERSON WEST ROAD
BORE 18
TP31
TP30 0.07
MB13
TP29
TP28
6 413 000mN
BORE 16
TP26
TP27
BORE 12
802
TP22
6 412 000mN
TP23 0.05
BORE 15
Lake Amarillo
TP36
BORE 6
TP24
TP25
TP35
TP19
TP20
TP21 0.05
BORE 2
TP33
TP18
801
TP34
River
TP32
6 410 000mN
BORE 4
TP16
TP15 0.04
TP17
BORE 20
Serpentine
TP14
BORE 5
6 409 000mN
BORE 14
TP10
TP12 0.2
TP13
Guanamup Pool
BORE 3
TP11 0.05
MB44
6 408 000mN
GULL
TP8
TP7 0.05
BORE 17
BORE 13
TP6
TP9 0.1
BORE 1
6 407 000mN
BORE 11
BORE 19
TP1 0.28
TP2
TP3
TP4
BORE 7
6 406 000mN
BORE 8
BORE 9
TP5 0.14
387 000mE
388 000mE
389 000mE
BORE 10
390 000mE
391 000mE
392 000mE
393 000mE

metres
0 250 500 750 1000
SCALE 1 : 25 000 @ A3

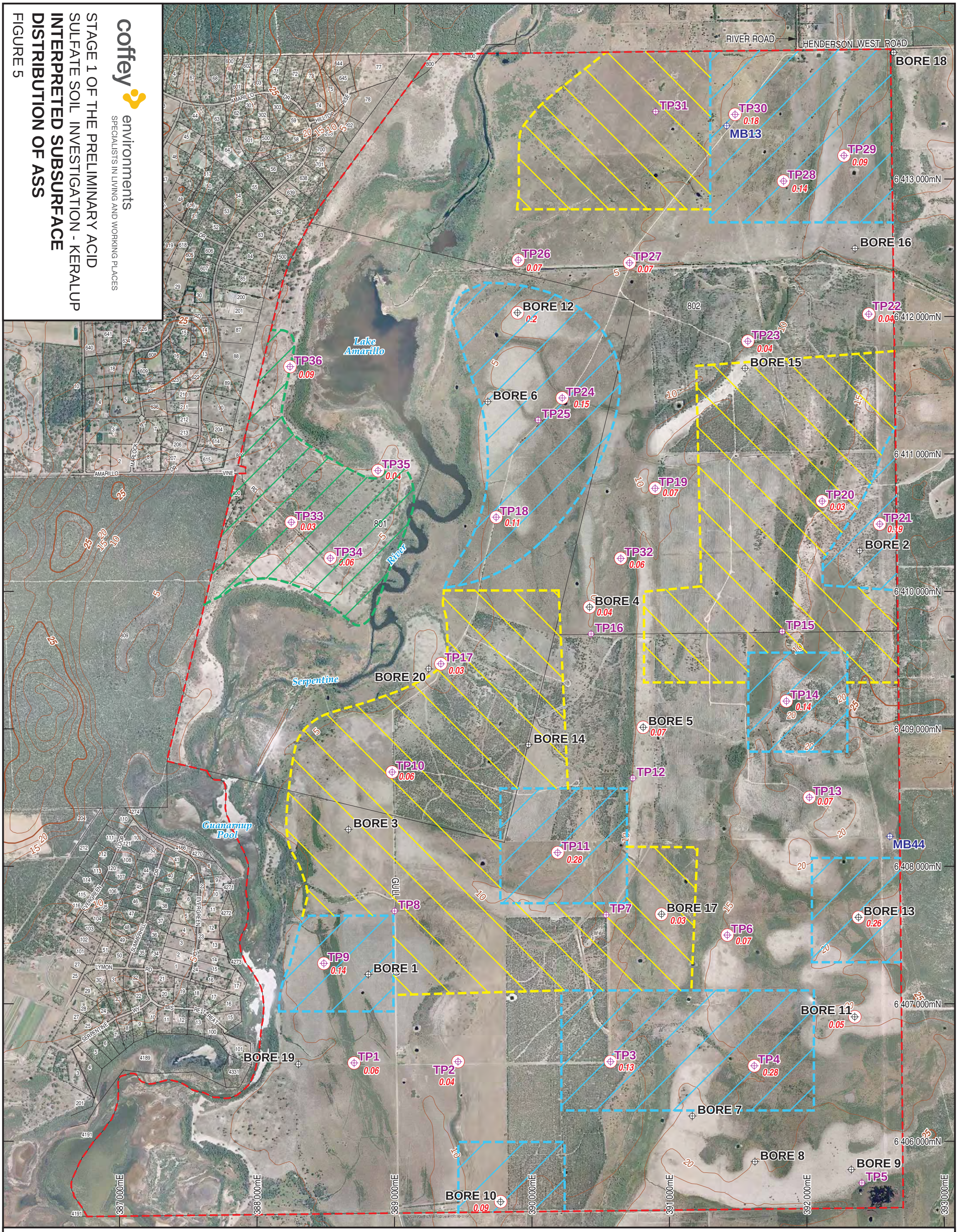
LEGEND

- Subject Land Boundary
- Cadastral Boundary
- Topographic Contour
- BORE 7 Endemic Soil Bore Location
- TP7 Coffey Soil Bore Location
- Stage 2 Investigation Required
- Surface ASS Present
- 0.14 Net Acidity of Surface Soil ($mgCaCO_3/l$)

AERIAL PHOTOGRAPH SOURCE: Landgate, SkyView, 2005.
TOPOGRAPHIC CONTOURS SOURCE: Auslig 1 : 50 000 Topographic Series.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

STAGE 1 OF THE PRELIMINARY ACID SULFATE SOIL INVESTIGATION - KERALUP
INTERPRETED SUBSURFACE DISTRIBUTION OF ASS
FIGURE 5



metres
0 250 500 750 1000
SCALE 1 : 25 000 @ A3

ASS SOURCE: DPI, 2007.

LEGEND

- Subject Land Boundary
- Cadastral Boundary
- Topographic Contour
- BORE 7 Endemic Soil Bore Location
- TP7 Coffey Soil Bore Location
- Surface ASS Present
- 0.14 Net Acidity (mean + std dev or geatest for hole) ($mgCaCO_3/l$)
- Stage 2 Investigation Required to Determine Extent of High NA Soils
- Recommended Stage 2 Investigation to Determine Extent of Low NA Soils
- Recommended Stage 2 Investigation for Western Area

Appendix 3 Baseline Environmental Report (Western Environmental, 2021)