Appendix A

Environmental Assessment and Management Strategy

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Environmental Assessment and Management Strategy

Alkimos Central Precinct Plan

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Executive Summary

This *Environmental Assessment and Management Strategy* (EAMS) has been prepared on behalf of Development WA. ('the proponent') to support the Alkimos Central Precinct Plan (PP). Located within the City of Wanneroo, the proposed PP applies to land within Lots 1 and 2 of Deposited Plan 419385,and part Lot 2000 of Deposited Plan 409771, located on Marmion Avenue in Alkimos (herein referred to as "the site").

This EAMS has been prepared to address the requirements of the Western Australian Planning Commission's (WAPC) *Structure Plan Framework* (WAPC 2015b) to support the preparation and implementation of the precinct plan. This EAMS provides a synthesis of information from a range of sources regarding the environmental features, attributes and values of the site.

The site comprises a total area of approximately 203 hectares (ha) and is primarily zoned 'Central city area' under the Metropolitan Region Scheme (MRS), with an 'Other Regional Road' and a 'Railway' running through the site. The site is currently zoned 'Centre' and is within a 'Special Control Area' known as Development Control Area 1 under the City of Wanneroo District Planning Scheme, No. 2., with regional open space to the north and east, Mitchell Freeway to the east, private landholdings to the south and Marmion Avenue to the west. The site is bisected by a rail corridor that is currently being developed by Public Transport Authority of Western Australia (PTA) for the purpose of the extension of the existing Butler passenger rail line to Yanchep as part of the State Government's METRONET project.

The relevant environmental attributes and values of the site are summarised as follows:

- A parabolic dune with geoheritage significance is located within the site.
- Acid Sulfate Soils and hydrology do not pose major environmental issues for the site.
- There are no recorded Rare or Priority listed flora species over the site.
- There are two potential Priority Ecological Communities (PECs) recorded over the site. These include FCT No. 24: Northern Spearwood shrublands and woodlands and FCT No. 29b: Acacia shrublands on taller dunes.
- Two small patches (0.83 ha) of a Threatened Ecological Community (TEC) were recently discovered in the site. This TEC is FCT 26a: Melaleuca huegelii - Melaleuca systena shrublands on limestone ridges.
- The site contains Carnaby's black cockatoo foraging habitat corresponding with areas of Banksia woodland.
- The majority of the site (approximately 69%) was determined to be in 'degraded' or 'completely degraded' condition. The vegetation in the south-eastern portion of the parabolic dune system is in 'very good' condition and represents the area of highest vegetation value within the site.
- No wetlands occur within the site.
- No registered Aboriginal heritage sites are mapped within the site. Place ID 37478 registered as 'stored data / not a site' occurs within the site and comprises limestone outcrops

(pinnacles) that are considered to have high cultural values. Other culturally significant features have also been identified within the site.
- Areas of extensive permanent bushfire hazard are located to the north, east and south of the site boundary. These hazards will be retained in the future, and therefore cannot be mitigated by any bushfire risk reduction required for the site.

The Precinct Plan (PP) design has responded to site-specific environmental considerations where necessary and possible, including accommodation of stormwater management requirements consistent with the Local Water Management Strategy (LWMS). The PP design provides for the future retention and revegetation of native flora, vegetation and fauna habitat values within the parabolic dune system, due to the geoheritage significance of the dune. Detailed design planning as part of future development stages will determine if any further retention of values is achievable.

This document provides an environmental management strategy to be implemented across the site for future subdivision and development stages. The key components of this management strategy are summarised as follows:

- Landform and soils: prepare Geotechnical Investigations to respond to karst features.
- Native vegetation: Implement Vegetation and Fauna Management Plan to manage vegetation and flora habitat. Refer a proposal under Section 38 of the *Environmental Protection Act 1986* to the Environmental Protection Authority (EPA) to allow for the assessment of TEC impacts.
- Native fauna: Fauna management protocols and actions will also need to be implemented prior to and during clearing activities, potentially through the implementation of a Vegetation and Fauna Management Plan.
- Hydrology: While there are no sensitive receptors or groundwater dependent ecosystems within the site, stormwater management requirements as outlined within the LWMS will be implemented through an Urban Water Management Plan (UWMP) for each stage of future subdivision.
- Heritage: the pinnacles site is to be retained and conserved through the alignment of public open space. Advice is to be sought from DPLH to determine whether any of the site's culturally significant location meet the any of the definitions in Section 5 of the *Aboriginal Heritage Act* 1972.
- Bushfire risks: To respond to the known bushfire hazards within and surrounding the site future development will be in accordance with the currently prepared BMP. This assumes that public open space (POS) within the site (excluding vegetation within the parabolic dune system) will be managed to a 'low threat' standard in accordance with the *Australian Standard 3959:2018 Construction of buildings in bushfire prone areas*. These bushfire hazards can be resolved in more detail as part of the subdivision process.

Overall, the environmental attributes and values of the site can be accommodated within the precinct plan design or can be managed appropriately through the future subdivision and development phases in line with the relevant state and local government legislation, policies and guidelines and best management practices.

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Introduction

1.1 Background

Development WA (the proponent) intend to progress an amendment to the existing Alkimos Central Structure Plan (Alkimos City Centre Structure Plan No. 89) within Lots 1 and 2 of Deposited Plan 419385, and part Lot 2000 of Deposited Plan 409771, located on Marmion Avenue in Alkimos (herein referred to as "the site"), in accordance with the proposed Activity Centre Plan, attached as **Appendix A**.

The site comprises a total area of approximately 203 hectares (ha) and is located approximately 39 km north-west of the Perth Central Business District (CBD), as shown in **Figure 1**. The site is bound by regional open space to the north and east, private landholdings to the south and Marmion Avenue to the west. The site is separate in the middle by a rail corridor that is currently being developed by Public Transport Authority of Western Australia (PTA).

The site is zoned 'Central city area' under the Metropolitan Region Scheme (MRS), with an 'Other Regional Road' and a 'Railway' running through the site (refer to **Figure 3**). The site is currently zoned 'Centre' and is within a 'Special Control Area' known as Development Control Area 1 under the City of Wanneroo District Planning Scheme, No. 2.

1.2 Purpose of this report

Emerge Associates was engaged by DevelopmentWA to prepare an Environmental Assessment and Management Strategy (EAMS) to support the Alkimos Central Precinct Plan (Precinct Plan). The Precinct Plan (PP) has been prepared as an amendment to the approved Alkimos City Centre Activity Centre Plan (ACP89). The EAMS replaces the previous environmental reports contained in ACP89 and provides an assessment of the potential environmental impacts that could arise from the proposed change in zoning/land use, and a strategy for the future environmental management of the site.

The Precinct Plan has been prepared by DevelopmentWA to support and guide Alkimos secondary centre. Following the approval of the Precinct Plan, development will be delivered through subdivision approvals and development applications, in a staged manner, in accordance with its layout.

The EAMS is the principal supporting environmental document for the PP amendment process, providing a synthesis of information regarding the environmental values and attributes of the site. It is consistent with the Western Australian Planning Commission's (WAPC) *Structure Plan Framework* (WAPC 2015b) and it:

- identifies and assesses the existing environmental values and attributes of the site (**Section 2**)
- discusses the land use planning context and the proposed PP (**Section 3**)
- discusses how the PP design responds to the existing environment and outlines the proposed future environmental management strategy (**Section 4**)
- describes how the environmental management strategy will be implemented (**Section 5**)
- summarises the PP's response to the existing environmental values and attributes of the site (**Section 6**).

1.3 Assessment scope

Emerge Associates were involved in the previous PP for the site and undertook a number of site-specific investigations to support this including:

- A Carnaby's black cockatoo habitat assessment (Emerge Associates 2013a).
- An update (Emerge Associates 2013b)) to the vegetation community and condition mapping based on the *Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information – Interpretation Report* by ATA Environmental (ATA Environmental 2005).

The results of these surveys have informed the design of the PP amendment.

In addition, Emerge Associates recently undertook updated Threatened Ecological Community (TEC) mapping for the site in late 2019, which has been incorporated into this assessment.

The EAMS has incorporated the outcomes of these investigations and assessments to provide an overarching environmental assessment. It documents the existing environmental attributes and values and ensures that significant values can be accommodated within the PP, and at future stages of development.

In addition to this EAMS, the following documents have been prepared or commissioned to support the PP:

- Local Water Management Strategy (LWMS) (Emerge Associates 2021b).
- Bushfire Management Plan (BMP) (Emerge Associates 2021a).
- Noise Assessment (Herring Storer Acoustics 2020).
- Aboriginal Heritage Survey (Moodjar Consultancy 2021).
- Archaeological survey (Dortch Cuthbert 2021).

2 Existing Environment

The outcomes of previously completed investigations, in addition to further site-specific targeted investigations undertaken by Emerge Associates, have informed the identification and assessment of the existing environmental attributes and values within the site and are discussed in further detail below.

2.1 Climate

The climate of the site (which applies to the wider Perth metropolitan region) is described as a Mediterranean climate, with hot, dry summers and moderately wet, mild winters.

Annual average temperatures in south-west WA have increased by 1.1°C between 1910 to 2013 (DPIRD 2020).

The majority of rainfall within the region occurs between May and October each year, and on average is between 600 to 1000 millimetres per year. Conditions between April to October have become drier across southwestern Australia. In the last 50 years there has been a marked decrease in rainfall (approximately 11 per cent decrease), with a noticeable shift to a drier climate across the south-west of Western Australia (BoM and CSIRO 2018).

The closest weather station to the site which records rainfall is at Tamala Park in Mindarie, situated approximately 12 kilometres south of the site. The annual rainfall at Tamala Park for 2017[1] and 2019 was 678.4 millimetres and 522.3 millimetres respectively. The annual average rainfall for the station is 594.8 millimetres per annum (BoM 2020). The monthly rainfall data for 2017-2019 and the monthly average has been summarised below in **Table 1.**

Table 1: Summary of rainfall for 2009 and 2010 and the average (2004-2012) at Tamala Park weather station (italicised data is not quality controlled)

Year	Rainfall in millimetres (mm)												
	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
2017	65.6	127.5	21.2	0.0	47.4	44.4	135.8	134.8	53.6	16.3	4.1	27.7	678.4
2018	114.1	0.0	1.0	N/A	54.5	155.6	119.1	154.6	22.2	*24.0*	4.6	4.4	N/A
2019	4.0	0.0	2.4	29.2	22.5	189.4	*108.3*	*117.3*	20.8	21.2	*5.8*	*1.4*	*522.3*
Average	19.6	16.5	20.6	38.1	81.7	109.1	117.6	107.0	61.1	29.9	21.8	9.6	594.8

[1] Rainfall for April 2018 and annual rainfall for 2018 was not available.

2.2 Landform and soils

2.2.1 Topography

The site has highly undulating topography due to the parabolic dunal system on which it lies. The site ranges in height from 29 m AHD to 55 m AHD. The southern arm of the parabolic dune runs from the north east through to the south west of the site. This dune ranges in height between 30 m AHD and 55 m AHD and has steep side slopes. The site has predominantly a northwest aspect on the windward side of the parabolic dune up to the parabolic dune. The leeward side of the parabolic dune varies from a south to a south easterly aspect. Topographic contours over the site are shown in **Figure 2.**

2.2.2 Soils and landforms

The site is located on the Swan Coastal Plain, which forms the central portion of the Perth basin. The Perth basin extends from the Darling Fault in the east to the continental slope west of Rottnest Island, and from the Murchison River in the north and the Southern Ocean in the south. The Perth basin is sedimentary in original and is marginal to the west of the Australian Shield (Seddon 2004).

The Swan Coastal Plain is generally flat and is approximately 20 to 30 kilometres wide, consisting of a series of geomorphic entities running parallel to the coastline. The youngest and most western of these geomorphic entities is the Quindalup Dunes, followed by the Spearwood Dunes and at the most eastern extent the Bassendean Dunes.

The site is situated within the coastal belt of the Swan Coastal Plain, within the Quindalup and Spearwood Dunes geomorphological units. A description of the soil-landform units present over the site is provided below in **Table 2**.

Table 2: Soil Landform Units (Churchward and McArthur 1980).

Soil Landform Unit	Description
Karrakatta Shallow Soils Phase (Ks)	Bare rock, yellow/brown shallow sands and stony soils
Karrakatta Sand Yellow Phase (Ky)	Yellow deep sands
Quindalup Second Dune Phase (Q2)	Calcareous sands with organic staining to about 20 cm, passing into pale brown sand; some cementation below 1m
Quindalup Deep Sand Flat Phase (Qp)	Dark grey brown sand to about 50 cm and then pale brown sand

The dominant landform units for the site are the Quindalup deep sand flat phase and the Karrakatta Sand Yellow phase. The Quindalup Second Dune phase is consistent with the parabolic dune formation through the site.

2.2.3 Geoheritage

The Australian Geological Society defines Geoheritage as "global to local features of geology that are intrinsically important sites or culturally important sites that provide information into the formation and evolution of the earth" (Brocx 2008).

The site contains a part of the Alkimos dune system. This dune system is a parabolic feature approximately 2 km wide which extends inland for 4 km. The Alkimos dune system was described by the Geological Society of Australia as an excellent example of a complex system of parabolic dunes of Holocene age belonging to the Quindalup system with national and international significance (EPA 2005). The system involves four Quindalup dune phases (Q1-Q4) which have been defined on the basis of profile maturity, soil development and vegetation cover. The site contains the Q2 dune phase which is the second oldest Quindalup system phase.

2.2.4 Geology

2.2.4.1 Environmental geology mapping

Environmental geology for the site has been mapped by the Geological Survey of Western Australia, Gozzard (1982). The site consists of limestone, sand and calcareous sand with the geological units listed in **Table 3** and shown in **Figure 4**.

Table 3: Environmental Geology (Gozzard 1982).

Geological Unit	Equivalent on Geological Maps	Description
LS1 - Limestone	Tamala limestone	Light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variable lithified, surface kankar, of eolian origin
LS4 – Limestone	Safety Bay Sand	Pale yellowish brown weakly cemented, friable, medium-grained, sub-rounded, quartz and shell debris, of eolian origin
S3 – Calcareous sand	Safety Bay Sand	As S2, occurs as relatively thick covering over LS1
S7 - Sand	Sand derived from Tamala limestone	Pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual origin

2.2.4.2 Karstic features

Karst features are known to generally occur within Tamala limestone. The CoW has produced the *Local Planning Policy 4.13 Caves and Karstic Features* (CoW 2018b), which has been prepared under the provisions of Section 8.11 of the *CoW District Planning Scheme No.2*. The purpose of the policy is to outline the information requirements required for investigation and management of caves and karstic features to assist in design, assessment and determination of structure plans, subdivision applications and development applications.

The karst assessment and risk map associated with this policy identifies areas of low and medium karst risk within the site. The management requirements for these karst risk levels at PP planning stage include a "Desktop Karst Survey" and a "Geotechnical Report".

2.2.4.3 Desktop geotechnical study

A desktop geotechnical study was completed by Douglas Partners for the site in 2012 (see **Appendix B**). This geotechnical study reviewed the environmental geology mapping discussed above (the Yanchep 1:50,000 Environmental Geology Sheet) for the site.

The results of the desktop geotechnical study indicate the ground conditions underlying the development site have a geological unit which has "common solution cavities and fissures" but is not known to have large karst features such as caves. Based on this information, Douglas Partners concluded that there was a very low susceptibility for development of large karst structures within the site and that the likelihood of karst formations impacting the proposed development is low.

2.2.5 Acid Sulfate Soils

Acid sulfate soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state, ASS are generally present in waterlogged and/or anoxic conditions and do not present any risk to the environment. ASS can pose issues when oxidised, producing sulphuric acid, which can present a range of risks for the surrounding environment, infrastructure and human health.

The Department of Water and Environment Regulation (DWER) provides broad-scale mapping indicating areas of potential ASS risk (Landgate 2020). A review of the DWER mapping indicates that the site has been classified as predominantly having no known risk of ASS occurring within three metres of the ground surface.

2.3 Biodiversity and natural area assets

2.3.1 Flora and vegetation

2.3.1.1 Regional context

The site lies within the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) region (Thackway and Cresswell 1995). The Swan Coastal Plain IBRA region is broadly compatible with the Swan Coastal Plain (Drummond Botanical Subdistrict) Phytogeographical Subregion as described by Beard (1990). This region is characterised by banksia low woodlands on leached sands, woodlands of tuart (*Eucalyptus gomphocephala*), jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) on less leached soils and *Melaleuca* swamps.

Vegetation complex mapping for the Swan Coastal Plain undertaken by (Heddle *et al.* 1980) indicates that two vegetation complexes occur within the site:

- Quindalup complex – Coastal dune complex consisting mainly of two alliances – the strand and fore dune alliance and the mobile and stable dune alliance. Local variations including the low closed forest of *Melaleuca lanceolata – Callitris preissii* and the closed scrub of *Acacia rostellifera*.
- Cottesloe complex Central and South – mosaic of woodland of *E. gomphocephala* and open forest of *E. gomphocephala – E. marginata – Corymbia calophylla;* closed heath on the limestone outcrops.

Based on Government of Western Australia (2018) approximately 60.49% of the Quindalup complex and 32.16% of the Cottesloe Central and South complex remains compared to the pre-European settlement. The figures for Cottesloe Central and South and Quindalup meet the generally accepted (best practice) 30% complex retention targets (Environment Australia 2001; EPA 2008). It is also greater than the 10% target which is the objective for "constrained areas" such as the Swan Coastal Plain portion of the Perth Metropolitan Region (the Bush Forever study area) in accordance with *Guidance Statement No. 33. Environmental Guidance for Planning and Development* (EPA 2008), and this is reflected in the *State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region* (Government of WA 2000a; WAPC 2010). Furthermore, both complexes have over 10% formally protected through DEC conservation estate and Bush Forever sites (PBP 2011). The vegetation complexes of the site are shown in **Figure 6**.

Within the City of Wanneroo, 14% of the pre-European extent of the Quindalup complex is protected and 21% of the Cottesloe Central and South complex (CoW 2018a)

2.3.2 Flora and vegetation survey

Flora and vegetation over the Alkimos – Eglinton DSP area has been surveyed numerous times including Trudgen and Keighery in 1990, Armstrong 1996, ATA Environmental in 2002 and later Bennett in 2004 (ATA Environmental 2005). The report entitled *Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information – Interpretation Report* (ATA Environmental 2005) provided detailed information to support the EPA assessment of the MRS amendment 1029/33. This was the only survey that covered the entire Alkimos – Eglinton amendment area.

A detailed field survey was conducted by Emerge Associates in October 2012 to verify the previously prepared vegetation association and vegetation condition mapping for the site. The survey involved visiting particular vegetation communities in varying vegetation condition and walking transects over the majority of the site to map changes in the vegetation associations and condition and determine the accuracy of the previously prepared mapping and to update at a finer mapping resolution that was specific for the site. The vegetation condition scale developed by Keighery (1994) and used in Bush Forever (Government of WA 2000a) was used for this assessment.

The flora and vegetation information described in this report is primarily sourced from the ATA Environmental (ATA Environmental 2005) with additional information from the Emerge Associates 2012 survey and 2019 TEC mapping.

2.3.2.1 Vegetation associations

Over 14 vegetation associations were identified over the site in ATA Environmental (2005) (ATA Environmental 2005), consisting of two broad groups, *Melaleuca* spp heath on dune systems or *Acacia* shrublands in lower lying areas and limestone. A site visit by Emerge Associates in 2011 and 2012 confirmed and updated the spatial extent of these vegetation associations.

The vegetation associations mapped by ATA Environmental (2005) and updated by Emerge Associates in 2012 are shown in **Figure 7**.

2.3.2.2 Vegetation condition

Vegetation condition over the site was recorded by ATA Environmental (2005) (ATA Environmental 2005) using the Bush Forever Vegetation Condition Scale(Government of WA 2000a). Emerge Associates visited the site in 2011 and 2012 and confirmed that the vegetation condition is generally consistent with that mapped by ATA Environmental (2005) (ATA Environmental 2005). The vegetation condition of the site based upon the 2012 site visit is shown in **Figure 8.**

Vegetation condition is variable over the site and the majority of the site is "Completely Degraded" or "Degraded" with remnant patches of "Very Good" and "Good" condition vegetation in the southern portion of the site. Large areas of the site have been historically grazed and have also been extensively impacted by recreational vehicles including four-wheel drives, quad bikes and trail bikes. Rabbits and weed invasion are also affecting the vegetation condition in this area. The parabolic dune formation ranges from "Degraded" to "Very Good" across its extent within the site.

2.3.3 Significant flora

Certain flora species that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

At a State level, plant species may also be classed as 'threatened' under the BC Act. Species which are potentially rare or threatened, or meet the criteria for near threatened, or have recently been removed from the threatened species list are classed as 'priority' flora species. However, priority flora species are not afforded statutory protection.

A search was conducted for threatened and priority flora within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2020), *NatureMap* (DBCA 2020) threatened and priority flora database. It is important to note that these do not consider the specific vegetation condition of the site in question but are based on the proximity of the site to known occurrences of significant species. These database search results were combined with the listed protected flora identified by ATA Environmental to form a comprehensive list of protected flora species which may occur over the site and are listed in **Table 4**.

Table 4: Conservation coded flora known to occur within the vicinity of the site based upon database searches and ATA Environmental (2005).

Species		Conservation Code[2]	
SCIENTIFIC NAME	COMMON NAME	FEDERAL	STATE
Acacia benthamii	-		P2
Andersonia gracilis	Slender Andersonia	E	
Anigozanthos viridis subsp. terraspectans	Dwarf Green Kangaroo Paw	V	
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)			P1
Caladenia huegelii	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	E	
Calectasia cyanea	Blue Tinsel Lily	CE	T
Centrolepis caespitosa	-	E	P4
Conostylis bracteata			P3
Conostylis pauciflora subsp. euryrhipis	-		P4
Conostylis pauciflora subsp. pauciflora	-		P4
Crassula colorata subsp. miriamae	-		P2
Diuris micrantha	Dwarf Bee-orchid	V	
Diuris purdiei	Purdie's Donkey-orchid	E	
Drakaea elastica	Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid	E	
Drakaea micrantha	Dwarf Hammer-orchid	V	
Eleocharis keigheryi	Keighery's Eleocharis	V	
Eucalyptus argutifolia	Yanchep Mallee, Wabling Hill Mallee	V	T
Fabronia hampeana	-		P2
Hibbertia spicata subsp. leptotheca	-		P3
Isopgoon uncinatus	Hook-leaf Isopogon	E	R
Jacksonia gracillima			P3

2 **Conservation Codes**
CE: Critically endangered
E: Endangered
V: Vulnerable
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
P1 - Priority 1
P2 - Priority 2
P3 - Priority 3
P4 - Priority 4
P5 - Priority 5

Table 4: Conservation coded flora known to occur within the vicinity of the site based upon database searches and ATA Environmental (2005).(continued)

Species		Conservation Code[3]	
Jacksonia sericea (Waldjumi)	Waldjumi		P4
Lasiopetalum membranaceum			P3
Lecania turicensis var. turicensis	-		P2
Lepidium pseudotasmanicum			P4
Leucopogon maritimus	-		P1
Leucopogon sp. Yanchep (M. Hislop 1986)	-		P3
Lepidosperma rostratum	Beaked Lepidosperma	E	R
Marianthus paralius			T
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	-	E	T
Pimelea calcicola	-		P3
Pithocarpa corymbulosa (Corymbose Pithocarpa)			P3
Sarcozona bicarinata	-		P3
Sphaerolobium calcicola			P3
Stylidium maritimum	-		P3
Tetraria sp. Chandala (G.J. Keighery 17055)			P2

In addition, ATA Environmental identified a number of locally significant flora species. Many of these species were found to occur widely over the Alkimos-Eglinton area. Based on vegetation associations, the following species may occur within the site.

- *Petrophile serruriae*.
- *Lechenaultia linarioides* (Yellow Leschenaultia).
- *Crassula colorata* (Dense Stonecrop).
- *Conospermum triplinervium* (Tree Smokebush).

A number of these species are recognised in Bush Forever (Government of WA 2000b) as significant flora of the Perth Metropolitan Region as they were either poorly reserved, significant populations or populations at the northern or southern limit of their known geographical range.

3 **Conservation Codes**
CE: Critically endangered
E: Endangered
V: Vulnerable
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
P1 - Priority 1
P2 - Priority 2
P3 - Priority 3
P4 - Priority 4
P5 - Priority 5

2.3.3.1 Threatened and Priority Ecological Communities

Generally, ecological communities can be described as vegetation communities that are assemblages of species that occur together in a particular type of habitat. An ecological community's structure, composition and distribution are determined by a range of environmental factors. 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a Commonwealth level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). TECs listed under the EPBC Act are categorised as either 'critically endangered', 'endangered' or 'vulnerable'. Any action likely to have a significant impact on a TEC listed under the EPBC Act (either critically endangered or endangered TECs) requires approval from the Commonwealth Minister for the Environment.

Within Western Australia, state-listed threatened flora and TECs are statutorily protected through the *Biodiversity Conservation Act 2016* (BC Act), and licences (or similar) may be required where these values are proposed to be disturbed or modified.

In addition to the BC Act, impacts to TECs are considered under the EP Act. The Environmental Protection Authority (EPA) produces environmental factor guidelines to outline how environmental factors are considered by the EPA in the environmental impact assessment. Under the flora and vegetation environmental factor guideline (EPA 2016) TECs are considered to be significant values, and approval may be required from the EPA in order to impact a TEC.

An ecological community under consideration for listing as a TEC in Western Australia, but which does not yet meet survey criteria or has not been adequately defined, or which is rare but not currently threatened, is referred to as a 'priority ecological community' (PEC). Whilst PECs are not afforded statutory protection in Western Australia, they are considered during the approval process.

FCTs for the vegetation associations occurring over the site were inferred by ATA Environmental (2005) (ATA Environmental 2005) with reference to FCT descriptions in Gibson *et al.* (1994) and Bush Forever (Government of Western Australia 2000). The following FCTs were inferred over the site:

- FCT No. 24: Northern Spearwood shrublands and woodlands.
- FCT No. 28: Spearwood *Banksia attenuata* or *B. attenuata* – Eucalyptus woodlands.
- FCT No. 29b: Acacia shrublands on taller dunes.
- FCT No. S11: Northern *Acacia rostellifera – Melaleuca systena* shrublands.

FCT 29 b and FCT 24 are recognised by the DPAW as PEC's, specifically Priority 3(i) PECs. In accordance with DPAW definition Priority 3 (i) PECs are those "that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation" (DEC 2010).

FCTs 24 and 28 can also form part of the Commonwealth 'banksia woodlands of the Swan Coastal Plain' TEC (herein referred to as the 'Commonwealth banksia woodland TEC'), which is listed as endangered pursuant to the EPBC Act. Whether a patch of vegetation is considered to represent the banksia woodland TEC depends on a number of diagnostic criteria including geographic location, soils, landform, structure, composition, condition and patch size (DoEE 2016). A detailed assessment

of the banksia woodlands TEC has not been undertaken for the site, given the site has an existing approval under the EPBC Act (discussed further in **Section 3.1.2**).

In addition, recent surveys of the PTA rail corridor (GHD 2018) revealed the presence of the state listed TEC *'Melaleuca huegelii - M. systena* shrublands on limestone ridges' within the site. This TEC which is listed as 'endangered' and is synonymous with the Gibson *et al.* (1994) floristic community type 26a '*Melaleuca huegelii – M. systena* shrublands of limestone ridges' and is hereafter referred to as the SCP26a TEC.

Emerge Associates undertook a detailed mapping exercise for the SCP26a TEC in late 2019 to ascertain the location and extent of the TEC. Subsequently two patches of the TEC were identified as shown in **Figure 7** totalling 0.83 ha and in 'excellent' condition.

2.3.4 Bush Forever

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

There are no Bush Forever sites occurring within the site. The Bush Forever sites that occur in the wider local area are shown in **Figure 9**. Bush Forever Site 139 (State Forest 65 Pinjar Plantation South Bushland) is located immediately east of the future Mitchell Freeway reserve which is on the site's eastern boundary.

2.3.5 Biodiversity Linkages

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004). These 500 m corridors link protected natural areas with other areas of native vegetation within the Perth Metropolitan Region and are intended to provide best practice guidance for biodiversity planning for local government's protection. These regional linkages are shown in **Figure 9**.

In addition, the City of Wanneroo's *Local Biodiversity Plan 2018/19 – 2023/24* (2018a) identifies local ecological linkages. A local biodiversity linkage has been located along the northern boundary and eastern boundaries of the site. The local biodiversity plan does not show any Local Natural Areas (LNAs) located within the site.

Both biodiversity documents provide a guide to assist local governments in planning for biodiversity and conservation. These are discretionary planning tools and have no strategic, statutory or policy context. These guidance documents should be considered in conjunction with and in balance with other state and local government policy.

2.3.6 Environmentally Sensitive Areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply within ESAs. However, exemptions under Schedule 6 of the EP Act still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* and clearing that was assessed as part of a formal assessment of a scheme amendment by the EPA.

The majority of the site is mapped as an ESA. This ESA is large and extends to the north of the site and is shown in **Figure 9.**

2.3.7 Terrestrial fauna

2.3.7.1 Historic fauna surveys

A vertebrate fauna survey of the Alkimos – Eglinton area was undertaken in October 1996 by Alan Tingay and Associates (Alan Tingay and Associates 1996). This survey included a trapping program using Elliott, pit-fall and cage traps as well as bird transect surveys, active searching and opportunistic observations. This survey recorded one amphibian, 18 species of reptile, 49 bird species and three native and three introduced mammal species across the entire Alkimos – Eglinton area. It was considered that the Alkimos - Eglinton area could support at least three frog species, more than 40 reptiles, over 80 birds and about 14 mammals, many of which are bat species.

Additional surveys were undertaken for the Alkimos Waste Water Treatment Plan (WWTP) in 2005, which is located west of Marmion Avenue and the site. This survey suggested that the WWTP site could support five frog species, 51 reptile species, 105 bird species and 22 mammal species.

Ecological Australia were engaged to undertake a Graceful Sun Moth Survey of the site in 2010 and 2011. This Graceful Sun Moth survey recorded the locations of the moth but since these surveys have been conducted, the Graceful Sun Moth was removed from Schedule 1 of the WC Act[4] and is no longer listed as Endangered under the EPBC Act 1999.

A survey of the site was also undertaken by Emerge Associates (2013a) to accurately determine the nature and extent of Carnaby's black cockatoo (*Calyptorhynchus latirostris*) foraging habitat and potential habitat trees. The site was systematically searched for foraging evidence and habitat trees (with a diameter at breast height of greater than 50 cm) of suitable species for Carnaby's black cockatoo. Foraging and nesting were recorded within the site. Observations were also made on the potential use of these trees by Carnaby's black cockatoo for nesting and/or roosting. An aboricultural survey by Paperbark Technologies (2014) located significant trees within the site, recording additional trees with a DBH greater than 50 cm providing potential habitat for black cockatoos

[4] As of 1st January 2019, the *Wildlife Conservation Act 1950* was repealed.

2.3.7.2 Fauna habitat types

The 1996 survey identified three broad habitat types within the Alkimos-Eglinton area being:

- Old Quindalup heath.
- Limestone heath.
- Banksia woodland.

ATA Environmental (2005) undertook a detailed fauna survey of the Alkimos-Eglinton area and identified several fauna habitats over the site. The habitats were classified based on the habitat type and condition. The majority of the site is degraded (69%) and provides minimal fauna habitat. The parabolic dune is classified as low open heath in good condition while remnant vegetation in the south eastern portion of the site provides a low woodland habitat.

2.3.7.3 Species of conservation significance

Certain fauna species that are considered to be rare or under threat warrant special protection under state and/or federal legislation. At a federal level, fauna species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

At a state level, fauna species can be classified as 'threatened' under the BC Act. In addition to this, DBCA maintains a list of priority fauna species which, while not considered threatened under the BC Act and therefore not protected directly, elicit some concern over their long-term survival.

To assess the potential for the site to contain specifically protected fauna species, the DBCA's *NatureMap* database and the DAWE *Protected Matters* database were searched. It is important to note that these searches do not consider the condition of the vegetation occurring on the site but are based on the proximity of the site to known occurrences of significant species. In addition, based on fauna surveys by Alan Tingay and Associates (1996) and ATA Environmental (2005), a number of species of conservation significance may occur within or potentially use the site. These significant species are listed below in **Table 5.**

Indicative habitat mapping for Carnaby's black cockatoo has been prepared by DEC (now DBCA) (DEC 2011) and updated vegetation mapping by (Emerge Associates 2013a) suggests that there is potential Carnaby's black cockatoo foraging habitat within the areas of banksia woodland. The field survey undertaken by Emerge Associates (2013a) recorded evidence of foraging by Carnaby's black cockatoo over the site. Foraging was recorded within the south eastern portion of the site and in areas on the leeward side of the parabolic dune (**Figure 10**). These areas contain open forests of *Banksia attenuata* and *Banksia menziesii* with *Eucalyptus marginata* and *E. todtiana* (which are also used for roosting) and areas of dense shrublands of *Banksia sessilis* and *Xanthorrhoea preissii.* A number of habitat trees (with a diameter at breast height greater than 50 cm) were also recorded at the site, particularly within the south eastern corner (**Figure 10**). This included trees of Coastal Blackbutt (*Eucalyptus todtiana),* Tuart *(E. gomphocephala)* and Marri (*Corymbia calophylla).* Although several habitat trees were recorded these trees did appear to have any hollows suitable for use by Carnaby's black cockatoo and there was no evidence of these trees being used for roosting or breeding.

Table 5: Species which may potentially use the site (based on database searches and (Alan Tingay and Associates 1996).

Species		Conservation Significance[5]	
Common name	**Scientific name**	**STATE**	**FEDERAL**
Mammals			
Western Brush Wallaby	*Notamacropus irma*	P4	
Western Brush Wallaby	*Macropus irma*	P4	
Chuditch, Western Quoll	*Dasyurus geoffroii*	S1	T
Water-rat, Rakali	*Hydromys chrysogaster*	P4	
Quenda, southwestern brown bandicoot	*Isoodon fusciventer*	P4	
Western Barred Bandicoot	*Perameles bougainville subsp. bougainville*	T	
Desert Bandicoot	*Perameles eremiana*	X	
Black-flanked Rock-wallaby	*Petrogale lateralis subsp. lateralis*	T	
Birds			
Common Sandpiper	*Actitis hypoleucos*		IA
Australian Lesser Noddy	*Anous tenuirostris subsp. melanops*	T	
Fork-tailed Swift	*Apus pacificus*		IA
Ruddy Turnstone	*Arenaria interpres*		IA
Boodie (inland), Burrowing Bettong (inland)	*Bettongia lesueur subsp. graii*	X	
Woylie Brush-tailed Bettong	*Bettongia penicillata subsp. ogilbyi*	T	
Sharp-tailed Sandpiper	*Calidris acuminata*		IA
Red Knot	*Calidris canutus*		IA
Curlew Sandpiper	*Calidris ferruginea*	T	
Red-necked Stint	*Calidris ruficollis*		IA
Long-toed Stint	*Calidris subminuta*		IA
Great Knot	*Calidris tenuirostris*	T	
White-tailed black cockatoo	*Calyptorhynchus sp.*	T	
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	S1	VU

5 **Conservation Codes**
CE: Critically endangered
E: Endangered
V: Vulnerable
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
P1 - Priority 1
P2 - Priority 2
P3 - Priority 3
P4 - Priority 4
P5 - Priority 5

Table 5: Species which may potentially use the site (based on database searches and (Alan Tingay and Associates 1996). (continued)

Species		Conservation Significance[6]	
Common name	**Scientific name**	**STATE**	**FEDERAL**
Carnaby's black cockatoo	*Calyptorhynchus latirostris*	T	EN
Peregrine Falcon	*Falco peregrinus*	S	
Caspian Tern	*Hydroprogne caspia*		IA
Bar-tailed Godwit	*Limosa lapponica*		IA
Southern Giant Petrel	*Macronectes giganteus*		IA
Rainbow Bee Eater	*Merops ornatus*		MIG
Osprey, Eastern Osprey	*Pandion cristatus*		IA
Grey Plover	*Pluvialis squatarola*		IA
Wedge-tailed Shearwater	*Puffinus pacificus*		IA
Graceful Sunmoth	*Synemon gratiosa*	P4	
Crested Tern	*Thalasseus bergii*		IA
Northern brushtail possum (Kimberley)	*Trichosurus vulpecula subsp. arnhemensis*	T	
Common Greenshan	*Tringa nebularia*		IA
Masked Owl (southwest)	*Tyto novaehollandiae subsp. novaehollandiae*	P3	
Reptiles			
Carpet Python (south-western spp.)	*Moreila spilota imbricata*	S4	
Black striped-snake	*Neelaps calontus*	P3	
Rottnest Island Dugite	*Pseudonaja affinis subsp. exilis*	P4	

6 **Conservation Codes**
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P1 - Priority 1
P2 - Priority 2
P3 - Priority 3
P4 - Priority 4
P5 - Priority 5

2.4 Hydrology

2.4.1 Groundwater

Information on the regional groundwater resources obtained from the DWER Water Register (DWER 2020c) indicates that the site is underlain by a multi-layered aquifer system comprised of the following resources:

- Perth - Superficial Swan
- Perth – Leederville
- Perth – Yarragadee North.

The *Perth Groundwater Map* (DWER 2020b) shows that groundwater levels across the site range from between 5 m AHD in the east to 2 m AHD in the west, with groundwater 34 – 44 m below the surface.

Groundwater monitoring has been carried out across the Alkimos-Eglinton DSP area with six rounds of monitoring undertaken between July 2010 and November 2011 including groundwater levels, as well as nutrient and metal analysis. The depth to groundwater ranged between 13 m to 40 m below the ground surface. Further information on groundwater levels and groundwater quality can be found in the LWMS for the site (Emerge Associates 2021b).

2.4.2 Surface water

There are no known surface water features associated with the site. The soils have a high infiltration capacity and there would be little to no surface run off except during extreme rainfall events.

2.4.3 Public drinking water sources

Public Drinking Water Source Areas (PDWSAs) are proclaimed by the Department of Water (DoW) to protect the quality of identified drinking water sources, which can be surface water or groundwater sources (DoW 2009). They are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947* as Water Reserves, Catchment Areas or Underground Water Pollution Areas (DWER 2019). PDWSA provide the community of Western Australia with the majority of its drinking water supplies and can be vulnerable to contamination from a range of land uses and water based activities (DWER 2019). Once an area is identified as a PDWSA consideration needs to be given to the intended land use and associated activities to ensure that they are appropriate in meeting the water protection quality objectives of the area.

The site is located within a Priority 3 PDWSA as part of the Perth Coastal and Gwelup Underground Water Pollution Control area.

Priority 3 PDWSA's areas are defined to *manage the risk of pollution* to the water source from catchment activities. Under the DoW policy (DWER 2019) it is expected that protection of P3 areas is achieved through guided or regulated environmental risk management for land use activities. Land uses considered to have significant pollution potential are generally opposed or constrained (DoW 2016).

The site also contains proposed Well Head Protection Zones (WHPZ) associated with drinking water and monitoring bores which are subject to restricted land uses in order to protect the water quality immediately surrounding extraction bores. WHPZ are circular with a radius of 300 m in P3 areas and are subject to special protection measures (DoW 2016).

The extent of the Priority 3 PDWSA and the WHPZ within the site are shown in **Figure 5**.

2.4.4 Wetlands

A review of the *Geomorphic Wetlands on the Swan Coastal Plain dataset* (Landgate 2020) indicates that there are no geomorphic wetlands within the site. Site investigations have confirmed that there are no wetland features on the site or wetland dependent vegetation types.

2.5 Heritage

2.5.1 Indigenous heritage

An online search for relevant Aboriginal heritage information was undertaken using the Department of Planning, Lands and Heritage's (DPLH) Aboriginal Heritage Inquiry System (AHIS) that incorporates both the heritage site register and the heritage survey database (DPLH 2020). The Aboriginal Heritage Site Register is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* (AHA) and contains information on over 22,000 listed Aboriginal sites throughout Western Australia.

the AHIS shows 'Other Heritage Place 37348 – Romeo Road Pinnacles' as located within the site. This area has the status of 'Stored Data/Not a Site'. The AHIS search also shows that an archaeological and ethnographic survey of the *Proposed Clarkson, Eglinton and Alkimos Housing Developments, North West Corridor* had been conducted for LandCorp in 1990 (DPLH 2020).

As part of a previous PP process, Ethnoscience was engaged to review ethnographic consultation and archaeological research in relation to the potential Aboriginal heritage values of the Alkimos City Centre PP area (Ethnosciences 2012). This confirmed that there are no known Aboriginal heritage sites within the site. However, further investigation has provided additional information on the Aboriginal heritage values now know to occur on the site.

An Aboriginal Heritage Engagement Strategy was undertaken by Gundi Consulting in 2020. This strategy included consultation with traditional owners in order to incorporate findings in the public realm design for Alkimos Central. During the site visit, the Pinnacles area located within the Romeo Road alignment was assessed as having significant meaning to the local *Nyoongar* people.

Additional surveys and reporting were carried out with regard to Aboriginal heritage values on the site in January 2021, following the acknowledgement that there are items of cultural significance within the site. Whilst no registered Aboriginal sites were identified in the Archaeological survey (Dortch Cuthbert 2021) three main points of interest were described including the pinnacles in and around Place ID 37478 (Stored Data/Not a Site), ancient soils potentially containing evidence of early Aboriginal occupation, and groves of culturally important plants.

An Aboriginal Heritage Survey (Moodjar Consultancy 2021) was carried out to engage the *Whadjuk* people in order to identify the significance of the Alkimos site with regard to the *Noongar* cultural

heritage. The Aboriginal Heritage Survey confirmed that the pinnacles, a small reed area and the sand dune systems and wooded area on the eastern side of the site, are of Nyoongar cultural significance.

There is potential that Aboriginal burials may be present in the parabolic dunes given the history and context of the site. The sands forming the Quindalup dunes contain a high shell content making them alkaline and potentially able to preserve bone, and they are loose and uncompacted making burial easier. Development of the site will need to accommodate the potential for finding skeletal remains and other items of Aboriginal significance.

2.5.2 Non-indigenous heritage

In order to determine the actual or potential presence of sites or features of non-indigenous heritage significance within the site, a review of readily available information at a federal, state and local government level was undertaken to determine if there were any of the following within the site:

- World Heritage Sites.
- National Heritage Sites.
- Commonwealth Heritage Sites.
- Sites on the Heritage Council of WA heritage register.
- Sites listed in the Local Municipal Inventory List.

Based on this review, there are no recorded non-indigenous heritage sites found within the site.

2.6 Bushfire

The site is identified within a 'bushfire prone area' on the state-wide *Map of Bush Fire Prone Areas* as prepared by the Office of Bushfire Risk Management (OBRM 2019), as shown in **Plate 1**. Strategic planning proposals, including precinct plans require a bushfire hazard level assessment under the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

A Bushfire Management Plan (BMP) (Emerge Associates 2021a) has been prepared to support the LPS amendment and PP which includes an assessment of vegetation within and surrounding the site to determine applicable bushfire hazards, in accordance with *Australian Standard 3959:2018 Construction of buildings in bushfire-prone areas (AS 3959),* and an assessment of the bushfire protection criteria outlined in the Guidelines. The BMP has determined that the future LPS amendment and PP can satisfy the requirements of SPP 3.7 and the Guidelines.

The BMP has considered the proposed environmental responses of the PP. The vegetation classified as 'scrub' within the dune ridge will remain a bushfire risk to future urban development. It has determined that the retention of these vegetated areas can be accommodated whilst still satisfying the requirements of SPP 3.7 and the Guidelines.

The anticipated environmental impacts of the PP, as outlined in **Section 4** have specifically considered any bushfire management requirements. No further environmental impacts (such as clearing of vegetation) beyond those outlined in **Section 4** will be required in order to implement urban development across the site, consistent with the PP.

This is discussed further in the BMP that accompanies the PP amendment (Emerge Associates 2021a).

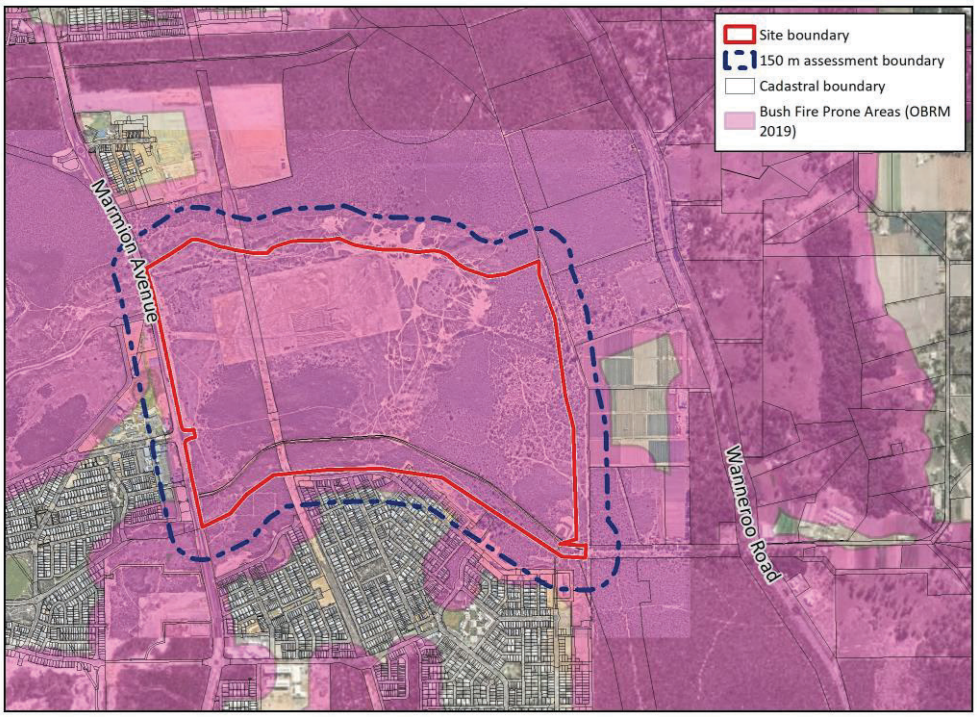

Plate 1: Areas within and surrounding the site identified as "Bushfire Prone Areas" (OBRM 2019).

2.7 Other land use considerations

2.7.1 Historic and existing land uses

Parts of the site have been historically grazed over a number of years prior to the purchase of the site by Development WA. Currently, the site is accessed illegally by recreational vehicles for off-road use, including four-wheel drives, quad bikes and trail bikes. In addition, accessible parts of the site have been subject to illegal rubbish disposal. Historical images provided by Landgate indicate clearing commenced at the site as early as 1974 with extensive land clearing from 1995). The extension of Marmion Avenue along the western boundary of the site and the construction of Romeo Road are both visible in 2008 images. From 2010 surrounding development and the construction of the WWTP west of the site is visible.

The site is also identified by the Department of Defence (DoD) mapping ('Where is UXO' map) available on the DoD website as having 'Slight' Unexploded Ordnance potential. The DoD defines *Areas categorised as slight will have a confirmed history of military activities that have resulted in residual UXO but which Defence considers it inappropriate to assess as substantial*'. This 'slight' UXO potential is recorded through the Butler-Jindalee and Alkimos-Eglinton area (DoD 2020).

2.7.2 Potential site contamination

The State government, through DWER has the overall responsibility for developing, administering and enforcing the *Contaminated Sites Act 2003* and its associated procedures. Part of this responsibility includes maintenance of the Contaminated Sites Database and Register. The

Contaminated Sites Database and Register holds information on known, previously or potentially contaminated sites within Western Australia. A search of this database and register indicated that the site is not listed. A review of aerial photography suggests that the previous land uses of the site are unlikely to have resulted in significant site contamination.

2.7.3 Surrounding land uses

The site is surrounded by land largely zoned "Urban" and reserved "Parks and Recreation" north of the site (**Figure 3**). Land uses to the east of the site include the future Mitchell Freeway extension, a long Parks and Recreation Reservation running north to south associated with Bush Forever Site No. 139 and rural zoned land primarily used for market gardens and turf farms.

West of the site across Marmion Avenue is the Alkimos WWTP reserved for "Public Purposes" under the MRS. An odour buffer of 450 to 600 m (based on specific odour modelling) has been provided for the Alkimos WWTP and is included within the "Public Purposes" reservation and "Urban Deferred" zoning.

3 The Proposal

3.1 Historical planning and environmental assessment context

3.1.1 Previous consideration by the Environmental Protection Authority

The site (and the wider Alkimos Eglinton area) was subject to MRS Amendment 1029/33 which was assessed by Environmental Review under Section 48A of the *Environmental Protection Act 1986* by the Environmental Protection Authority (EPA).

The EPA assessed a range of relevant environmental factors during the assessment of MRS Amendment 1029/33 including:

- Vegetation.
- Fauna.
- Odour.
- Geoheritage.
- Aboriginal heritage.
- Risk.

The EPA's assessment of Amendment 1029/33 considered the environmental values across the entire Alkimos Eglinton area. Environmental surveys were conducted by ATA Environmental (2005) to support the EPA's assessment. The EPA used this information to outline areas of regionally significant environmental value. This assessment was largely independent of the proposed reservations and zonings considered as part of the MRS amendment and resulted in areas being identified by the EPA as being "regionally significant" which were not accounted for within the original MRS amendment. The differences between the EPA's assessment and the original MRS amendment is shown as **Appendix C**.

In relation to the site, the EPA considered the parabolic dune a significant landscape/vegetation linkage. The environmental investigations undertaken as part of the Environmental Review determined the northern arm of the parabolic dune has high biodiversity and natural value as well as geoheritage significance. With this advice from the EPA, the northern arm of the dune was proposed to be retained as "Parks and Recreation" (immediately north of the site, located within the Central Alkimos PP area) which is also referred to as Regional Open Space (ROS).

Overall, the EPA's assessment resulted in changes to areas proposed to be reserved "Parks and Recreation" within the Alkimos- Eglinton area to that which was originally proposed by the WAPC. As a result of the EPAs recommendations areas of environmental significance were reserved for "Parks and Recreation". The MRS amendment was supported by the Minister for the Environment in 2006 through Ministerial Statement 722 (**Appendix D**).

3.1.2 Approval under the EPBC Act

The site was referred pursuant to the EPBC Act in 2015 for potential impacts on matters on national environmental significance (black cockatoo species). Approval under the EPBC Act for urban land uses over the site was granted in March 2017 (EPBC 2015/7561).

Approval was granted subject to a number of conditions, including:

- Preparation and implementation of a Construction Environmental Management Plan
- Preparation and implementation of a Park and Recreation Reserve management Plan
- Purchase of an offset property.

Future development of the site will need to implement the Construction Environmental Management Plan (Strategen Environmental 2019) to ensure compliance with the EPBC Act approval.

3.1.3 Alkimos - Eglinton District Structure Plan

The Alkimos – Eglinton District Structure Plan (DSP) provides the broad district level land use strategy for the area, and critically, over the site includes:

- The Alkimos secondary centre.
- The Alkimos train station.
- A high school.
- Opportunities for additional business, commercial and mixed-use development within the site.

The Alkimos – Eglinton (DSP) outlined a number of requirements relevant to be addressed at the structure planning stage including:

- PPs to include a Local Water Management Strategy that incorporates best practice water sensitive urban design principles and which is in line with the district water management design objectives and standards in the DSP.
- PPs to conserve and enhance local biodiversity through design facilitating the retention of significant natural features in POS areas, road reserves, social/pedestrian/cycle linkages or provide suitable justification otherwise.
- PPs to identify significant landscape features, such as ridge lines and dunal formations, and significant natural features, such as locally significant vegetation and fauna habitat and integrate these either within POS or with a suitably controlled and managed, highly landscape responsive form of development or provide suitable justification otherwise.
- PPs to investigate and facilitate interlinking recreational areas, environmental reserves, landscaped streetscapes and local POS to provide “stepping stones” from hinterland to the coast generally in accordance with the social/pedestrian/cycle linkages shown on the DSP.
- PPs to identify conservation areas, such as conservation POS, or passive open space with conservation function, and design these in such a way, so they remain viable.

The DSP also recommended the preparation of a number of environmental strategies to be prepared in conjunction with the PP including:

- Vegetation and Fauna Management Strategy.
- Local Water Management Strategy.
- Landscape Concept Plan.
- Open Space Strategy.
- Sustainability Strategy (in conjunction with PP).

The project team has acknowledged these strategies, and a number of these have been undertaken to support the PP. However, some of these studies require a greater level of detail then is available at the PP stage. Therefore, these will be prepared at future planning stages such as subdivision. This is further discussed in **Section 4**.

3.1.4 Alkimos City Centre Structure Plan

The previous PP for the site (Alkimos City Centre Activity Centre Structure Plan No. 89) was endorsed by the City of Wanneroo in March 2017 and approved by the WAPC in August 2018 following a long and detailed approval process.

3.2 Amendment to the Alkimos City Centre Activity Centre Structure Plan No. 89

The amendment to the Alkimos City Centre Activity Centre Structure Plan No. 89 has been designed to be a focal point for the local and wider community integrating civic, commercial, residential and retail areas to provide a diverse, multi-functional and mixed-use centre. The PP area includes a total land area of 203 hectares and proposed land uses include:

- Residential
- Mixed Use
- Retail
- Service Commercial
- Public Purpose (Primary School and shared oval and facilities)
- Public Open Space.

The proposed Activity Centre Plan for the site is attached as **Appendix A**.

3.3 Future planning and approvals

3.3.1 Environmental Protection Act 1986

As outlined in **Section 3.1.1**, the site was part of a previous Section 48A assessment for the historic MRS amendment over the site. However, this assessment did not include the recently discovered FCT26a TEC patch within the site (**Figure 7**), although the TEC was recorded in other areas of the MRS amendment.

Given this patch was not known at the time of the historic MRS Environmental Review, it is possible that the responsible authority may refer a future proposal under an assessed scheme under Section 48I of the EP Act.

3.3.2 Planning and Development Act 2005

Subject to approval and endorsement of the precinct plan by the City of Wanneroo and the WAPC, urban development of the site would be progressed through subdivision and/or development approvals (collectively referred to as 'future planning stages').

The key environmental values and attributes that will require further consideration as part of future planning stages have been outlined in **Section 4** of this report and include:

- karstic features
- native vegetation
- native fauna
- hydrology
- bushfire

The WAPC can impose conditions on subdivision applications to ensure subdivision incorporates all the appropriate environmental management measures. These conditions are usually determined in accordance with WAPC's *Model Subdivision Conditions Schedule 2017* and include those relating to environmental considerations. It is envisaged that there would be future subdivision conditions applied for any subdivision within the site, that would deal with environmental, hydrological and bushfire related requirements.

3.3.3 Aboriginal Heritage Act 1972

The Aboriginal Heritage Act 1972 (AH Act) provides protection for Aboriginal sites as defined under Act. The identification of culturally significant features on the site requires further consideration by DPLH to determine whether they are considered Aboriginal sites for the purpose of the Aboriginal Heritage Act. If they are determined to be Aboriginal sites, then a Section 18 application would need to be submitted and approved for the removal or disturbance of these features.

4 Environmental Assessment and Management Strategies

This section outlines the spatial response of the PP to the environmental attributes and values associated with the site and the environmental management considerations that will be required as part of future planning stages. Only those environmental values and attributes that require specific consideration based on their presence within the site, and/or applicable legislation and policy requirements are assessed.

4.1 Landform and soils

4.1.1 Policy framework, site context and management objectives

The City of Wanneroo's *Draft Local Planning Policy Caves and Karstic Features* (2012) (Draft LPP 4.13) outlines the City's information requirements for the investigation and management of caves and karstic features at the different planning stages. The site is within a low and medium Karst Risk area, and in accordance with the Draft LPP 4.13 the minimum requirements to support an PP are a Geotechnical Study and associated mapping showing the extent and severity of karst risk by reducing clearing and erosion risk.

A desktop Geotechnical Assessment by Coffey Geosciences (2006) has been completed for the Alkimos-Eglinton DSP area. A site-specific Geotechnical Study was prepared by Douglas Partners for the Alkimos City Centre site (**Appendix B**).

4.1.2 Precinct plan layout considerations for karstic features

The Geotechnical Study concluded that based on the available information there is a low risk of large karstic features within the site.

4.1.3 Future management strategies

The Desktop Geotechnical Study (2012) recommends that a site-specific assessment of possible karst features is undertaken as part of ongoing geotechnical investigation over the site. This would involve:

- Walk-over inspection by experienced professionals.
- Test pit and cone penetration tests as part of geotechnical investigations.
- Observations during bulk earthworks phase of the construction of the development.

Furthermore, this site-specific assessment is likely to be required as a condition of subdivision in accordance with Draft LPP 4.13 (CoW 2012).

4.2 Flora and vegetation

4.2.1 Policy framework, site context and management objectives

In the context of environmental impact assessments, the EPA's objective for flora and vegetation is '*to protect flora and vegetation so that biological diversity and ecological integrity are maintained'.* Where a proposal may potentially impact upon flora and vegetation values, the following mitigation hierarchy should be applied to minimise potential impacts:

1. **Avoid** impacts
2. **Minimise** impacts
3. **Offset** impacts

The majority of the site (69%) was mapped as being in 'degraded' to 'completely degraded' condition due to the historical use and clearing of the site. The balance of the vegetation is considered 'good' to 'very good'. One significant area of 'very good' condition vegetation will be retained in the southern portion of the parabolic dune POS, whilst the balance will be removed for residential development. There is one proposed POS adjoining the eastern edge of the dune POS that will retain some of the 'very good' vegetation but this will be modified to remove the bushfire hazard.

Native vegetation clearance will be required to implement the proposed PP amendment. The change in land use was considered by the EPA as part of the MRS amendment.

4.2.2 Precinct plan considerations for flora and vegetation

The retention of natural environmental values within the site was an important design consideration throughout the PP design process, and as a result the PP provides for the retention of significant environmental features.

The entire area of the parabolic dune system will be incorporated into POS. The southern area of the dune system contains vegetation in 'very good' condition. This vegetation is representative of a PEC and will be protected and enhanced through designation as POS. This area will be revegetated using locally native coastal plants.

The TEC FCT 26a is to be retained within future POS areas east and west of the railway line. The intention is to conserve the community by protecting against threats to its integrity including:

- Clearing
- Inappropriate fire regime
- Weed invasion
- Trampling/track creation.

Landscaping plans for the PP include the retention of the TEC vegetation with a retained native vegetation buffer around the TEC. Ideally, a non-vegetated path would then surround the vegetation buffer. Fencing will be installed to limit access into the TEC. The fencing, together with the path, will limit the incursion of invasive/non-native species and avoid animals (such as dogs, kangaroos, rabbits) and people entering the TEC. The fencing treatment should provide visual access whilst limiting physical access. Additional information on conservation fencing specifications will be sought

from the City. Interpretive signage is also an option to highlight the conservation significance of the vegetation and make the community aware of why they shouldn't enter the area.

4.2.3 Future management requirements

As outlined in the DSP (see **Section 3.1.3**), a vegetation and fauna management plan may be required to address impacts to flora and vegetation during construction and development. This is expected to be a condition of subdivision, cleared by the City of Wanneroo on advice of DBCA.

4.3 Fauna

4.3.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for terrestrial fauna is *'to protect fauna so that biological diversity and ecological integrity are maintained'.* The application of the mitigation hierarchy should be applied to avoid or minimise impacts to terrestrial fauna where possible.

The EPBC Act also provides protection for listed 'threatened' species, including black cockatoos. The site provides 95.84 ha of potential foraging habitat for three threatened black cockatoo species (Carnaby's black cockatoos, and Forest red-tailed black cockatoos). The development of the site and adjacent areas was referred to the federal government for assessment against the EPBC Act. The proposed development has been approved under the EPBC Act with conditions.

4.3.2 Precinct plan considerations for fauna

The retention of vegetation along the parabolic dune system should ensure that vegetation within the site continues to provide an ecological linkage to large areas of vegetation to the north of the site. Vegetation in the southern portion of the dune system is in 'very good' condition and has been identified for retention within the precinct plan. This retention of vegetation allows for the retention of functional fauna habitat.

4.3.3 Future management requirements

As outlined in the DSP (see **Section 3.1.3**), a vegetation and fauna management plan may be required to be prepared to address impacts to fauna during construction and development. This is expected to include fauna management protocols and actions prior to and during clearing activities and is expected to be a condition of subdivision, cleared by the City of Wanneroo on advice of DBCA.

In addition, a construction environmental management plan was prepared by (Strategen Environmental 2019) as a condition of the EPBC Act approval over the site. This management plan requires that any potential breeding trees are inspected prior to clearing, if clearing is undertaken during the breeding season for black cockatoos. If active black cockatoo nests are found within the site, the tree cannot be cleared until any fledglings have left the nest. The location of these tree, as recorded by Paperbark Technologies (2014) are shown in **Figure 10**.

4.4 Hydrology

4.4.1 Management objectives

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

The site is located within a Priority 3 PDWSA, as shown in **Figure 5.** The current policy framework requires that urban, industrial and commercial subdivision in Priority 3 PDSWA must be connected to reticulated sewerage (DPLH 2019a). This does not pose a constraint for the site, or the design of the PP. The land uses proposed within the site are compatible with Priority 3 areas in accordance with the land use capability table as outlined in *Water Quality Protection Note: Landuse Compatibility in Public Drinking Water Source Areas* (DoW 2016).

The principal management objectives for hydrology within the site is to ensure that the post-development environmental flows and/or hydrological cycles are maintained relative to pre-development conditions, and that water quality is maintained and/or improved with the aim of maintaining and restoring ecological systems. In relation to the site this will require infiltration of surface runoff on site up to the major event (1% annual exceedance probability (AEP)), and treatment of the small runoff event (first 15 mm).

4.4.2 Precinct plan layout considerations for hydrology

A local water management strategy (LWMS) has been prepared by Emerge Associates to support the PP, in accordance with the requirements of State and local planning policies. The LWMS provides a framework for the future delivery of a best practice approach to integrated water cycle management utilising WSUD principles. The LWMS includes detailed management approaches for groundwater, stormwater, and water conservation and supply.

Stormwater management at the site will include the retention and infiltration of surface runoff (up to the major event) in lot soakwells, tree pits, raingardens, median/verge swales, bio-retention areas and flood storage areas. The use of vegetation in surface structures will provide treatment of runoff, as well as infiltration through the underlying soil profile.

Depth to groundwater varies between 29 m to 41.0 m below the natural surface. The main objective for the management of the groundwater quality is to maintain the existing groundwater quality. This will be achieved by treating surface runoff prior to infiltration via application of appropriate WSUD measures (as discussed above), thereby reducing the total nutrient load into the groundwater that originates from the development. The retention and infiltration of surface runoff will also assist in recharging the superficial aquifer.

Fit for purpose water use principles will be applied using non-potable supply sources for irrigation of public open space areas. Initially the supply will use groundwater for which an allocation has been approved sufficient for the development. Emerge Associates understands that a wastewater recycling scheme is still being negotiated with the CoW and the Water Corporation to provide an

alternative non-potable source to developments in Alkimos. Until this source is available for use, groundwater will be provided for non-potable irrigation uses.

Water conservation for the development will include the use of waterwise garden (WWG) principle in all POS areas, installation of water efficient fittings in all new properties, and education and promotion of water efficient fittings and appliances and WWG to the local community to reduce overall lot usage.

4.4.3 Future management requirements

Within the areas identified as WHPZ, by-laws pursuant to the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* may prohibit, restrict or approve defined land uses to prevent water source pollution and contamination. The broad land uses identified in the PP are compatible with these WHPZ.

The LWMS provides for the environmental management framework for groundwater and surface water within the site.

It is anticipated that environmental condition D2 of the WAPC's *Model Subdivision Conditions Schedule* 2017 will be attached to all subdivision approvals, requiring the preparation of an urban water management plan (UWMP) which states:

Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water, consistent with any approved Local Water Management Strategy. (Local Government).

Generally, an UWMP will address the following considerations:

- The detailed drainage design
- Imported fill specifications and requirements
- Implementation of water conservation strategies
- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program
- Status of groundwater abstraction license.

4.5 Heritage

4.5.1 Policy framework, site context and management objectives

The *Aboriginal Heritage Act 1972* (WA) is the primary legal instrument used to manage impacts on Aboriginal heritage in Western Australia. The EPA also provides the *Environmental Factor Guideline Social Surroundings* to detail how this element is considered during environmental impact assessment under the EP Act.

All Aboriginal Heritage Sites, whether known or unknown, are protected under the *Aboriginal Heritage Act 1972* (AH Act). Permission under Section 18 of the AH Act is required to impact or disturb any Aboriginal heritage site.

No registered Aboriginal heritage sites have been identified on the site, though the Pinnacles area is included as 'Other Heritage Place 37348 – Romeo Road Pinnacles' with the status of Stored Data/Not a Site. However, features have been identified on the site that are of Nyoongar cultural significance. There is also the potential to uncover additional items of significance including skeletal remains, due to the undisturbed state of the site, the presence of features of cultural significance, and the type of soils present.

4.5.2 Precinct plan considerations for heritage

The Alkimos Pinnacles of significant heritage value are located due east of the existing Marmion Avenue and Romeo Road intersection and immediately west of the Rail Corridor. The amended PP layout has realigned Romeo Road to deviate south around the Alkimos Pinnacles with sufficient separation to allow the Pinnacles to be retained within future public open space. This allows for the cultural heritage values to be conserved and highlighted within the future community.

4.5.3 Future management requirements

Advice is to be sought from the Department of Planning, Lands and Heritage to determine whether any features identified during survey would be considered an Aboriginal site as defined by the AH Act. In the event that any of the culturally significant features area determined to be Aboriginal sites, an application would need to be made under Section 18 of the AH Act if disturbance of the site/s is proposed.

'No-go' areas will be established within 20 m of the pinnacles using stake and bunting fencing installed prior to clearing to ensure the 'no-go areas' are visible. This fencing method is proposed as it has minimal impact on the environment and allows fauna movement through vegetation.

Suspected Aboriginal skeletal remains should be professionally assessed, initially without removing them, in consultation with Aboriginal community representatives, the police, and DPLH.

The following recommendations were made by the supporting archaeological and cultural survey reports:

- The area of the pinnacles should be mapped with the additional ethnographic commentary recorded (Palmer 2021), the additional heritage information could then be submitted to DPLH for reconsideration of the area of pinnacles as an Aboriginal heritage site.
- Prior to any ground-disturbing work, suitably experienced Noongar people should be engaged to monitor the works in case sub-surface heritage material is inadvertently unearthed. An archaeologist should also be engaged on a call-out basis should monitors require further assessment of any suspected heritage material.
- Protection of mature trees should be considered wherever possible.
- An Aboriginal Cultural Heritage Management Plan or similar should be developed, before ground disturbance occurs, to allow for culturally appropriate management of any discoveries of suspected or actual heritage material.
- The Aboriginal Cultural Heritage Management Plan should include a requirement that site inductions include the legal requirement to avoid disturbance to any Aboriginal site as defined in the *Aboriginal Heritage Act 1972* (Western Australia), whether registered or otherwise, and that disturbance of a site includes ground disturbance, souveniring or defacement.

4.6 Bushfire

4.6.1 Policy framework, site context and management objectives

State Planning Policy 3.7 Planning in Bushfire Prone Areas (WAPC 2015a) stipulates that any development proposal which occurs partly or wholly within a bushfire prone area is required to be accompanied by a bushfire management plan. The preparation of the BMP is required to incorporate the following tasks:

- Classification of existing vegetation types within the site and surrounding 100 m, in accordance with *Australia Standard 3959-2018 Construction of buildings in bushfire-prone areas* (AS 3959) (Standards Australia 2018).
- Assessment of bushfire hazard levels within the site and surrounding 150 m, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017).
- Assessment of effective slope under areas of classified vegetation.
- Completion of an indicative Bushfire Attack Level (BAL) assessment and preparation of an associated BAL contour plan.
- Assessment of the precinct plan design against the bushfire protection criteria, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017).

Policy objective 5.4 of SPP 3.7 specifies that development is required to:

'achieve an appropriate balance between bushfire risk management measures and biodiversity conservation values, environmental protection and biodiversity management and landscape amenity'.

This policy objective ensures that future development appropriately considers the bushfire risks and provides appropriate separation from any identified risks without negatively impacting existing environmental values.

The majority of the vegetation within the site will be removed to facilitate future development, in order to achieve low threat classification in accordance with Section 2.2.3.2 of AS 3959.

All vegetation will be retained within the parabolic dune system POS and revegetated to a 'scrub' standard. These areas of vegetation within the site have been assumed to remain in their current state in the future and will pose a long-term bushfire hazard within the site. Recreational POS 'nodes' are assumed to be managed to a 'low threat' standard.

External to the site, the WAPC-owned ROS is expected to be allowed to regenerate to a 'scrub' classification.

The principal management objective for the bushfire risk to the site is to ensure that the risk to future dwellings is appropriately minimised without negatively impacting on environmental values within or surrounding the site.

4.6.2 Precinct plan considerations for bushfire management

The site is suitably sized to accommodate the minimum separation distances required to achieve BAL-29 or less for future habitable buildings from classified vegetation within and surrounding the site through the provision of public roads, public open space, and in-lot setbacks.

There are no constraints to meeting the bushfire compliance criteria outlined in the *Guidelines for Planning in Bushfire Prone Areas version 1.3* (WAPC and DFES 2017).

Further discussion in this regard is provided in the BMP that accompanies the PP (Emerge Associates 2021a).

4.6.3 Future management requirements

As outlined in the BMP, development within 100 m of classified vegetation will require a BAL assessment to be completed as part of subdivision and certified prior to dwelling construction. This BAL assessment will inform the requirement for increased construction standards in accordance with AS 3959, which will then be implemented through the building licence process. An indicative BAL assessment has been completed as part of the BMP and indicates that building footprints within lots will be subject to BAL ratings of BAL-29 or less.

As part of future subdivision and development, roads will be provided to support two access routes, hydrants will be constructed and public open space will typically be implemented and maintained as 'low threat' in accordance with Clause 2.2.3.2(f) of AS 3959.

Where public open space areas are landscaped (outside of conservation areas), these areas will be managed to a 'low threat' standard. Management of vegetation to a low threat standard includes:

- Clearing of vegetation.
- Irrigation of grass and garden beds (where required).
- Regular maintenance including removal of weeds and dead material.
- Low pruning of trees.
- Application of ground covers such as mulch or non-flammable materials.
- Regularly mowing/slashing of grass to less than 100mm in height.

4.7 Acoustic Impacts

4.7.1 Policy framework, site context and management objectives

Statement of Planning Policy 5.4 *Road and Rail Noise* (SPP 5.4) (DPLH 2019b) guides the process to determine compliance of noise sensitive developments when located near a major road and/or rail infrastructure.

The outdoor noise criteria are shown below (**Table 11**). These criteria apply at any point 1-metre from a habitable facade of a noise sensitive premise (residential, school and aged care) and in one outdoor living area. These levels are separated into a "target" and a "limit" for both day and night. The "target" provides and objective noise level for the site, whereas the "limit" is the noise level that cannot be exceeded.

Table 6: Noise Criteria in accordance with State Planning Policy 5.4 (DPLH 2019b)

Period	Noise limit (External)	Noise limit (Internal)
Day (6am – 10pm)	55 dB $_{LAeq\ (day)}$	40 dB $_{LAeq\ (day)}$
Night (10pm – 6am)	50 dB $_{LAeq\ (night)}$	35 dB $_{LAeq\ (night)}$

Noise received at an outdoor area should also be reduced as far as practicable, with an aim of achieving an LAeq (night) of 50 dB(A).

An acoustic assessment was conducted by Herring Storer Acoustics in July 2012 and updated in July 2020 and July 2021 to determine the expected noise impacts from Marmion Avenue, Mitchell Freeway and the Northern Suburbs Railway (refer to **Appendix G**). The updated assessment was commissioned to address the latest version of SPP 5.4 and provide additional, detailed acoustic advice for the updated precinct plan.

The acoustic assessment conducted for the future Marmion Avenue and Mitchell Freeway (Herring Storer Acoustics 2021) found that, without any noise mitigation:

- Noise received at the development would exceed the acoustic criteria

Results from the acoustic impact assessment adjacent to Northern Suburbs Railway found that without any noise mitigation:

- noise received at the closest residence to the extension of the Northern Suburbs Passenger Railway Line would comply with the above criteria. However, some lots are on the margin of 55 dB(A) and these Lots would require notifications on titles relating to rail noise

4.7.2 Precinct plan layout considerations for noise

The acoustic assessment concluded that the most significant noise impacts over the site are from Marmion Avenue as noise levels exceed the noise criteria. The Mitchell Freeway would exceed the noise criteria without further treatment; however, the final design of the freeway is currently unknown, so a conservative approach has been taken. The noise impacts from Marmion Ave, Mitchell Freeway and the Northern Suburbs Railway could be managed through the implementation of a range of noise mitigation measures and approaches.

The mitigation options considered appropriate include Quiet House Design Packages as appropriate, and wall or barrier associated with the freeway development. These options will be addressed further at the detailed design stage prior to subdivision. Marmion Avenue and Mitchell Freeway are likely to require the implementation of “Quiet House” design guidelines for dwellings which outline noise insulation measures designed to ensure the noise standards in the policy are achieved (Herring Storer Acoustics 2021).

The requirements in accordance with “Quiet House” design guidelines will be determined prior to subdivision based on the outcomes of detailed design. Furthermore, the acoustic assessment recommends that a notification of road/rail noise is stated on the titles for lots adjacent to the Northern Suburbs Railway, Marmion Avenue and the Mitchell Freeway.

In summary, the noise acoustic assessments indicate that future noise emissions can be accommodated for in the current layout of the PP and that further noise management and mitigation will be required as discussed below.

4.7.3 Future management requirements

A detailed Noise Management Plan for areas adjacent to Marmion Ave, Mitchell Freeway and the Northern Suburbs Railway will be prepared at the subdivision stage. As part of the Noise Management Plan, more detailed noise modelling for these areas will be conducted. This modelling will be undertaken as detailed site-specific information (i.e. finalised lot levels) is available. The Noise Management Plan will also provide details on proposed noise mitigation measures, refined as part of detailed design, including the requirements for Quiet House design. The Noise Management Plan will also identify which lots are likely to require a notification on titles to advise future residents of road/rail noise.

5 Implementation Framework

A summary of how the precinct plan responds to the environmental values and attributes within the site is provided in **Table 7**. The table also outlines the proposed and potential future management measures required as part of the subdivision and development process.

Table 7: Environmental management framework implementation table

Factor	Precinct plan phase	Subdivision phase	Part of development works
Landform and soils	• Parabolic dune to retain landform values.	• Prepare detailed information on dune treatment (batters, retaining walls). • Geotechnical Investigations to respond to karst features.	
Flora and Vegetation	• The Activity Centre Plan design allows for retention of the significant PEC vegetation along the parabolic dune and FCT 26a. • Ecological linkage.	• Vegetation and Fauna Management Plan to be prepared to respond to vegetation and fauna habitat • Referral of proposal for impacts to TEC.	• Implementation of Vegetation and Fauna Management Plan to manage vegetation and flora habitat.
Fauna	• The Activity Centre Plan design allows for retention of fauna habitat along the parabolic dune.	• Vegetation and Fauna Management Plan to be prepared to respond to vegetation and fauna habitat.	• Implementation of Vegetation and Fauna Management Plan to manage vegetation and flora habitat. • Inspection of habitat trees prior to clearing if clearing is undertaken during black cockatoo breeding season.
Heritage	• The Activity Centre Plan provides for the protection of the pinnacles site within future POS.	• Advice to be sought from DPLH to determine the presence of any Aboriginal sites. • Prepare Aboriginal Cultural Heritage Management Plan.	• Implementation of Aboriginal Cultural Heritage Management Plan • Monitoring of works by suitably experienced Noongar people.
Bushfire	• Bushfire Management Plan to determine the overall level of risk presented by the development. • Assessment of design in accordance with Planning for Bush Fire Protection and based on the City of Wanneroo's specification D10 "Bushfire Protection", Part 3 of the City's "Bushfire Protection Requirements for Subdivision and Development', and the WAPC/FESA's "Planning for Bushfire Protection Guidelines'	• Implementation of the Bushfire Management Plan prepared at the Precinct Planning stage. • Prepare new Bushfire Management Plans for each subdivision application.	• Dwellings to demonstrate compliance with AS3959 as per Bushfire Management Plan.
Acoustic	• Identify areas for future implementation of mitigation measures.	• Noise Modelling and Noise Management Plan.	• Implementation of noise mitigation measures as determined by Noise Modelling and Noise Management Plan.

6 Conclusion

Emerge Associates was engaged by Development WA to provide environmental consulting services to inform the preparation and design of an amendment to the PP for Alkimos Central (the site). The PP area is intended to be developed as a 'Secondary Centre' and will have a diversity of uses, activity and functions, which will provide a liveable and sustainable place to work, live and play.

This report forms a key supporting document for the PP amendment providing detail on the environmental values and attributes of the site, the spatial response of the PP and Activity Centre Plan to these values and attributes and any required environmental management as a part of the future subdivision and development processes.

The environmental attributes and values identified within the site have been outlined in **Section 2** and summarised below:

- A parabolic dune with geoheritage significance is located within the site.
- Acid Sulfate Soils and hydrology do not pose major environmental issues for the site.
- There are no recorded Threatened or Priority listed flora species over the site.
- There are two potential Priority Ecological Communities (PECs) recorded over the site. These include FCT No. 24: Northern Spearwood shrublands and woodlands, and FCT No. 29b: Acacia shrublands on taller dunes.
- There is one Threatened Ecological Community (TEC) over the site, being FCT 26a *Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges (Gibson *et al.* 1994 type 26a).
- The site contains Carnaby's black cockatoo foraging habitat corresponding with areas of Banksia woodland.
- There are several features considered to be of cultural significance to the Nyoongar people, none of which are currently registered with DPLH as Aboriginal sites.

The environmental values and attributes of the site have been considered during the preparation of the PP and Activity Centre Plan design, and include a number of specific design responses, such as the retention of flora, vegetation, fauna habitat and heritage values.

The key considerations of the environmental values and attributes have been outlined in **Section 4** and summarised below:

- Opportunities for retention of potential Priority Ecological Communities (PECs) within the parabolic dune POS.
- Opportunity for retention of Threatened Ecological Community (TEC) within the POS areas.
- A road reserve adjacent to areas of POS incorporating retained remnant vegetation to provide for bush fire suppression access to satisfy the requirements of SPP3.7.
- Retention and protection of culturally significant limestone pinnacles within the POS area.
- The intention of the PP is to provide for the retention of values associated with the parabolic dune, and the form and treatment of these areas will be examined in detail at future planning stages. Furthermore, the key environmental values and attributes on a regional scale within the Alkimos Eglinton area have been considered in detail through the planning process at the MRS Amendment and DSP stage, including a formal EPA assessment. This assessment resulted in the reservation of significant areas of Regional Open Space, including a large area immediately north of the site (associated with the Central Alkimos PP area).

This report, in conjunction with the PP documentation sets up an environmental management framework to outline the ongoing and future requirements to respond to environmental attributes and values through the planning process. Therefore, at the subdivision stage, the following studies and management plans will be required:

- An Urban Water Management Plan (UWMP) for each stage of subdivision.
- Detailed noise modelling based on final lot levels and the preparation of a Noise Management Plan.
- Preparation of a Vegetation and Fauna Management Plan to outline how vegetation and fauna values will be retained and managed.
- Geotechnical Investigation including a site-specific assessment of karstic features.
- A Bushfire Management Plan for each stage of subdivision.
- An Aboriginal Cultural Heritage Management Plan and potential application(s) under Section 18 of the AH Act.

The EAMS has found that the proposed urban development can be suitably managed through the standard planning process, to remove the likelihood of it giving rise to significant adverse environmental impacts.

7 References

7.1 General references

Alan Tingay and Associates 1996, *Alkimos-Eglinton Vertebrate Fauna Survey*.

ATA Environmental 2005, *Alkimos Eglinton - Flora, Vegetation and Fauna Baseline Information*.

Beard, J. S. 1990, *Plant Life of Western Australia*, Kangaroo Press Pty Ltd., Kenthurst, N.S.W.

Bureau of Meteorology, and Commonwealth Scientific and Industrial Research Organisation, (BoM and CSIRO) 2018, *State of the Climate 2018*.

Brocx, M. 2008, *Geoheritage: from global perspectives to local principles for conservation and planning*, Western Australian Museum, Western Australia.

Churchward, H. M. and McArthur, W. M. 1980, *'Landforms and Soils of the Darling System, Western Australia'*, in Department of Conservation and Environment (ed.), *Atlas of Natural Resources Darling System Western Australia*, Department of Conservation and Environment.

City of Wanneroo (CoW) 2018a, *Local Biodiversity Plan 2018/19 - 2023/2024*, Wanneroo.

City of Wanneroo (CoW) 2018b, *Local Planning Policy 4.13: Caves and Karstic Features*.

Department of Environment and Conservation (DEC) 2011, *Carnaby's cockatoo (Calyptorhynchus latirostris) spatial data for Swan Coastal Plain and Jarrah Forest IBRA regions*, Perth.

Department of the Environment and Energy (DoEE) 2016, *Banksia Woodlands of the Swan Coastal Plain in Community and Species Profile and Threats Database*, Canberra.

Dortch Cuthbert 2021, *Archaeological survey of a proposed development area at Alkimos, Western Australia*.

DoW 2009, *Protecting public drinking water source areas* Western Australia.

Department of Water (DoW) 2016, *Water quality protection note no. 25: land use compatiblity tables for public drinking water source areas*, Perth.

Department of Planning, Lands and Heritage (DPLH) 2019a, *Government Sewerage Policy*, Perth.

Department of Planning, Lands and Heritage (DPLH) 2019b, *State Planning Policy 5.4 - Road and Rail Noise*

Department of Water and Environmental Regulation (DWER) 2019, *Water quality protection note no. 75: gazetted public drinking water source areas*, Government of Western Australia, Perth.

Emerge Associates 2013a, *Black Cockatoo Habitat Assessment - Alkimos City Centre and Central Alkimos*.

Emerge Associates 2013b, *Vegetation Association and Condition - Alkimos City Centre and Central Alkimos*.

Emerge Associates 2021a, *Alkimos Central Local Structure Plan Bushfire Management Plan*, EP19-077(07)--007 DAE, Version D.

Emerge Associates 2021b, *Alkimos Central Structure Plan Local Water Management Strategy*, EP19-077(08) TEM, Version C.

Environment Australia 2001, *National Objectives and Targets for Biodiversity Conservation 2001-2005*, Commonwealth of Australia, Canberra.

Environmental Protection Authority (EPA) 2005, *Alkimos-Eglinton Metropolitan Region Scheme Amendment No. 1029/33 Report and recommendations of the Environmental Protection Authority*, Perth, Western Australia.

Environmental Protection Authority (EPA) 2008, *Guidance Statement No. 33. Environmental Guidance for Planning and Development*, Perth.

Environmental Protection Authority (EPA) 2016, *Environmental Factor Guideline: Flora and Vegetation*, Perth.

Ethnosciences 2012, *Aboriginal Heritage Management Plan: Alkimos City Centre (Regional Centre) Local Structure Plan, Alkimos, Western Australia*.

Government of WA 2000a, *Bush Forever - Volume 1: Policies, principles and processes*, Perth.

Government of WA 2000b, *Bush Forever, Volume 2: Bush Forever Site Descriptions*, Perth.

Government of WA 2003, *A State Water Strategy for Western Australia*, Perth.

Government of Western Australia 2018, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of December 2017*, WA Department of Biodiversity, Conservation and Attractions, Perth.

Gozzard, J. R. 1982, *Yanchep Sheet 2034 IV*, Perth Metropolitan Region 1:50 000 Environmental Geology Series. Geological Survey of Western Australia, Perth.

Heddle, E. M., Loneragan, O. W. and Havel, J. J. 1980, *'Vegetation Complexes of the Darling System Western Australia'*, in Department of Conservation and Environment (ed.), *Atlas of Natural Resources Darling System Western Australia*, Perth.

Herring Storer Acoustics 2020, *Central Alkimos Local Structure Plan SPP 5.4 Noise Assessment*, 26007-1-20170, Version 1.

Herring Storer Acoustics 2021, *Alkimos Central Precinct Plan SPP 5.4 Noise Assessment*, 26007-1-20170, Version 1, Revision 1.

Keighery, B. 1994, *Bushland Plant Survey: A guide to plant community survey for the community*, Wildflower Society of WA (Inc), Nedlands.

Moodjar Consultancy 2021, *Alkimos Aboriginal Heritage Survey - Cultural Survey*.

Paperbark Technologies 2014, *Tree Survey for Alkimos City and Central Land*.

Perth Biodiversity Project (PBP) 2011, *2010 Remnant vegetation by vegetation complex dataset for Perth and Peel*, Western Australian Local Government Association, Perth.

Seddon, G. 2004, *A Sense of Place: a response to an environment, the Swan Coastal Plain Western Australia*, Blooming Books, Melbourne.

Standards Australia 2018, *AS 3959:2018 Construction of buildings in bushfire-prone areas*, Sydney.

Strategen Environmental 2019, *Alkimos City Centre and Central (EPBC 2015/7561) Construction Environmental Management Plan*, LLC16557 01 R001, 4.

Thackway, R. and Cresswell, I.D. (Eds) 1995, *An Interim Biogeographical Regionalisation for Australia: a framework for establishing the national system of reserves, Version 4.0*, Australian Nature Conservation Agency, Canberra.

Western Australian Local Government Association and Perth Biodiversity Project (WALGA and PBP) 2004, *Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region*, Perth.

Western Australian Planning Commission (WAPC) 2008, *Better Urban Water Management*, Perth.

Western Australian Planning Commission (WAPC) 2010, *State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region*, Western Australian Planning Commission, Perth, Perth.

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

Western Australian Planning Commission (WAPC) 2015b, *Structure Plan Framework, Planning and Development (Local Planning Schemes) Regulations 2015*.

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3*, Western Australia. December 2017.

7.2 Online references

Department of Agriculture, Water and the Environment (DAWE) 2020, *EPBC Act Protected Matters Report*, generated from the EPBC Act Protected Matters Database, report generated 9 June 2020, <https://www.environment.gov.au/epbc/protected-matters-search-tool>.

Department of Biodiversity, Conservation and Attractions (DBCA) 2020, *NatureMap,* report generated 9 June 2020, < https://naturemap.dbca.wa.gov.au/>.

Department of Defence (DoD) 2020, *Unexploded Ordnance Mapping Application,* viewed June 2020, <https://www.defence.gov.au/UXO/Where/>.

Department of Planning, Lands and Heritage (DPLH) 2021, *Aboriginal Heritage Inquiry System,* viewed June 2021, <https://espatial.dplh.wa.gov.au/AHIS/index.html?viewer=AHIS>

Department of Primary Industries and Regional Development (DPIRD) 2020, *Climate trends in Western Australia*, viewed June 2020, < https://www.agric.wa.gov.au/climate-change/climate-trends-western-australia#:~:text=Western%20Australia's%20climate%20has%20changed,over%20the%20lower%20south%2Dwest.>.

Department of Water and Environmental Regulation (DWER) 2020b, *Perth Groundwater Map,* viewed June 2020, < https://maps.water.wa.gov.au/#/webmap/gwm>.

Department of Water and Environmental Regulation (DWER) 2020c, *Water Register*, viewed June 2020, <https://maps.water.wa.gov.au/#/webmap/register>.

Landgate 2020, *Shared Land Information Platform (SLIP)*, viewed June 2020, < https://maps.slip.wa.gov.au/landgate/locate/>.

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Figures

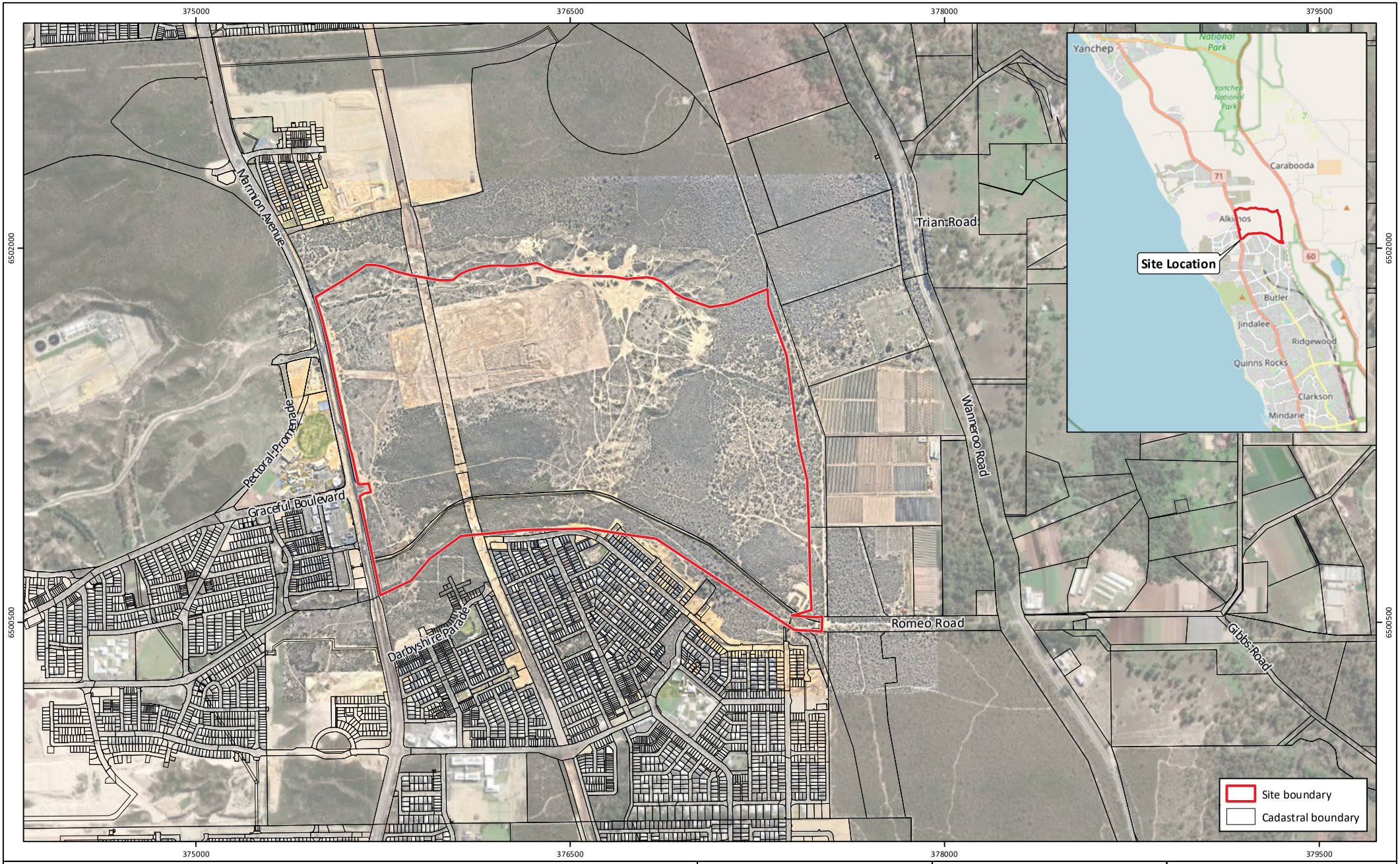

Figure 1: Site Locality

Project:	Environmental Assessment and Management Strategy Alkimos Central Precinct Plan
Client:	Development WA

Plan Number:
EP19-077(06)--F07a

Drawn:	GAR
Date:	13/10/2021
Checked:	DAE
Approved:	RLE
Date:	13/10/2021

N

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Metres

Scale: 1:20,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

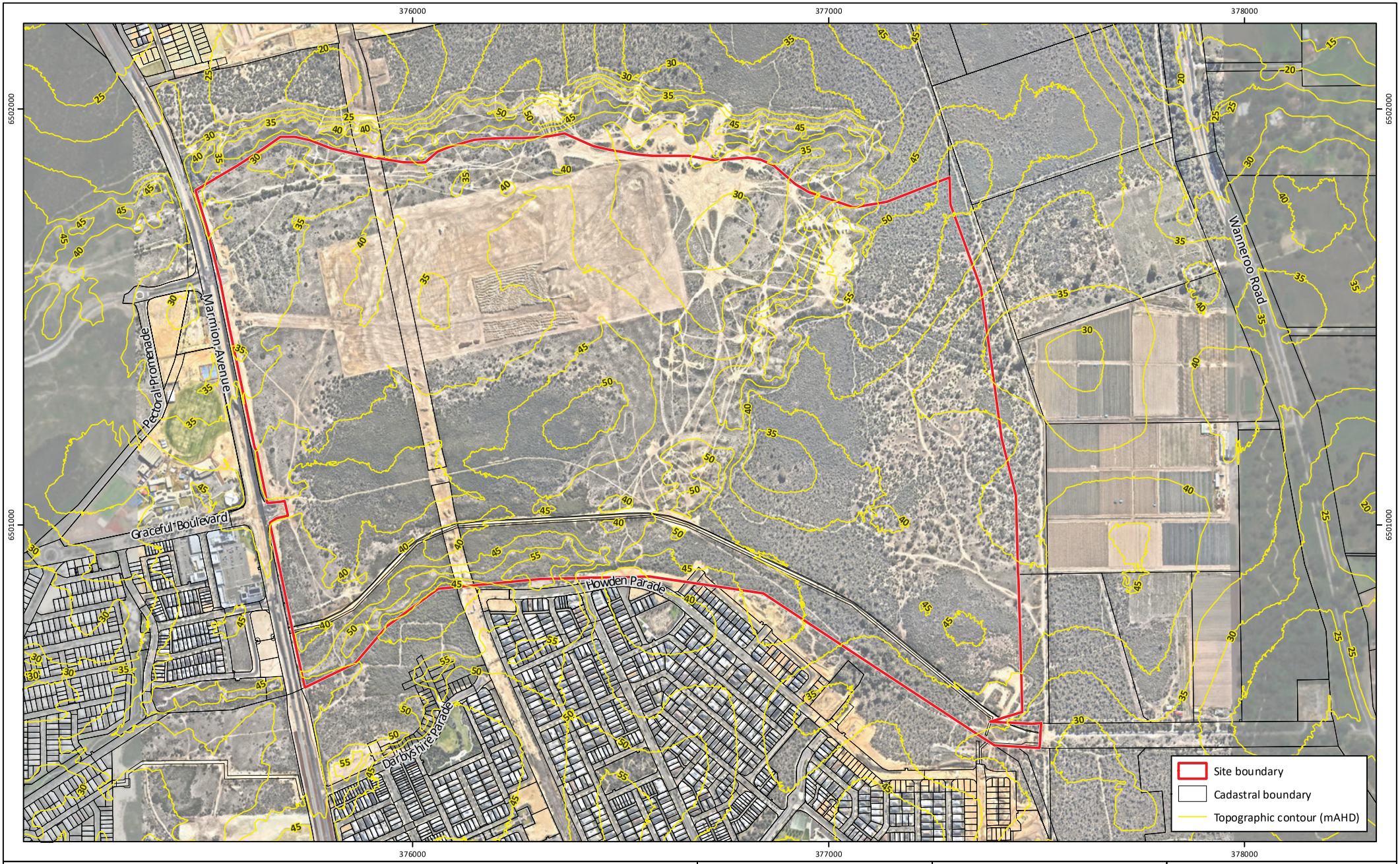

Figure 2: Topographic Contours

Project:	Environmental Assessment and Management Strategy Alkimos Central Precinct Plan
Client:	Development WA

Plan Number:
EP19-077(06)–F08a

Drawn:	GAR
Date:	13/10/2021
Checked:	DAE
Approved:	RLE
Date:	13/10/2021

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

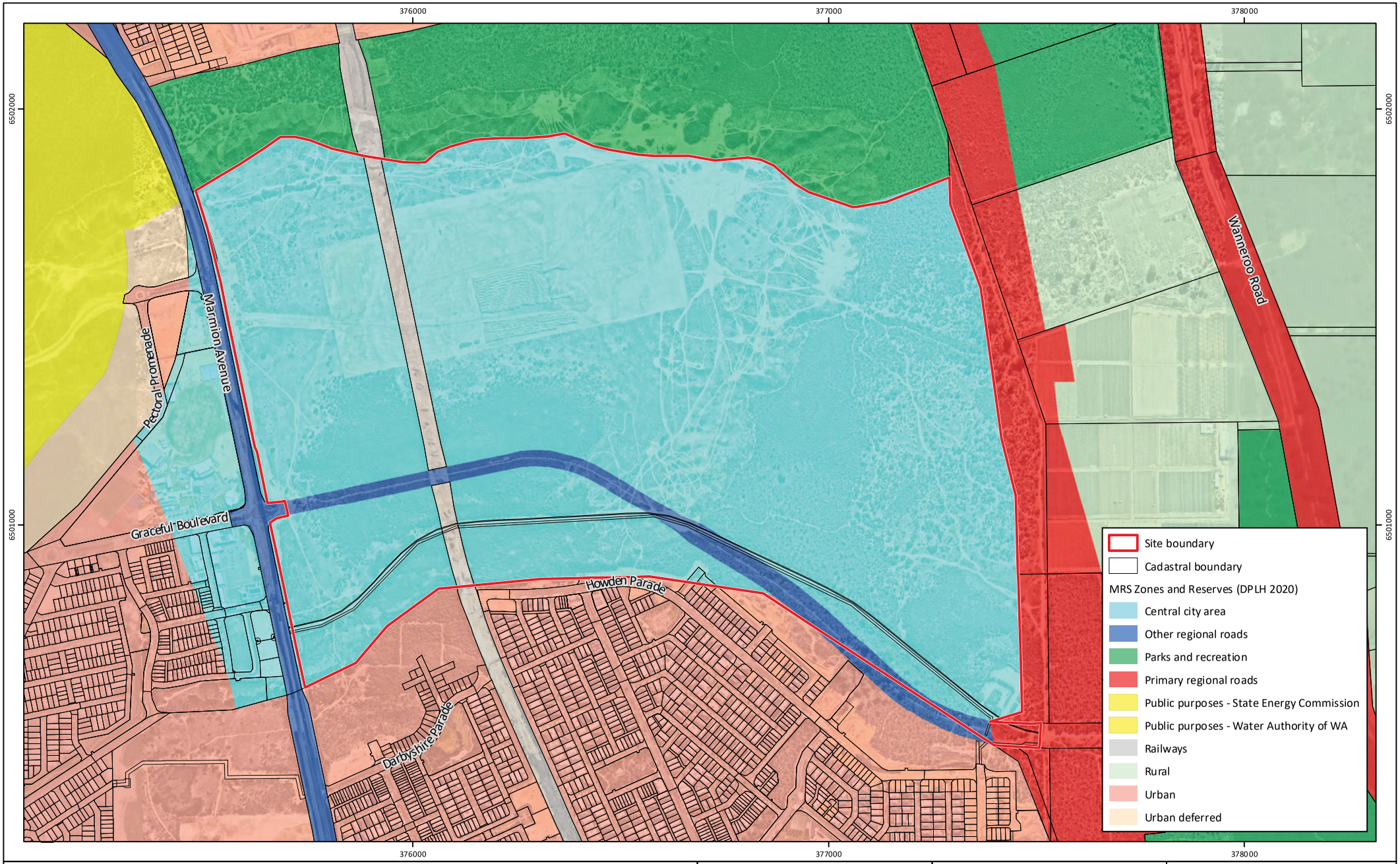

Figure 3: MRS Zones and Reserves

Project: Environmental Assessment and Management Strategy
Alkimos Central Precinct Plan
Client: Development WA

Plan Number:
EP19-077(06)--F09a
Drawn: GAR
Date: 13/10/2021
Checked: DAE
Approved: RLE
Date: 13/10/2021

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

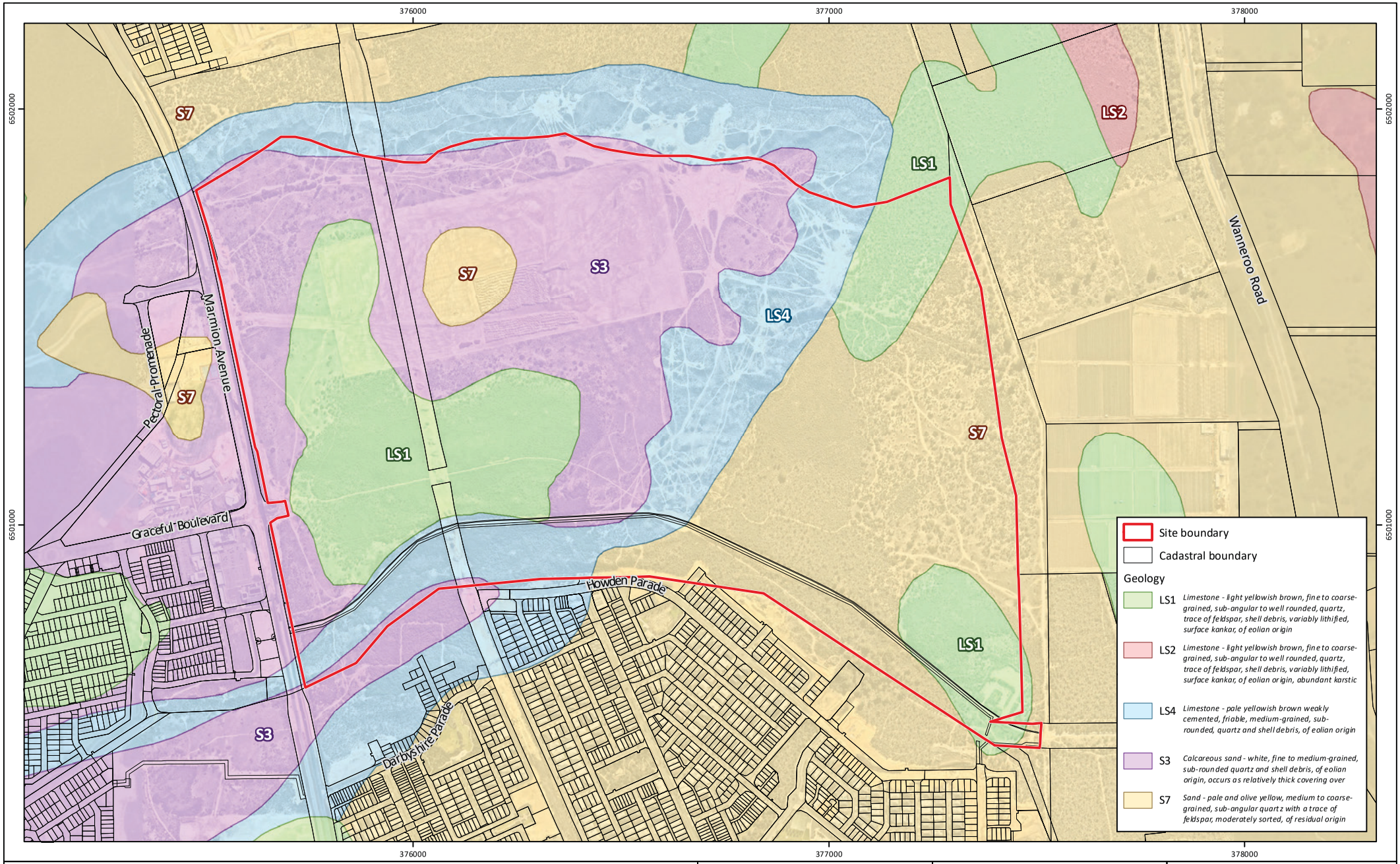

Figure 4: Environmental Geology

Project:	Environmental Assessment and Management Strategy Alkimos Central Precinct Plan
Client:	Development WA

Plan Number:
EP19-077(06)–F10a

Drawn:	GAR
Date:	13/10/2021
Checked:	DAE
Approved:	RLE
Date:	13/10/2021

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

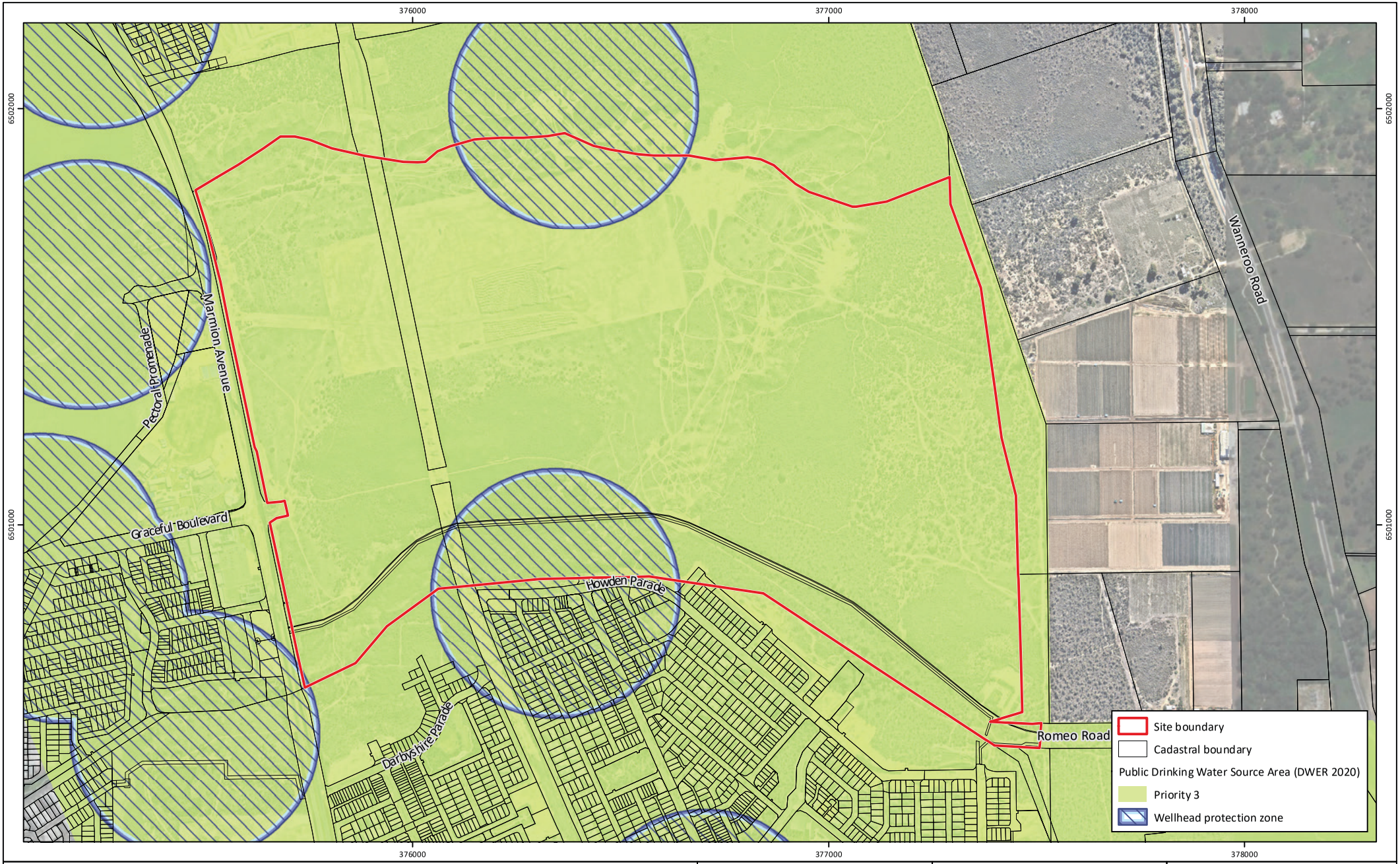

Figure 5: Public Drinking Water Source Areas

Project:	Environmental Assessment and Management Strategy Alkimos Central Precinct Plan
Client:	Development WA

Plan Number:
EP19-077(06)--F11a

Drawn:	GAR
Date:	13/10/2021
Checked:	DAE
Approved:	RLE
Date:	13/10/2021

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

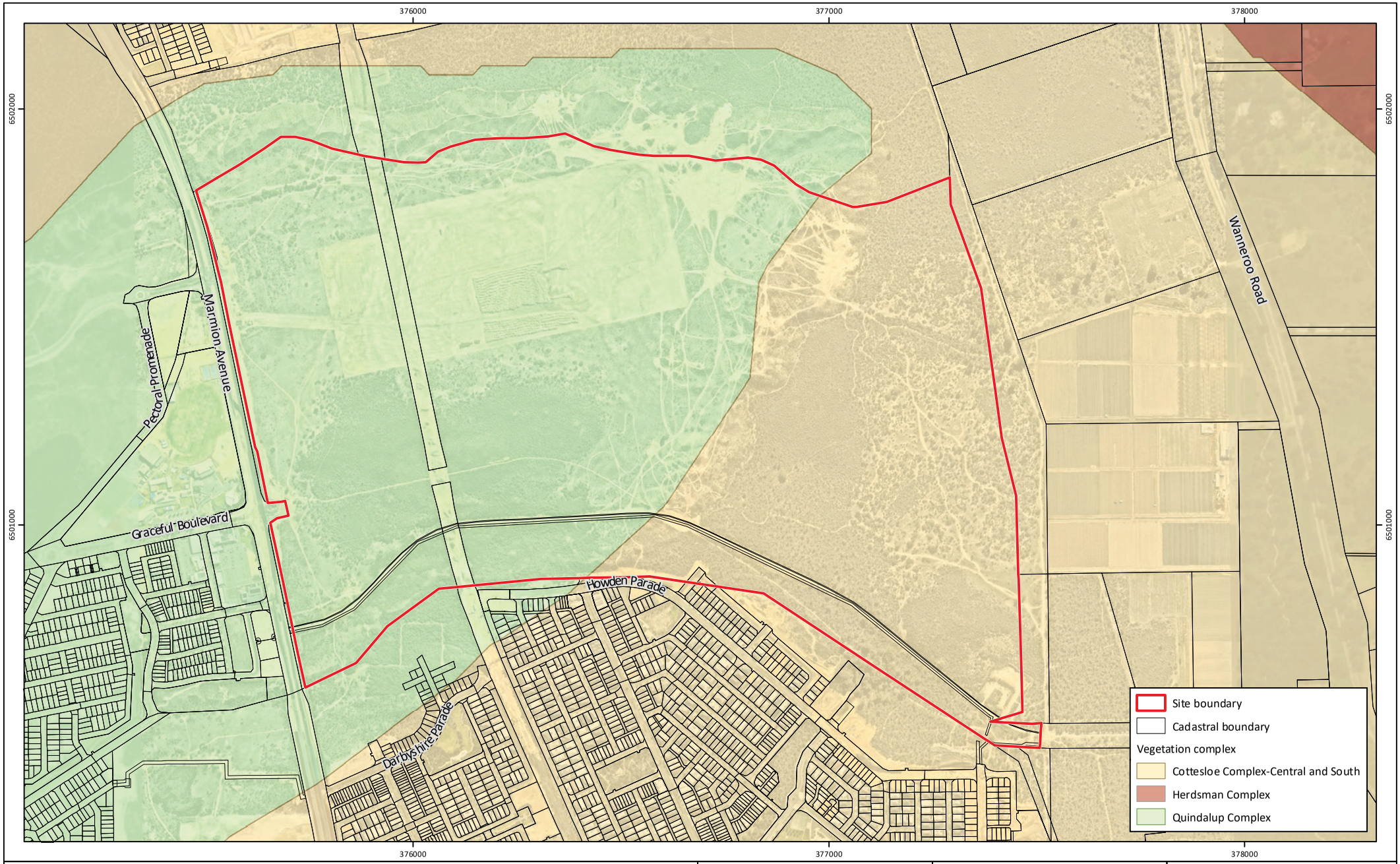

Figure 6: Vegetation Complexes

Project:	Environmental Assessment and Management Strategy Alkimos Central Precinct Plan
Client:	Development WA

Plan Number:
EP19-077(06)–F12a

Drawn:	GAR
Date:	13/10/2021
Checked:	DAE
Approved:	RLE
Date:	13/10/2021

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Metres

Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

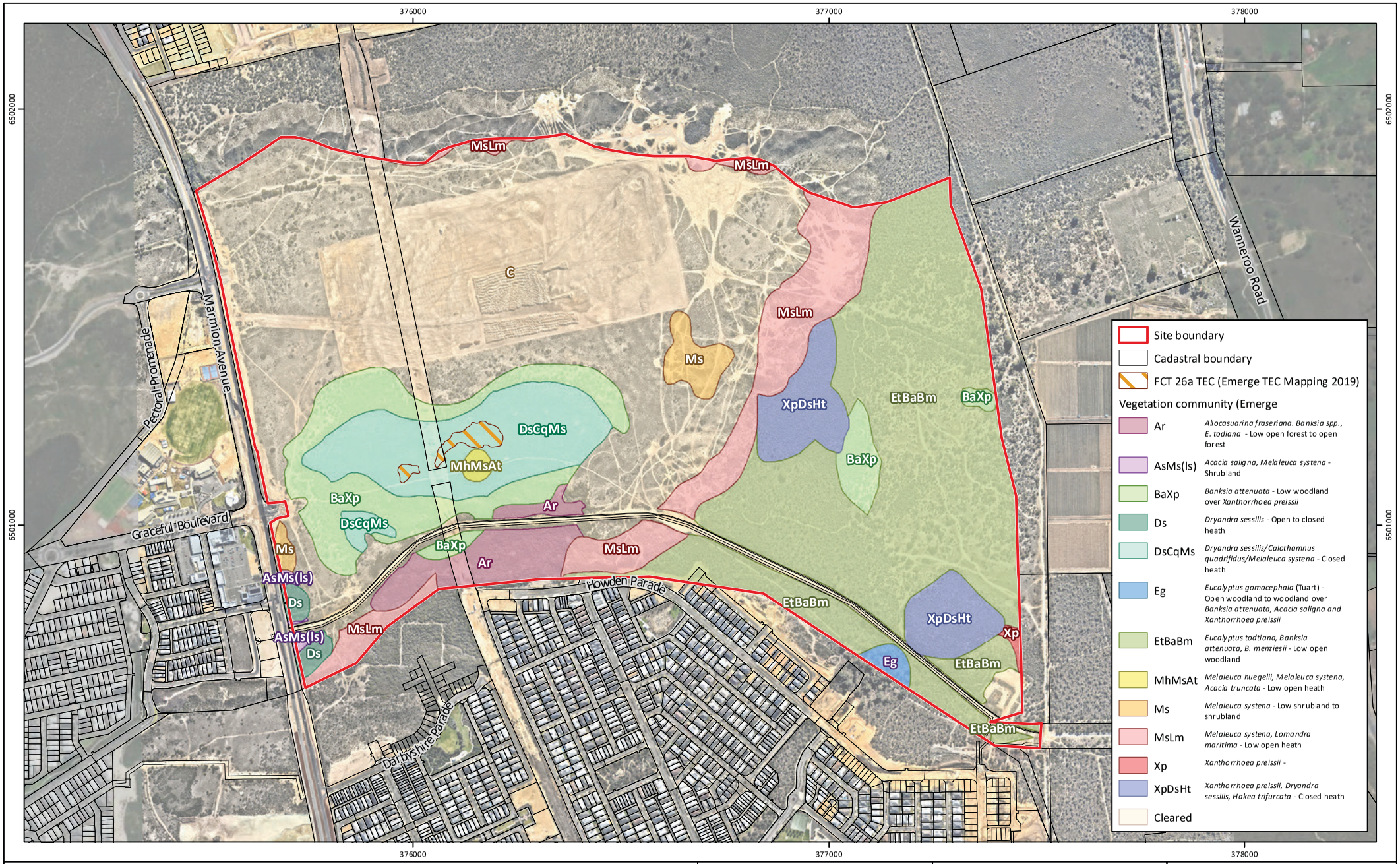

Figure 7: Vegetation Communities and FCT 26a TEC

Project:	Environmental Assessment and Management Strategy Alkimos Central Precinct Plan
Client:	Development WA

Plan Number:
EP19-077(06)–F13a

Drawn:	GAR
Date:	13/10/2021
Checked:	DAE
Approved:	RLE
Date:	13/10/2021

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

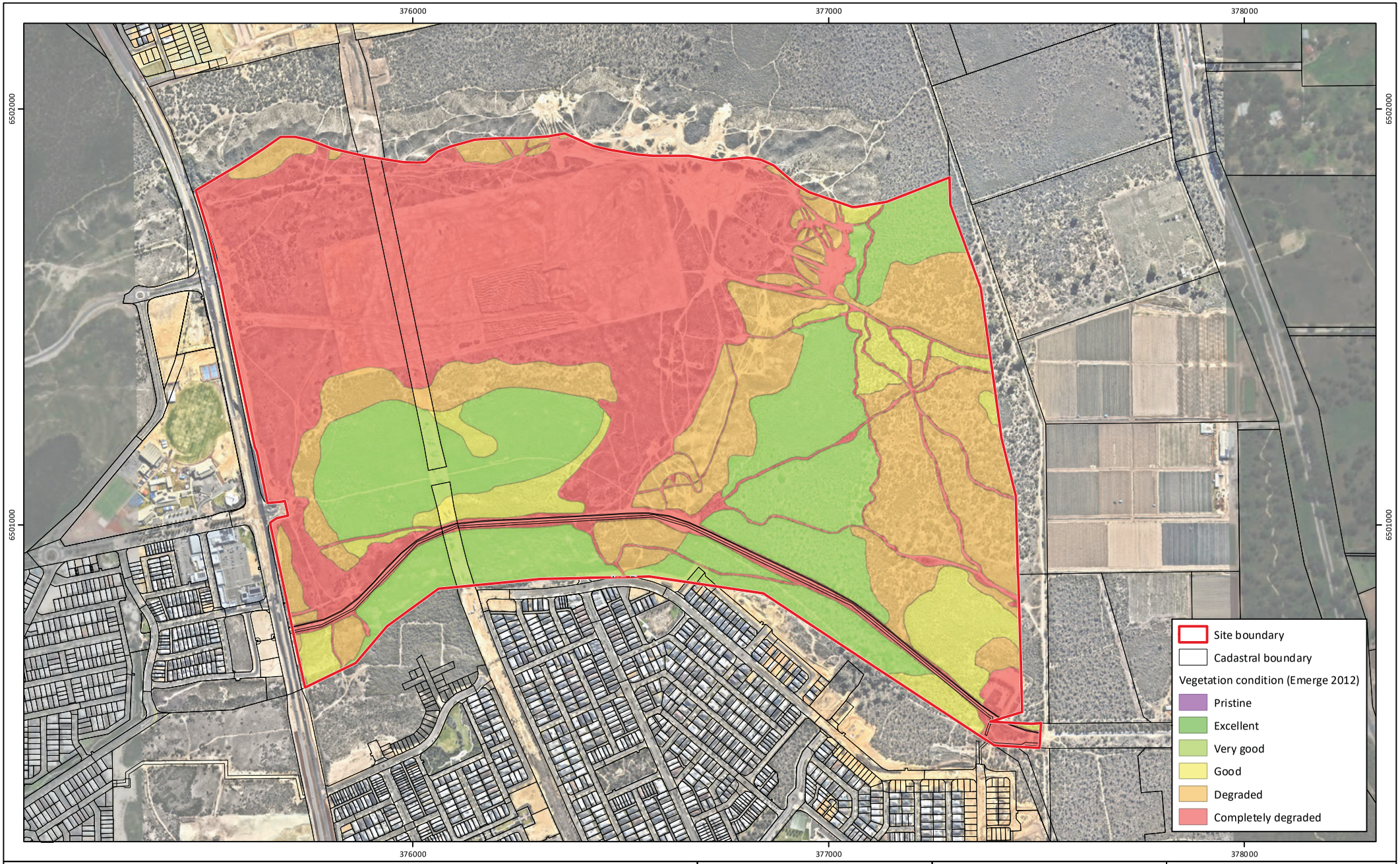

Figure 8: Vegetation Condition

Project:	Environmental Assessment and Management Strategy Alkimos Central Precinct Plan
Client:	Development WA

Plan Number:
EP19-077(06)--F14a

Drawn:	GAR
Date:	13/10/2021
Checked:	DAE
Approved:	RLE
Date:	13/10/2021

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Scale: 1:12,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

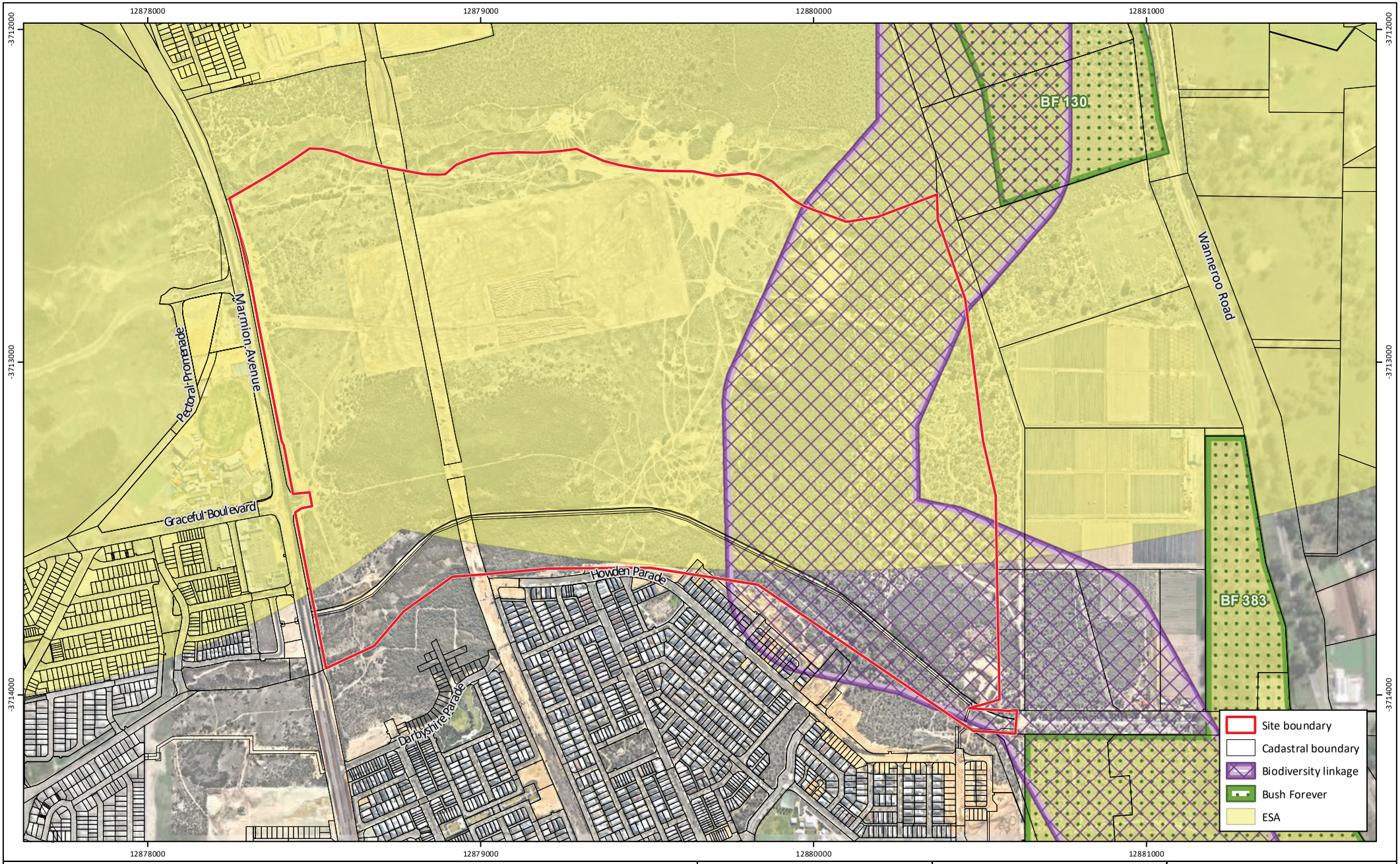

Figure 9: Environmentally Sensitive Areas, Regional Ecological Linkages and Bush Forever Sites

Project: Environmental Assessment and Management Strategy
Alkimos Central Precinct Plan
Client: Development WA

Plan Number:
EP19-077(06)--F15a
Drawn: GAR
Date: 13/10/2021
Checked: DAE
Approved: RLE
Date: 13/10/2021

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

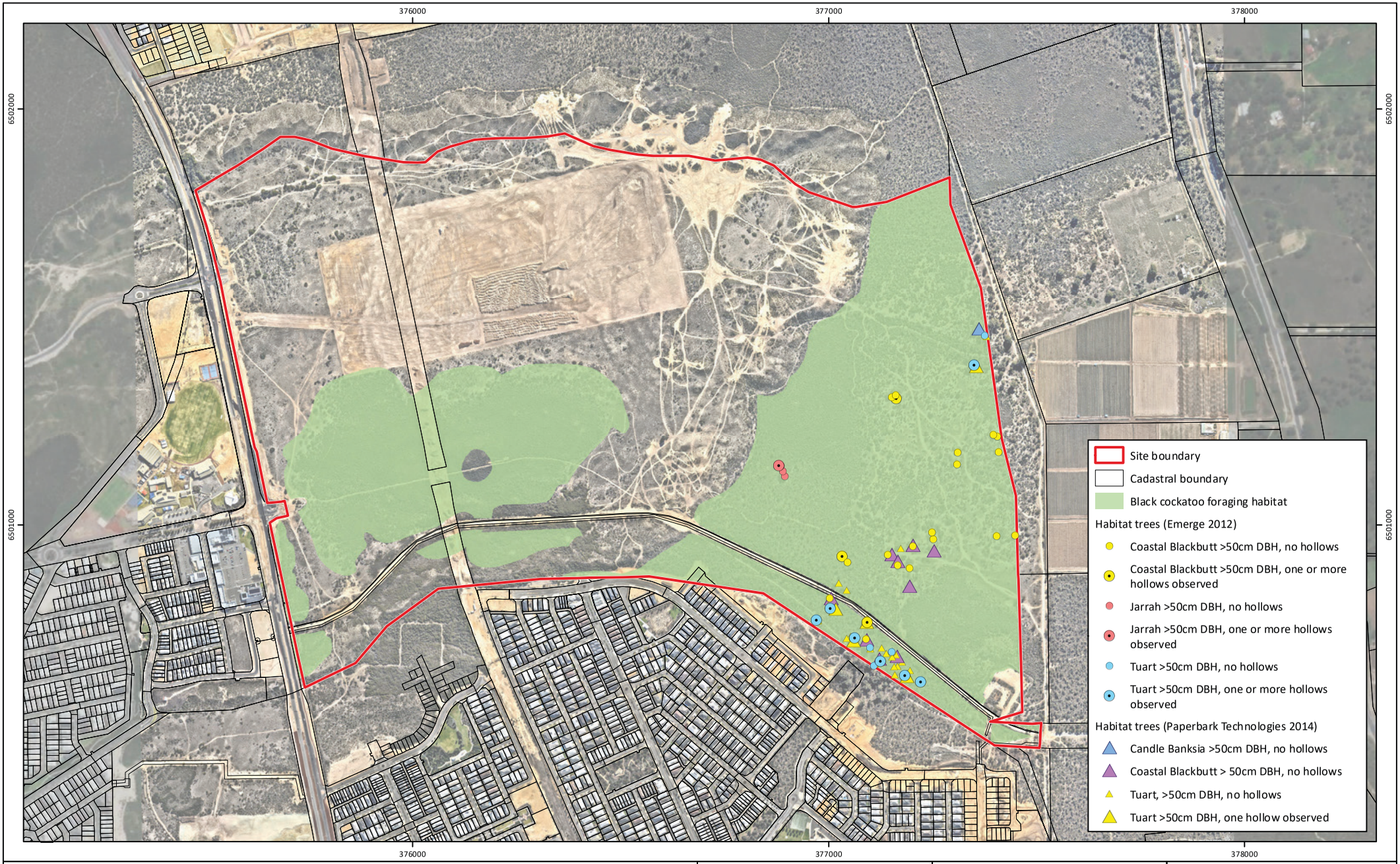

Figure 10: Black Cockatoo Habitat

Project: Environmental Assessment and Management Strategy
Alkimos Central Precinct Plan
Client: Development WA

Plan Number:
EP19-077(06)--F16a
Drawn: GAR
Date: 13/10/2021
Checked: DAE
Approved: RLE
Date: 13/10/2021

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Metres
Scale: 1:12,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

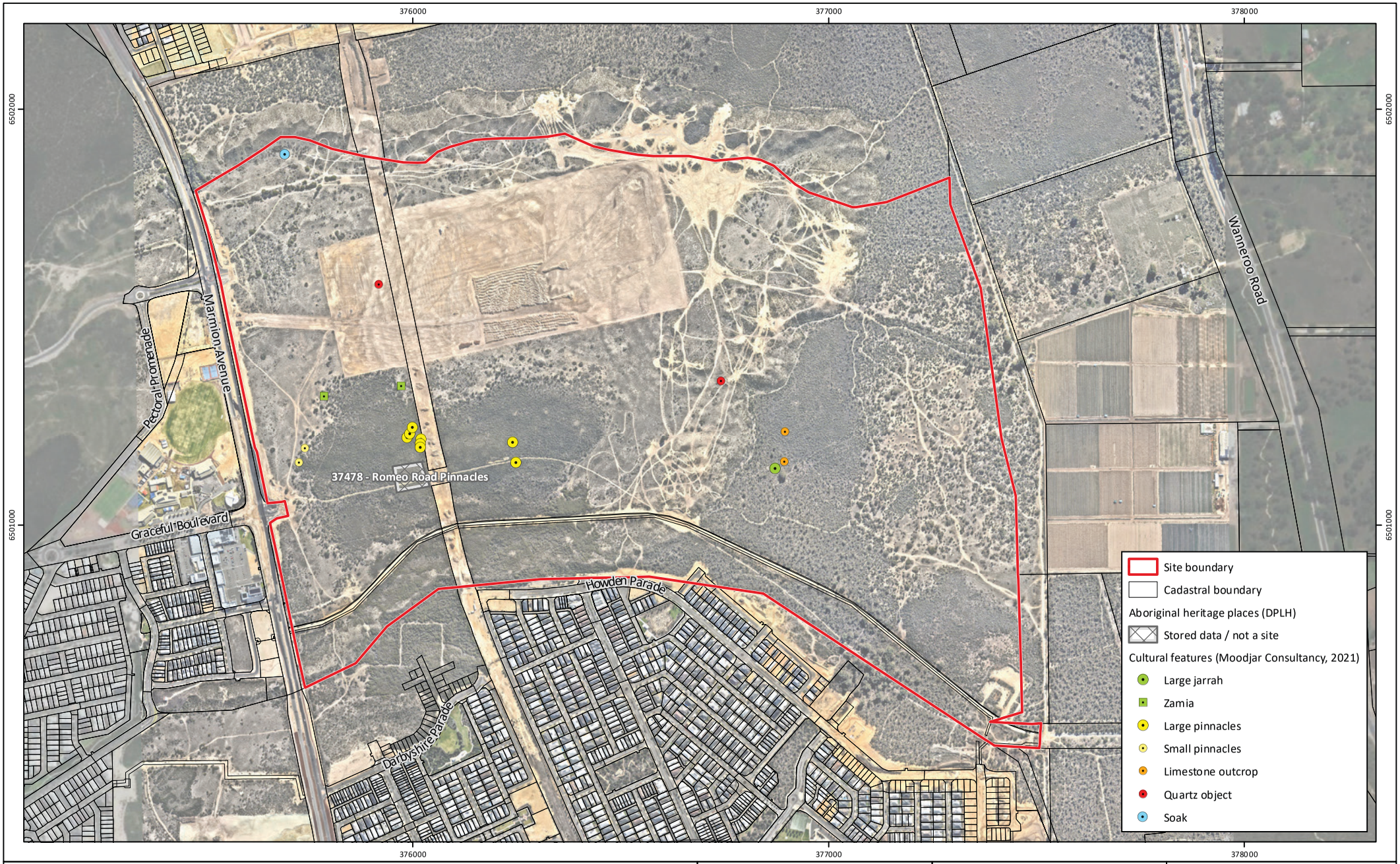


Figure 11: Cultural Heritage

Project: Environmental Assessment and Management Strategy
Alkimos Central Precinct Plan
Client: Development WA

Plan Number:
EP19-077(06)--F37a
Drawn: GAR
Date: 13/10/2021
Checked: DAE
Approved: RLE
Date: 13/10/2021

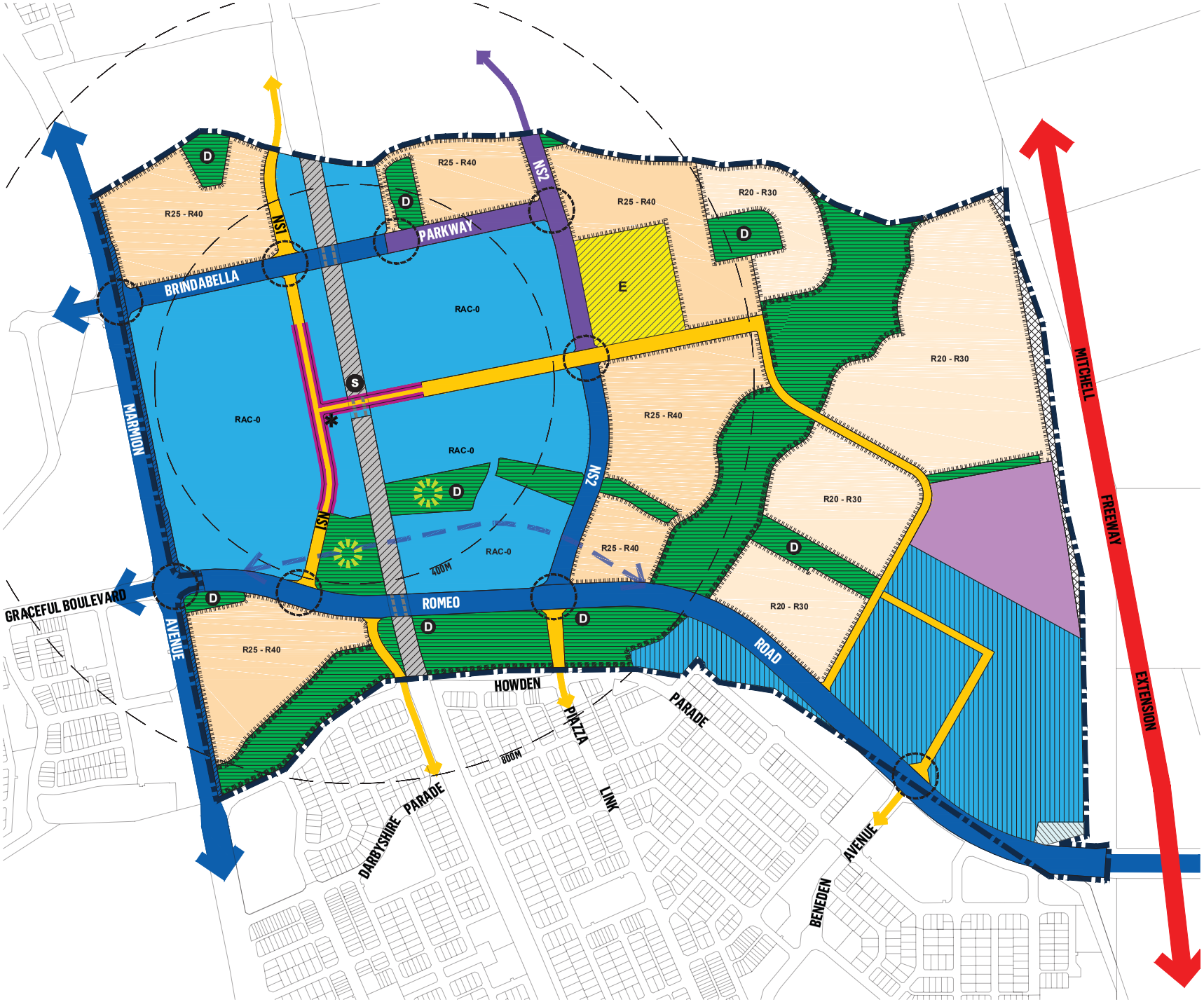
N

0 200 400
Metres
Scale: 1:12,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Alkimos Central Precinct Plan and
Alkimos Central Indicative Land Use and Density Plan (Urbis 2021)



LEGEND

- PRECINCT PLAN AREA

ZONES

- RESIDENTIAL
  - R20 - R30
  - R25 - R40
- COMMERCIAL
- BUSINESS
- SERVICE INDUSTRIAL

RESERVES

- EDUCATION
- PUBLIC OPEN SPACE
- DRAINAGE
- PRIMARY DISTRIBUTOR ROAD
- INTEGRATOR A
- FUTURE INTEGRATOR A
- INTEGRATOR B
- NEIGHBOURHOOD CONNECTOR ROAD
- RAILWAYS

OTHER

- DRAINAGE
- RAILWAY STATION
- RAILWAY ALIGNMENT
- WALKABLE CATCHMENT
- TOWN SQUARE
- MAIN STREET
- ENVIRONMENTAL / HERITAGE VALUE
- INDICATIVE FUTURE WESTERN POWER CORRIDOR
- CONTROLLED INTERSECTION
- EXISTING ROMEO ROAD MRS RESERVATION
- POS / DUNE INTERFACE SUBJECT TO DETAIL DESIGN

NOTES

1) Ultimate Road Hierarchy at 2051
2) Traffic Signals subject to Main Roads WA approval
3) Extent of POS subject to detailed design in accordance with provisions of Part 1 of the Precinct Plan
4) Future Western Power Corridor is subject to further investigation through more detail planning including the review ot Western Power network requirements

URBIS

Precinct Plan

Alkimos Central Precinct Plan

Level 14, The Quadrant, 1 William Street | Perth WA 6000 Australia | +61 8 9346 0500 | URBIS Pty Ltd | ABN 50 105 256 228

DATA SOURCE
MNG

PROJECTION
PCG94

CLIENT
Development WA

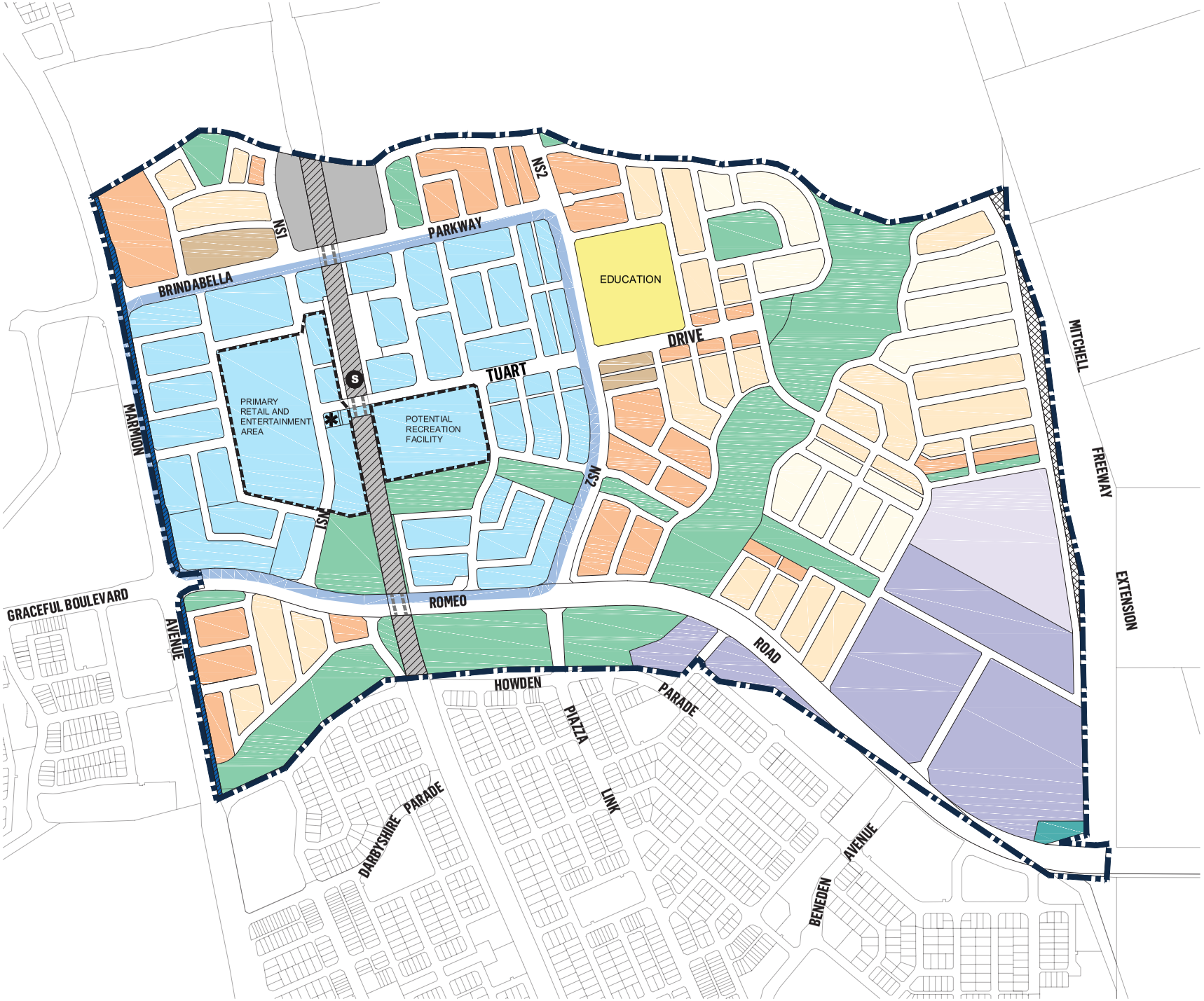
1:7,500 @ A3
0 50 100 150m

PROJECT NO.
P0008935

DATE
07.10.2021

DRAWING NO.
12.1

REVISION
i



LEGEND

- PRECINCT PLAN AREA
- CITY CENTRE CORE

INDICATIVE LAND USE & DENSITIES

- RESIDENTIAL - R20
- RESIDENTIAL - R25
- RESIDENTIAL - R30
- RESIDENTIAL - R40
- COMMERCIAL (RAC-0)
- BUSINESS
- SERVICE INDUSTRIAL
- PUBLIC PURPOSE
- PUBLIC OPEN SPACE
- DRAINAGE
- PTA CARPARK

OTHER

- RAILWAYS
- FUTURE WESTERN POWER CORRIDOR
- TOWN SQUARE
- FUTURE MARMION AVENUE ROAD WIDENING
- INDICATIVE ROAD LAYOUT
- RAILWAY ALIGNMENT
- ALKIMOS TRAIN STATION

NOTE

1) R-Code densities are indicative. Refer to Plan 1 in Part 1
2) For land within RAC-0 built form controls are guided by the provisions of Part 1
3) Land uses within the Commercial Zone shall be in accordance with the land use permissibility in DPS2 (including a mix of retail, commercial, entertainment, food and beverage, recreational, civic, cultural and some residential land uses)

URBIS

Indicative Land Use & Density Plan

Alkimos Central Precinct Plan

Level 14, The Quadrant, 1 William Street | Perth WA 6000 Australia | +61 8 9346 0500 | URBIS Pty Ltd | ABN 50 105 256 228

DATA SOURCE
MNG

PROJECTION
PCG94

CLIENT
Development WA

1:7,500 @ A3
0 50 100 150m

PROJECT NO.
P0008935

DATE
26.10.2021

DRAWING NO.
12.3

REVISION
j

Appendix B

Geotechnical Report (Douglas Partners 2012)

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
36 O'Malley Street
Osborne Park WA 6017
Phone (08) 9204 3511
Fax (08) 9204 3522

Project 76396.00
11 July 2012
MOW:DR

Lend Lease Communities (Alkimos) Pty Ltd
Level 2, 10 Ord Street
WEST PERTH WA 6005

Attention: Mr Peter Dockett

Dear Sirs

Desktop Geotechnical Study
Proposed Central Alkimos Development, Alkimos, WA

1. Introduction

This letter presents the results of a geotechnical desktop study undertaken by Douglas Partners Pty Ltd (DP) for the proposed Central Alkimos development site, located in Alkimos, Western Australia (WA). This report was commissioned by Lend Lease Communities (Alkimos) Pty Ltd (Lend Lease) by way of a Professional Services Agreement dated 6 June 2012.

The purpose of this desktop study is to review available geological information in order to identify the likelihood of karst formations being present within the site, and provide comments on potential risks for the development associated with such landforms. As directed by Lend Lease, this report is limited to desktop analysis of available information only. No site inspections or testing were undertaken as part of this assessment.

A plan provided by Lend Lease indicates that the subject area comprises approximately 530 ha of coastal land on Marmion Avenue in Alkimos (refer to Drawing 1, attached), located to the north of the Perth Metropolitan Area It is understood that the development will include both residential and commercial land use.

2. Background on Karst

Karst features are erosional landforms occurring within calcareous rock, and in particular include caves, dolines and swallow holes. They form over long periods of time by the dissolution of the rock's carbonate minerals by groundwater movement and percolation. Major cavities are thought to generally form at or near the water table level (which may have varied over geological time).

Karst features exist within the coastal area of south-western WA, however only a small number are known to result in a subsidence risk to structures or personnel. Phenomena such as caves and dolines have been mapped within a belt of karsts, which generally occurs with the geological unit

described as Limestone (LS_2) on Drawing 1. The Central Alkimos development site does not lie within this belt, and is situated to its west.

It is understood that no fatalities have occurred from cave roof collapses in WA. Fatalities have, however, occurred as a result of collapsed open overhangs in marine cliffs.

3. Review of Available Geological Information

The Yanchep 1:50,000 Environmental Geology Sheet (Ref 1) indicates that the Central Alkimos development site (refer to Drawing 1) is underlain by the following soil and rock units:

- **Calcareous Sand (S_2 and S_3)** – fine to medium grained, sub-rounded quartz and shell debris forming part of the Safety Bay Sand Unit;
- **Sand (S_7) -** medium to coarse grained, sub-angular quartz sand, derived from Tamala Limestone Unit;
- **Limestone (LS_1) –** fine to coarse grained, quartz and shell debris, variably lithified and with common solution cavities and fissures, forming part of the Tamala Limestone Unit;
- **Limestone (LS_4) –** medium grained, quartz and shell debris, weakly cemented, friable, no karst features noted, forming part of the Safety Bay Sand Unit.

There are no known karst features identified on the geology map sheet as lying within the boundary of the site. The nearest known karst feature identified on the sheet is a doline (collapsed cave) located 1.25 km east of the site. The closest cave is marked 1.4 km north-east of the site. A number of caves and dolines are known to be in the wider area and are marked on the geological sheet within the geological unit indentified as Limestone (LS_2). Extensive cave systems and other large scale karstic phenomena are known to occur within this unit. The closest mapped occurrence of Limestone (LS_2) to the site is approximately 150 m east of the site.

The Perth Groundwater Atlas (Ref 2) indicates that the level of the regional near surface groundwater aquifer beneath the site was between RL 0 m and RL 3 m relative to Australian Height Datum (AHD) in May 2003. These levels correspond to depths below the existing surface level of between 0 m to 50 m across the site.

4. Comments

The results of the desktop geotechnical study indicate that the ground conditions underlying the development site contain a geological unit which has “common solution cavities and fissures” but is not known to have large karst features such as caves. Based on this desktop information, it is considered that there is only a very low susceptibility for development of large karst structures within the site and that, following detailed investigation, the likelihood of karst landforms impacting the proposed development is rare. An extract (Appendix C) of the Practice Note Guidelines for Landslide Risk Management (Ref 3) defining terminology is attached.

Necessarily, these comments are provided based on the analysis of desktop information only, and site based identification of possible karst features has not been undertaken. It is therefore considered prudent that consideration to potential karst phenomena are given during the subsequent site based elements of ongoing geotechnical testing for the development at the site, including:

- Walk-over inspections by experienced professionals;
- Test pit and cone penetration tests as part of geotechnical investigations; and
- Observations during the bulk earthworks phase of the construction of the development.

In the event that features indicating the presence of karst landforms are identified at the site, specific testing will be warranted to assess the likelihood and consequence of failure, and impact (risk) on the development.

5. References

1. Geological Survey of Western Australia (1986), Geology of Yanchep 1:50,000 Environmental Geology Sheet.
2. Department of Environment, Perth Groundwater Atlas, Second Edition, December 2004.
3. Australian Geomechanics Society. “Practice Note Guidelines for Landslide Risk Management”, Australian Geomechanics, Vol. 42 No. 1 (2007c).

6. Limitations

DP has prepared this desktop geotechnical study for the proposed Central Alkimos development, WA in accordance with DP's fee proposal dated 3 May 2012 and commissioned by Lend Lease Communities (Alkimos) Pty Ltd by way of a Professional Services Agreement dated 6 June 2012. This report is provided for the exclusive use of Lend Lease Communities (Alkimos) Pty Ltd for this project only and for the purposes described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Yours faithfully
Douglas Partners Pty Ltd

Dan Reaveley
Senior Associate

Reviewed by

Grahame Wilson
Senior Consultant

Attachments:
About this Report
Drawing 1 - Site Boundary and Geology
Appendix C of the Practice Note Guidelines for Landslide Risk Management

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

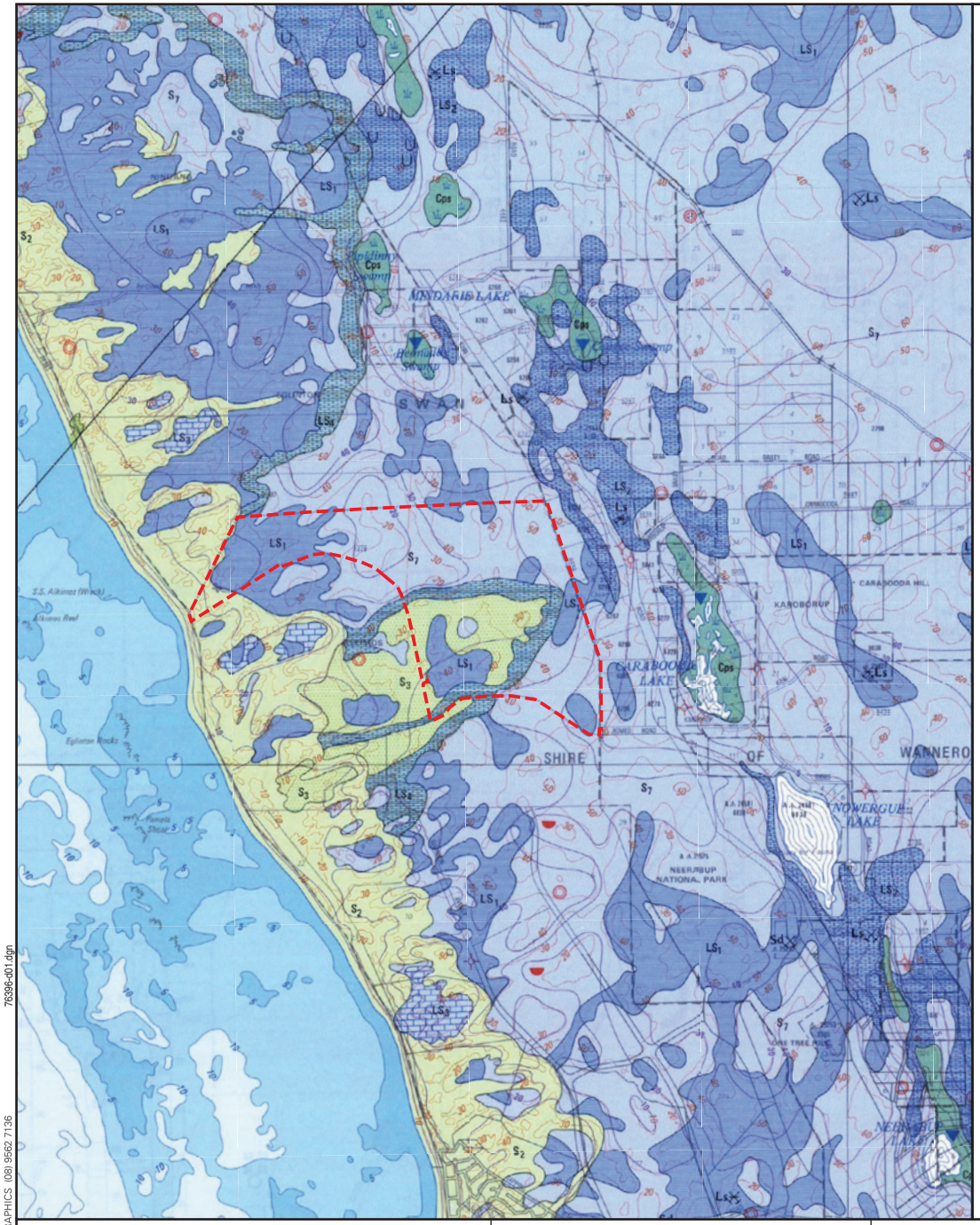
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

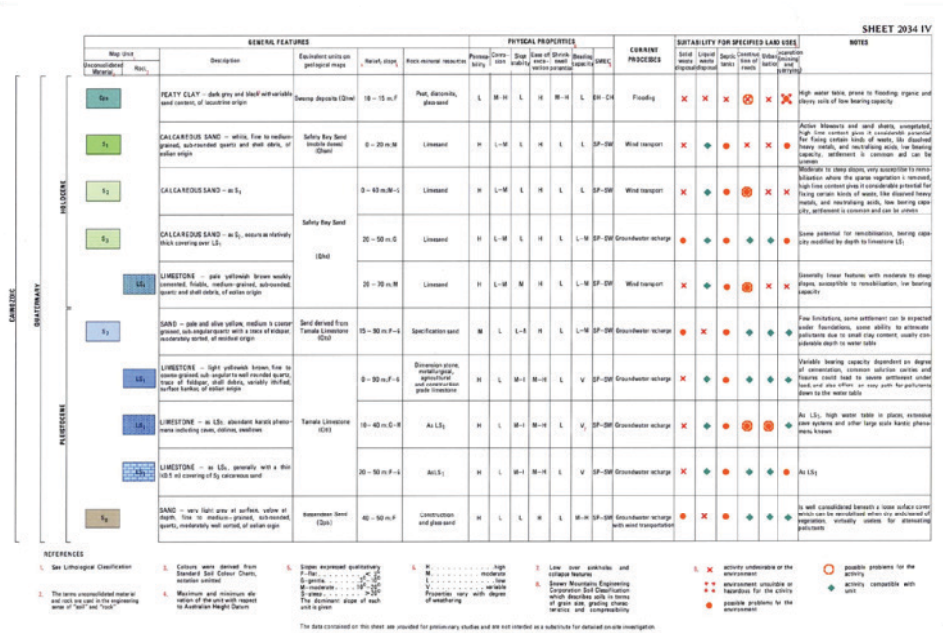
Information for Contractual Purposes

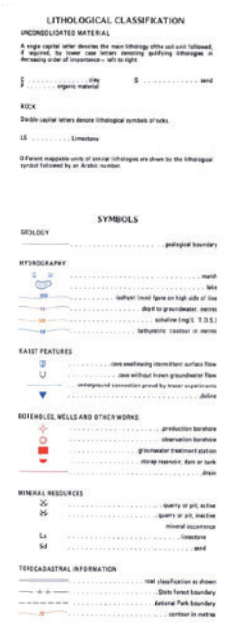
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.







0 0.5 1 1.5 2km

SCALE 1 : 50 000 at A3

Legend

Site Boundary

76396-d01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Lend Lease Communities (Alkimos) Pty Ltd		TITLE: **Site Boundary and Geology**	PROJECT No.: 76396
OFFICE: Perth	DRAWN BY: D. Reaveley	**Desktop Geotechnical Study, Proposed Central Alkimos**	DRAWING No.: 1
SCALE: As shown	DATE: 21 Jun 2012	**Development, Alkimos, WA** SOURCE: Geological Survey of WA, 1 : 50 000 Environmental Geology Series. MGA	REVISION: A

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}		100 years		The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-3}$	1000 years	200 years 2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-4}$	10,000 years		The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-5}$	100,000 years	20,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}	$5x10^{-6}$	1,000,000 years	200,000 years	The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or L (5)
B - LIKELY	10^{-2}	VH	VH	H	M	L
C - POSSIBLE	10^{-3}	VH	H	M	M	VL
D - UNLIKELY	10^{-4}	H	M	L	L	VL
E - RARE	10^{-5}	M	L	L	VL	VL
F - BARELY CREDIBLE	10^{-6}	L	VL	VL	VL	VL

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

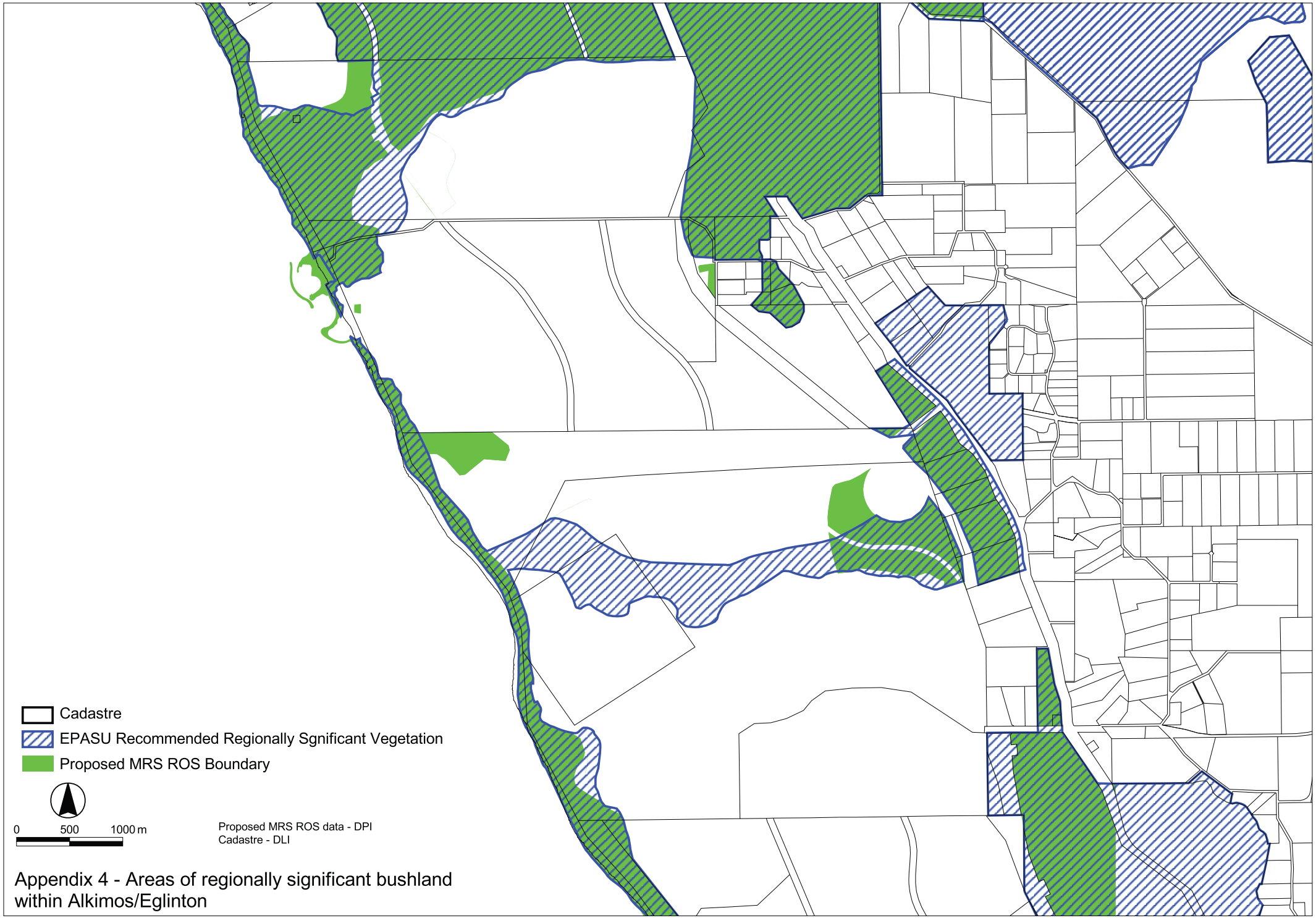
Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

Appendix C

Regionally Significant Bushland within the Alkimos Eglinton Area

Appendix 4

Areas of regionally significant bushland within Alkimos - Eglinton



Appendix 4 - Areas of regionally significant bushland within Alkimos/Eglinton

Appendix D

Ministerial Statement No. 722

Hon Mark McGowan MLA
Minister for the Environment;
Racing and Gaming

Statement No. 722

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF DIVISION 3 OF PART IV OF THE ENVIRONMENTAL PROTECTION ACT 1986)

ALKIMOS-EGLINTON METROPOLITAN REGION SCHEME AMENDMENT 1029/33

Scheme Purpose: To amend reservations and zonings in the Metropolitan Region Scheme consistent with the Alkimos-Eglinton Structure Plan.

Responsible Authority: Western Australian Planning Commission

Responsible Authority Address: 469 Wellington Street, PERTH WA 6000

Assessment Number: 1365

Report of the Environmental Protection Authority: Bulletin 1207

Subject to the following conditions, there is no known environmental reason why the amendment to the Metropolitan Region Scheme to which the above report of the Environmental Protection Authority relates should not be implemented:

1 Additional Land to be Reserved

1-1 All or portions of the following sites shall be reserved, in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be Implemented" No. (insert number) published on (date):

1) Public Purpose reserve surrounding the Wastewater Treatment Plant;
2) Parks and Recreation Reserve north of Ningana Bushland;
3) Parks and Recreation Reserves south of Ningana Bushland;

Published on

24 APR 2006

4) Parks and Recreation Reserve north of the Waste Water Treatment Plant;
5) Town park immediately north of the Alkimos Regional Centre;
6) Rationalisation and reductions to the coastal foreshore Regional Open Space reservation; and,
7) East-west parabolic dune linkage.

2 Environmental Management Plans

2-1 Prior to approving subdivision or development applications (whichever is sooner) for infrastructure proposals, the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed subdivision, development or infrastructure on the following:

1) land which is reserved as Regional Open Space in the Scheme; and,

2) bushland or land that may be part of an ecological linkage.

The Environmental Management Plan shall include:

1) a description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of this plan;

2) clear delineation of boundaries or significant areas to be protected;

3) management of construction, access and rehabilitation;

4) vegetation mitigation strategies;

5) allocation of responsibilities and identification of timing and duration of implementation;

6) provision for routine monitoring and environmental values; and

7) provision of details of contingency plans in the event that the monitoring surveys indicate that the development is having or has had an adverse impact upon environmental values.

2-2 An Environmental Management Plan prepared pursuant to condition 2-1 shall be prepared to the satisfaction of the WAPC or the local authority as required, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.

3 Areas of Public Purpose Reservation to be protected for conservation purposes

3-1 Portions of the Public Purpose reservation for the Wastewater Treatment Plant shall be set aside and managed for conservation purposes in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be implemented" No. (insert number) published on (date):

4 Lifting of Urban Deferment – Wastewater Treatment Plant Buffer

4-1 Lifting of Urban Deferment within the southern portion of the Wastewater Treatment Plant Buffer shall not occur unless it is demonstrated to the requirements of the Environmental Protection Authority that the area within which Urban Deferment is to be lifted is not subject to odour at a level likely to cause adverse impacts on the amenity of odour sensitive land uses.

5 Development within areas reserved for Parks and Recreation

5-1 With the exception of the areas specified in condition 5-2, all land reserved for Parks and Recreation shall be managed to protect the integrity, function and environmental values of the bushland and landforms to the requirements of the Western Australian Planning Commission on the advice of the Environmental Protection Authority and shall only be used for conservation, landscape and complimentary purposes.

5-2 A maximum of 25 percent of the area of the land to be reserved for Parks and Recreation identified as Areas 6a and 6b on the attached Figure may be developed for Parks and Recreation purposes in accordance with an Environmental Management Plan prepared to the requirements of the Environmental Protection Authority.

HON MARK McGOWAN MLA
MINISTER FOR THE ENVIRONMENT;
RACING AND GAMING

24 APR 2006

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED – METROPOLITAN REGION SCHEME AMENDMENT 1029/33

SPECIFICATIONS FOR RESERVATION FOR THE WASTE WATER TREATMENT PLANT AND ADDITIONAL LAND TO BE RESERVED

1 Additional Land to be Reserved

Prior to finalisation of the scheme the following land shall be reserved:

1-1 **Public Purpose Reserve surrounding the Wastewater Treatment Plant**

Land surrounding the Wastewater Treatment Plant as detailed in the attached Figure shall be reserved for Public Purposes to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for complementary purposes.

1-2 **Parks and Recreation Reserve north of Ningana Bushland**

A portion of Lot M1503 (Area 1b as detailed in the attached Figure), Eglinton shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-3 **Parks and Recreation Reserve south of Ningana Bushland**

A portion of Lot M1503, Eglinton (Area 2b as detailed in the attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-4 **Parks and Recreation Reserve south of Ningana Bushland**

A portion of Lots M1503 and 11, Eglinton (Area 3a as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-5 **Parks and Recreation Reserve north of the Waste Water Treatment Plant**

A portion of Lots M1482 and 102, Alkimos (Areas 5a and 5d as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the

Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-6 Town Park immediately north of the Alkimos Regional Centre

A portion of Lot 102, Alkimos (Areas 6b and 6c as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-7 **Rationalisation and reductions to the coastal foreshore Regional Open Space reservation**

A portion of Lot 102, Alkimos (Area 7c as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

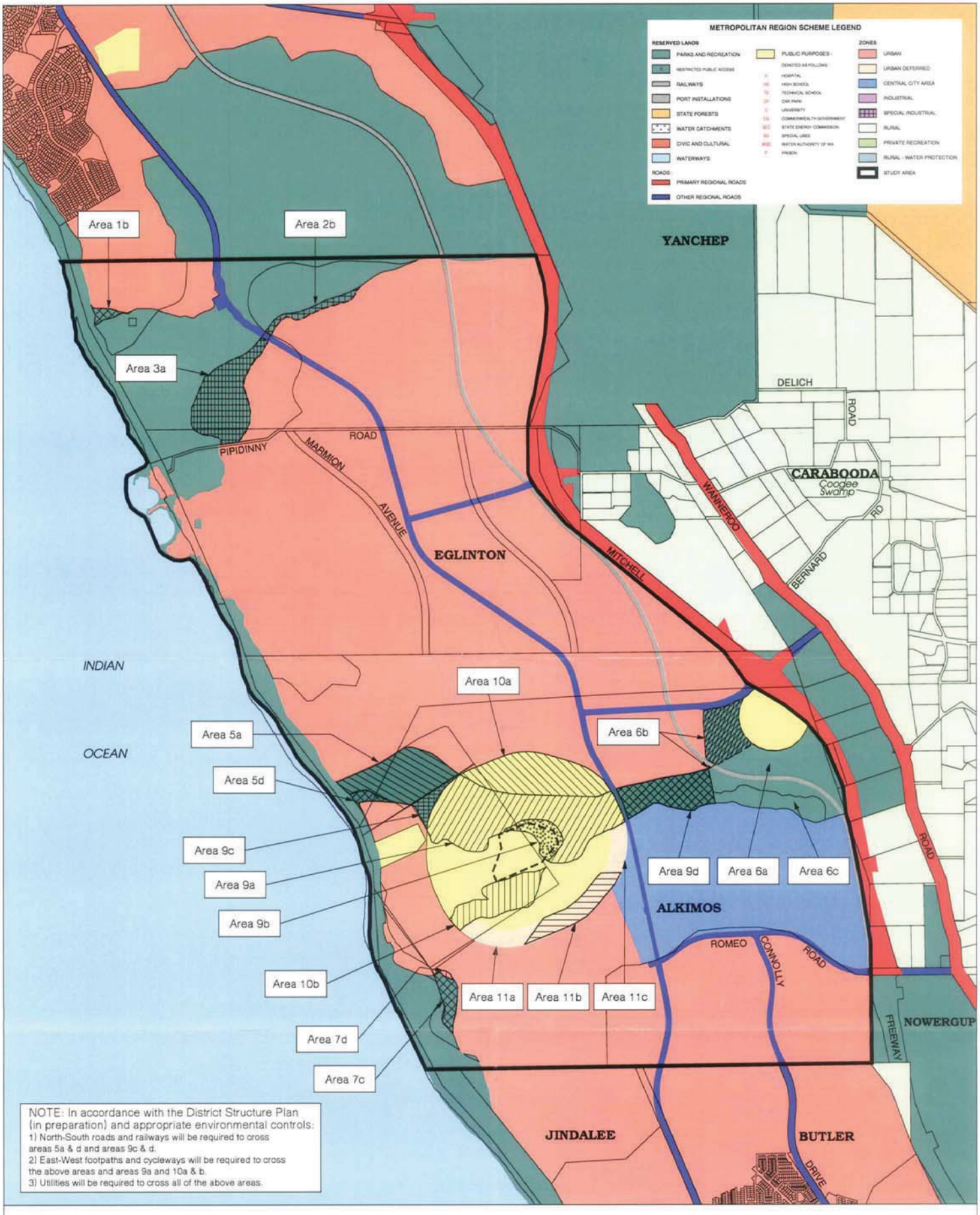
1-8 **East-west parabolic dune linkage**

A portion of Lots 101 and 102, Alkimos (Areas 9c and 9d as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

2 **Areas of Public Purpose reservation to be protected for conservation purposes**

2-1 **Portions of Lots 101 & 102, Alkimos to be reserved for Public Purposes**

(Areas 9a, 10a and 10b in the attached Figure) shall be protected and managed for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes. Minor infrastructure may be installed within these areas, providing the work is undertaken in accordance with a Management Plan approved by the Environmental Protection Authority



Western Australian Planning Commission

GDA

MRS AMENDMENT 1029/33 ALKIMOS-EGLINTON
As determined by Minister for the Environment

N

1.5 km 0 1.5 km

SCALE 1:30000

Base information supplied by DLI PA 23-2003
mindeterm.dgn
20 Apr 2006
Produced by Statutory Mapping Section, Spatial Information & Research - Mapping & GeoSpatial Data, Department for Planning and Infrastructure, on behalf of the Western Australian Planning Commission, Perth WA

Appendix E

Archaeological survey (Dortch Cuthbert 2021)

Archaeological survey of a proposed development area at Alkimos, Western Australia

Report prepared for
Moodjar Consultancy

Joe Dortch

March 2021

Dortch Cuthbert
HERITAGE FUTURES

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Mob. 0428 601 008
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Fremantle WA 6160
ABN 46 854 471 403

Geographic Co-ordinates

Geographic co-ordinates in this report are based on the Map Grid of Australia and use the Geocentric Datum of Australia 1994 (GDA94) datum. Co-ordinates in this report were obtained using Garmin Etrex and Legend hand-held Global Positioning System receivers. The manufacturer states that these devices are on average accurate to within 10 metres.

Disclaimer

This report has been prepared from information available at the time of research and writing. Dortch & Cuthbert Pty Ltd is not responsible for any omissions of or inconsistencies with information that may subsequently become available.

Project reference

The Dortch Cuthbert reference is 0223.

Executive Summary

Project background

On 27 and 29 January 2021, an archaeological survey team inspected a proposed development site at Alkimos (City of Wanneroo Local Government Area) where Development WA (the proponent) propose to create a new commercial centre and residential development (the survey area; Maps 1, 2) referred to as "Alkimos Central". The archaeological survey team comprised six Noongar consultants, and archaeologist Joe Dortch, project manager Len Collard, camera-person Miranda Chirida, and anthropologist Dave Palmer of Moodjar Consultancy. The same team conducted an ethnographic survey in parallel (Palmer 2021).

Previous archaeological research and surveys

Archival research showed that the survey area contains no known Aboriginal sites with archaeological components, but it does include limestone outcrops known in Western Australia as "pinnacles", or limestone root-casts. The pinnacles in the survey area are mapped as Place ID 37478 *Romeo Road Pinnacles* "Stored Data / Not a Site" in the Register of Places and Objects maintained by the Department of Planning, Lands, and Heritage (DPLH). Despite this downgrading of protection, Place ID 37478 is reported to have high cultural values and has largely been avoided by previously approved development work within the survey area. The site can be identified from the physical extent of pinnacles on the surface, which suggests Place ID 37478 is mapped incorrectly. The survey team identified numerous pinnacles outside of the mapped rectangular area currently defining Place ID 37478.

There are numerous heritage sites within 5 km of the survey area. The nature of these sites and other regional archaeological evidence indicates that stone artefact scatters, limestone features, modified trees and burials may be found in or near the present survey area, including material concealed by vegetation or below ground surface. Any well-preserved archaeological sites would be of value to archaeological research in the region as well as having probable Noongar cultural or broader community significance. Much of the survey area has not been cleared or excavated, and therefore has some potential to contain yet-unidentified archaeological material. It should be acknowledged that the survey area contains no obvious water sources, which are attractors for past Aboriginal occupation, and therefore the survey area probably has a lower potential for containing archaeological material than other areas that have better water sources.

Archaeological survey methods

The survey method comprised surface inspection of the survey area. The inspection was partial because of dense plant cover in most areas. The team inspected firebreaks, tracks, and natural exposures of the ground surface. The team recorded the positions of surveyed areas with hand-held GPS units accurate to +/- 10 m (a Garmin Legend HCx30 and a Garmin GPS60). Some areas were inaccessible due to current development work (previously approved) or very thick vegetation. Nevertheless, the survey team was able to assess about 64% of the survey area.

Archaeological survey results

The survey located no archaeological sites in the survey area but did identify points of interest, including (1) the pinnacles in and around Place ID 37478; (2) ancient soils that potentially contain evidence of early Aboriginal occupation; and (3) groves of culturally important plants (Map 2).

The proposed development work will involve ground clearing and excavation and therefore could disturb presently concealed archaeological material if it is present, including burials/skeletal remains. Therefore, some form of archaeological monitoring of clearing and ground-disturbing work is desirable.

Recommendations

While no archaeological sites are currently evident in the survey area, the survey area holds importance for Noongar custodians in the form of pinnacles and culturally significant plants. In addition, the soils of the survey area may conceal archaeological evidence of Aboriginal occupation.

On this basis, it is **recommended**:

1. The area of the pinnacles should be mapped using aerial photography shot on drone transects, as pedestrian access is impractical due to thick vegetation. With the additional ethnographic commentary recorded in the survey (Palmer 2021), more detailed and accurate heritage information could then be submitted to DPLH for reconsideration of the area of pinnacles as an Aboriginal heritage site.
2. Prior to any ground-disturbing work, DevelopmentWA should consider engaging suitably experienced Noongar people to monitor the works in case sub-surface heritage material is inadvertently unearthed. An archaeologist should also be engaged on a call-out basis should monitors require further assessment of any suspected heritage material.
3. Protection of mature trees is important for Noongar consultants and should be considered wherever possible.
4. An Aboriginal Cultural Heritage Management Plan or similar should be developed, before ground disturbance occurs, to allow for culturally appropriate management of any discoveries of suspected or actual heritage material.
5. The Aboriginal Cultural Heritage Management Plan should include a requirement that staff and contractors should be informed of the legal requirement to avoid disturbance to any Aboriginal site as defined in the *Aboriginal Heritage Act 1972* (Western Australia), whether registered or otherwise, and the view that disturbance of a site includes ground disturbance, souveniring or defacement.

Contents

Maps

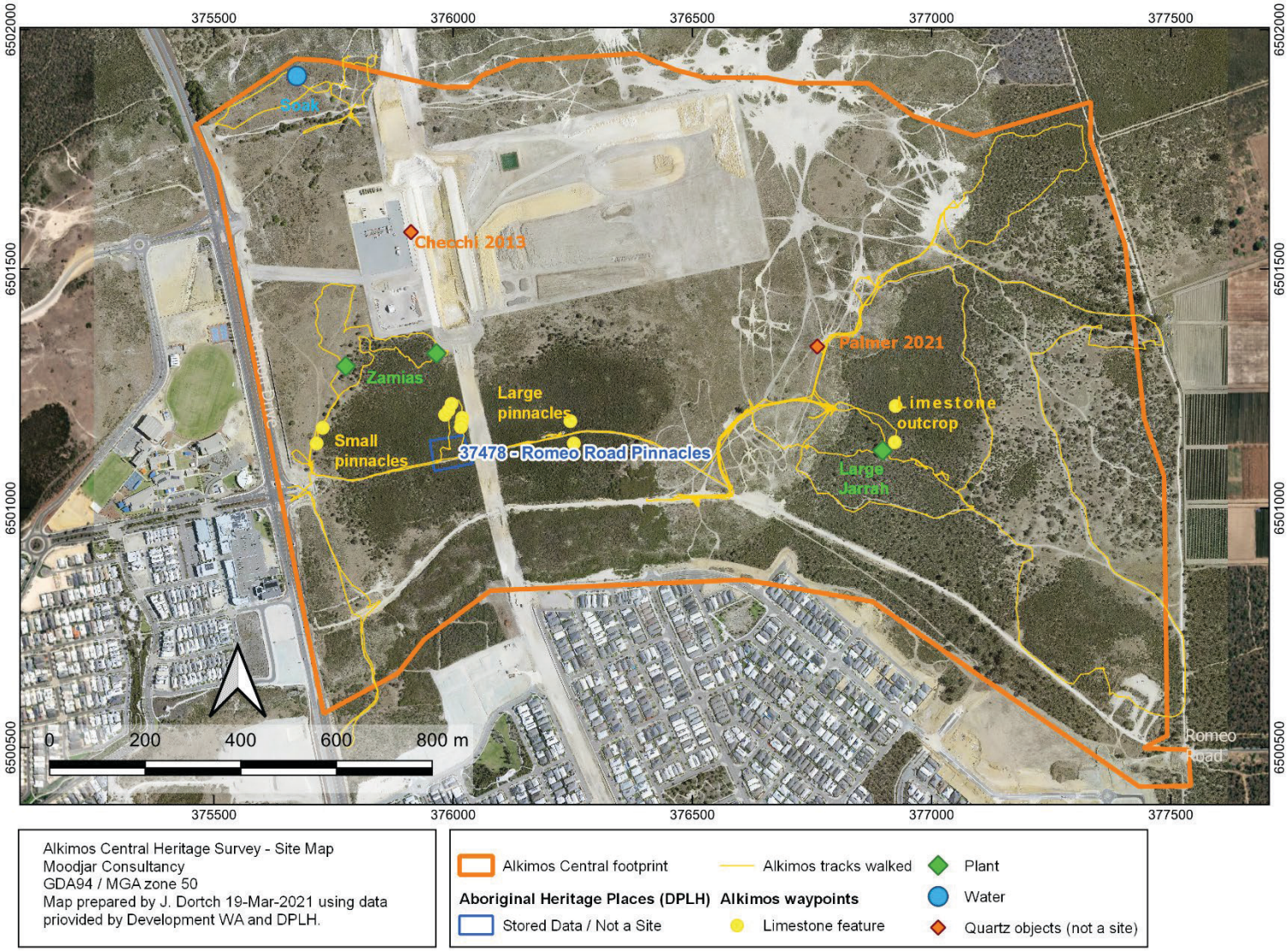
Photos

Tables

Terms used in this report

ACMC	Aboriginal Cultural Materials Committee
AHA	*The Aboriginal Heritage Act 1972* (WA)
AHIS	Aboriginal Heritage Inquiry System
BP	Before Present – for the purposes of reporting radiocarbon dates, "present" is 1950.
DAA	Department of Aboriginal Affairs, former administrator of the Register of Places and Objects. Also known previously as DIA, Department of Indigenous Affairs.
DPLH	Department of Planning, Lands and Heritage, administrator of the Register of Places and Objects
GDA94	Geocentric Datum of Australia 1994. The datum used for the MGA (see below).
GIS	Geographical Information System: software for analysing and presenting spatial data.
GPS	Global Positioning System, a group of high-orbit satellites communicating with individual mobile transceivers, enabling accurate locations.
MGA	Map Grid of Australia. A map grid used for Global Positioning Systems and Geographic Information Systems coordinates including the DPLH Register.
Noongar	The Indigenous people and Traditional Owners of south-western Australia. Alternative spellings include *Nyoongar* and *Nyungar*.
NTA	*The Native Title Act 1993* (Commonwealth)
Register	Register of Places and Objects – the Western Australian government's list of Aboriginal heritage places and other heritage materials, accessible on-line.
SWALSC	South-West Aboriginal Land and Sea Council
UTM	Universal Transverse Mercator (map projection)

Map 1: Survey area



Map 2: Heritage survey results

Photo 1: View west along northern boundary of DPH Place ID 37478, with Philip Collard, Betty Garlett, Faron Garlett and Miranda Chirinda, and limestone pinnacles.

Photo 2: View south-east of limestone pinnacles located north of DPLH ID 37478, with railway cutting through dune in background, revealing yellow Spearwood type sands.

Photo 3: View west over introduced pasture grasses in the western part of the survey area – typical of the northern half of the survey area before the current construction project began.

Photo 4: View south-west over steep mobile dunes in the north-western part of the survey area

Photo 5: View north of reeds growing in the small soak in the north-west of the survey area

Photo 6: View north-east over dune blow-outs in Quindalup-type sands in the centre of the survey area. The current construction project is visible in the background.

Photo 7: View north-east over extensive area of Banksia woodland in a dune swale in the south-east quarter of the survey area. Some of the survey team in middle ground.

Photo 8: Narelle Ogilvie standing near an old balga in the south-east of the survey area

Introduction

On 27 and 29 January 2021, an archaeological survey team inspected a proposed development site in the suburb of Alkimos (City of Wanneroo Local Government Area) where DevelopmentWA (the proponent) propose to create a new commercial centre and residential development (the survey area; Map 1) referred to as "Alkimos Central". The archaeological survey team comprised Joe Dortch (PhD, Archaeology UWA) and Noongar consultants who also advised the ethnographic survey.

The survey aimed to identify any archaeological places within the survey areas that may constitute sites under Section 5 of the *Aboriginal Heritage Act 1972* (the Act); and to record them in sufficient detail to inform recommendations for their management. An additional aim of the survey was to support the identification and recording of any features or materials of general Aboriginal cultural significance. Archaeologist Joe Dortch (PhD, Archaeology) and Noongar representatives conducted the archaeological survey. Whadjuk Traditional Owner Len Collard of Moodjar Consultancy managed and coordinated the survey fieldwork for the respective archaeological and ethnographic components. Anthropologist Dave Palmer (PhD, Sociology & Anthropology) undertook ethnographic research with the Noongar consultants at the same time (Palmer 2021).

This report details the findings of the surveys and provides recommendations to Moodjar Consultancy and DevelopmentWA.

Project background

DevelopmentWA, which is part of the Western Australian Government, proposes to manage the construction of a commercial hub to be called Alkimos Central. This project will occupy all the survey area. It will provide private and public services, retail complexes, offices, a social hub, and amenities for the 57,000 residents of the Alkimos-Eglinton District over the next two to three decades. The land on all sides of the survey area is also being developed, or will be developed, for various residential, commercial, and transport uses, including residential sub-divisions, the Mitchell Freeway extension, and shops and businesses.

Survey area

The survey area covers an irregular rectangular area covering 205 ha, bounded by Marmion Drive to the west, new sub-divisions to the north and south, and market gardens to the east (some of which will become part of the Mitchell Freeway) (Map 1). The terrain in the survey area comprises rolling sand dunes and dune swales (Photos 1-7). Much of the area was converted to pastoral use some decades ago, but large parts, especially in the southern half, appear not to have been cleared or have re-growth vegetation. Currently the survey area includes areas of introduced pasture grasses (mostly across the northern half of the survey area; Photo 3), native dune vegetation (on the dune crests; Photo 4), and mature native trees and grass-trees (mostly across the southern half of the survey area; Photos 1-2, 5-8). The vegetation appears to be in good condition in parts (Photos 7-8). A north-south corridor through the entre survey area is being developed for a suburban railway (Photo 2). Currently there is evidence of substantial illicit activity in the survey area, e.g. off-road vehicle driving (including trail bikes), burning of stolen cars, rubbish dumping. These activities mostly pose minor disturbances. However, vehicle use is causing some erosion around dune crests which also feature

blow-outs (Photo 6). There is also a current development project, previously approved, in the centre of the survey area.

No spatial data were provided to the Moodjar team before fieldwork. The archaeologist geo-referenced an image of the survey area and plotted a survey area polygon based on that image, with vertices shown below (Table 1).

Table 1: Survey area and bounding coordinates (MGA, GDA94)

Node	mE	mN	Node	mE	mN
1	376714.23	6501888.47	18	375729.32	6500571.13
2	376868.35	6501887.96	19	376078.46	6500827.89
3	376523.96	6501900.24	20	375939.6	6500725.67
4	376656.06	6501899.47	21	376877.21	6500804.67
5	376383.27	6501950.01	22	376608.51	6500850.59
6	376465.73	6501915.92	23	377542.16	6500419.65
7	375460.42	6501798.65	24	377434.11	6500418.38
8	376059.58	6501904.05	25	377443.17	6500498.58
9	376137.27	6501935.38	26	377537.27	6500495.02
10	375505.58	6501705.06	27	377486.47	6501067.4
11	375979.82	6501879.71	28	377492.89	6500524.9
12	375505.58	6501705.06	29	377404.71	6501550.54
13	376033.85	6501880.36	30	377445.05	6501186.18
14	375670.89	6501939.16	31	377333.13	6501849.04
15	375736.98	6501935.27	32	377332.05	6501771.85
16	375460.42	6501798.65	33	376963.23	6501818.93
17	375884.41	6500654.85	34	377089.8	6501778.34

Survey team

The Survey Team comprised six senior Noongar representatives with knowledge of the survey area, an archaeologist, an anthropologist, a cameraperson, and a project manager (Table 2). The expertise of the Noongar consultants is detailed by Palmer (2021).

Table 2: Participants in the heritage survey

Name	Role	Dates attending
Phillip Collard	Noongar consultant	27 Jan 2021
Betty Garlett	Noongar consultant	27 & 29 Jan 2021
Faron Garlett	Noongar consultant	27 & 29 Jan 2021
Dennis Simmons	Noongar consultant	27 & 29 Jan 2021
Narelle Ogilvie	Noongar consultant	29 Jan 2021
Freda Ogilvie	Noongar consultant	29 Jan 2021
Len Collard	Project Manager	27 & 29 Jan 2021
Dave Palmer	Anthropologist	27 & 29 Jan 2021
Miranda Chirinda	Cameraperson	27 & 29 Jan 2021
Joe Dortch	Archaeologist	27 & 29 Jan 2021

Study brief

DevelopmentWA and Gundi Consulting (through Oral McGuire) asked Moodjar Consultancy to undertake a combined archaeological and ethnographic heritage assessment of the survey area suitable for a Work Area clearance. In this approach, a survey team aims to identify all Aboriginal heritage issues within the Survey Areas, including the extents of smaller areas or places within those Survey Areas that require management or protection. From an Aboriginal heritage perspective, the balance of the Survey Area that does not require management or protection is then cleared for development. The survey involved:

- a summary of the potential legal obligations for the proponent,
- a desktop review of relevant past heritage findings and backgrounds materials in the literature of the area in question,
- a field inspection of the survey area with representatives of the traditional owner group,
- a summary of field results, and
- formulation of cultural heritage management recommendations.

The work by Moodjar Consultancy was to include assessment of an area of limestone pinnacles, known as DPLH Place ID 37478 *Romeo Road Pinnacles*.

Impact of proposed work

From the point of view of protecting heritage material, the primary concern with any proposed project is the impact on heritage sites. As part of this concern, archaeologists are concerned with the extent of ground disturbance of previously undisturbed or *in situ* archaeological deposits.

The proposed work also involves clearing vegetation in the survey areas and large-scale excavation in advance of construction of roads and buildings. These activities may alter any archaeological remains down to the depths of excavations for foundations, footings, pilings, etc, because such heritage material could be either destroyed, or removed from its stratigraphic context. These disturbances may also impact ethnographic (cultural) values.

Legal obligations

Proponents should be aware of any legal obligations or potential legal obligations they may have in relation to ground-disturbing activities they propose to undertake. For small to medium scale exploration works and minor infrastructure in Western Australia there are two main Acts the proponent should be aware of – the *Aboriginal Heritage Act 1972* (WA; the AHA) and the *Native Title Act 1993* (Commonwealth).

The principal Act in Western Australia through which nearly all Aboriginal heritage is managed is the AHA. The proponent should be aware that under this Act:

- It is an offence to disturb or alter Aboriginal sites or objects, whether they are registered under s17 of the AHA or not, unless consent to do so has been granted by the Minister of Aboriginal Affairs (WA).
- All land users who wish to use land for a purpose which might contravene s17 of the AHA must exercise due diligence in trying to establish whether their proposed activity in a

specified area may damage or destroy an Aboriginal site. A land user is obliged to comply with the provisions of the AHA and failure to do so may result in prosecution.

- If a proponent wishes to use the land in a manner that impacts an Aboriginal site, they may do so only with permission from the Minister for Aboriginal Affairs under s18 of the AHA. Section 18 applications are made to the Aboriginal Cultural Materials Committee (ACMC), which advises the Minister. Depending on the level of significance accorded to a site, which is determined through comprehensive ethnographic and archaeological investigations, the ACMC may advise that a s.18 permit is allowable.
- All Aboriginal sites are protected by the AHA, whether or not they have previously been identified or registered, provided that the site can be determined to meet the definitions under s.5 and s.39 (Appendix 1).

Though the AHA is the principal heritage Act in Western Australia, particularly in relation to the activities of the mining and construction industries, many proposed new works in the state are located on land subject to native title claims and/or falling under areas controlled by heritage agreements.

In the former Noongar native title claim area, the South West Settlement Agreement between the Western Australian state government and SWALSC effectively removes native title while providing certain rights and benefits to Noongar (Noongar) people. Although this agreement eliminates the old "Future Acts" regime in the former Single Noongar claim area, ground-disturbing activities by Government proponents will still be subject to heritage agreements appropriate to the level of impact. In the case of the Alkimos Central project, the South West Settlement Agreement requires DevelopmentWA to enter into a Noongar Standard Heritage Agreement with Whadjuk people governing the conduct of the survey.

Background

This section addresses environmental characteristics of the survey area to indicate survey conditions for potential future work, and the locations and nature of Aboriginal sites in the survey area. It also discusses Aboriginal land-use history and nearby archaeological research and surveys to help ascertain the significance and distribution of potential archaeological sites in the survey area.

Environment

In south-western Australia, past Aboriginal settlement patterns relate to the marked seasonal climatic changes of the Mediterranean climate (Anderson 1984). Oral and written histories indicate that people gathered in large groups for relatively long periods in coastal areas near lakes and streams in the dry summer and dispersed inland in small groups in winter. The survey area is some 2 km from fresh-water lakes and swamps. Freshwater lakes were particularly important for historical groups of Noongar people (Green 1979).

The survey area is located on the Swan Coastal Plain, which represents the surface sediments of part of the Perth Basin (Geological Survey of Western Australia 1990). The Swan Coastal Plain is formed almost entirely of aeolian or alluvial sands and silts (McArthur 1991). The alluvial deposits are mostly at the foot of the Darling Scarp, 30 km to the east. This sedimentary context has two implications for archaeology in the survey area.

Firstly, the coastal plain is largely devoid of hard rocks with conchoidal fracture, implying that any rock in the survey area, that is suitable for stone artefact manufacture, is likely to derive from a source such as the Darling Scarp, which forms the western rim of the Yilgarn Craton. Artefacts may also be made from Eocene fossiliferous chert, a rock thought to be outcropping on now-submerged parts of the palaeo-Swan Coastal Plain west of the present shoreline (Glover 1984). Before sea-level rises that terminated at about 5,000 BP, Aboriginal people quarried this rock for stone tools, and through seasonal movements over the region, discarded thousands of fossiliferous chert artefacts at locations across the presently emergent parts of the coastal plain (Hallam 1987).

Secondly, the types of dune systems, deposited during successive high sea-level stands, indicate the age range and significance of archaeological materials found in them. The dune systems (Bassendean, Spearwood, and Quindalup) are arranged in successively younger parallel bands from scarp to coast. The survey area is covered entirely by sands belonging to the Spearwood and Quindalup Systems (Department of Agriculture 2003).

The yellowish-brown Spearwood dunes are Late Pleistocene to early Holocene in age (120,000-5,000 years old), have high relief, and are generally well-vegetated and stable. They interfinger with Tamala Limestone, a calcarenite formed by wind-deposition of shelly sand followed by partial or complete lithification. At the surface, the limestone can form pinnacles, created primarily by the dissolution of softer rock but also the cementation of harder calcrete in voids or around root or trunk casts (Lipar and Webb 2015). Along the west coast of south-western Australia, limestone pinnacles form extensive fields of cylindrical or conical rocks emerging from dune surfaces. They have cultural significance across the region.

Radiocarbon-dated charcoal sequences, including archaeological sites (Clarke and Dortch 1977, Ferguson 1980, Dortch and Dortch 2019), and cases of well-preserved dune-bedding suggest good potential for preservation of Late Pleistocene and early Holocene stratigraphy (Glassford and Semeniuk 1990). Yellowish sands and limestone indicating components of the Spearwood System are evident across the survey area, either directly exposed or outcropping, or in the case of the Spearwood sands, visible around ant nests.

The creamy-white Quindalup dunes are late Holocene in age (less than 5,000 years old), have high relief and are sparsely vegetated. They are being actively formed in the present high sea-level stand (and over the last 5,000 years), as wind and waves pile up sand from the sea floor onto the coastline. With prevailing onshore winds, they are mobile and advancing over some inland areas. Two factors suggest potential for finding Aboriginal burials in Quindalup dunes: (1) these sands contain a high percentage of shell, which means that they are alkaline and have potential for preserving bone, and (2) being loose and uncompacted, they also may have been more easier locations for burying the dead. Quindalup dunes cover several parts of the survey area, especially on its northern boundary and in an arc curving southward through the centre.

The survey area is located 900 m from Lake Carabooda to the east, and 1.9 km from Lake Nowergup to the south-east (Map 1). Guided by local Noongar people, the British explorer Grey (1841) recounted the name of the latter lake as "Now-oor-goop". He notes the "good land" and abundant wetland plants and animals around the lakes in general, in contrast to the surrounding sandy country. In the surrounding region, several lakes are listed as Aboriginal heritage places by DPLH, as sources of fresh water and traditional plant and animal food resources and because of their mythological associations.

Survey area vegetation comprises dense heath and shrubland, with groves of eucalypts (e.g. *Eucalyptus gomphocephala*, Djuart/Tuart; and *Eucalyptus marginata*, Djaree/Jarrah) and banksias in pockets in the eastern third (Beard 1981). Other plants found in the eastern areas include large grasstrees (*Xanthorrhoea preissii*, Balga) and zamia palms (*Macrozamia* spp., Jeeriji).

Ground visibility is only about 10% in areas of remnant vegetation in the survey area, but dune blow-outs and firebreaks give 100% visibility. Firebreaks and access tracks running throughout the survey area expose the surface sediments and artefacts in some places, allowing some assessment of the archaeological potential of the survey area. Where ground visibility is as poor as the present survey area, and the potential for intersecting archaeological remains is deemed to be high, sub-surface survey is sometimes recommended (Nance and Ball 1986).

Aboriginal land-use history

Oral histories of south-western Australia are highly informative about Noongar economic and cultural practices (Harben et al. 2009, Palmer 2021 and references therein). Knowledge of these practices inform archaeology and provides important context for heritage assessments. In the Perth area, written histories are also informative because early European settlement, largely restricted to the Swan River and the Avon valley, did not stop Noongar people from traditional hunting and gathering over neighbouring regions for many decades, and they also permitted a degree of inter-cultural contact and observation (*e.g.* Grey 1841, Hammond 1933, Moore 1884). The following

discission emphasises historical values and written sources. Palmer (2021) reports oral histories in more detail and provides a discussion of contemporary Noongar values as an expression of these traditions.

The pre-European Noongar economy was based on the systematic exploitation of seasonally available resources in coastal and adjacent inland districts (Berndt 1979, Dortch 2002; Green 1979; Meagher 1974; Hallam 1975, 1987). Family groups travelled seasonally from their core estate territories across larger dialectal group ranges. They established marriage networks and alliances with other family and other dialect groups according to moiety and totemic affiliation. Economic activities such as trapping of fish in estuaries or firing of vegetation for resource management and animal drives, required coordinated group effort between families. Responsibilities and rights for food gathering and other activities and rituals were determined by totemic and estate affiliation.

The diversity of resources and the adaptability of the subsistence economy meant that food could be obtained almost anywhere throughout the year (Meagher 1974), but seasonal abundances and shortages influenced settlement patterns (Anderson 1984, Hallam 1987). Generally, people exploited coastal and estuarine resources in summer and moved inland in winter. Summertime gatherings satisfied social and economic needs. Sustained by large quantities of fish and wetland resources, people organised marriages and ceremonies, settled dispute, and conducted rituals during these gatherings (Dortch 2002).

Considering these interpretations of regional economy and social organisation, and the distance between the survey area and permanent tracts of surface fresh-water and wetlands, past activities in the survey area probably comprised short-term occupations. Given that historic Noongar people tended to avoid coastal storms in winter (*Makuru*, June-July), favoured seasons to visit the survey area may have been summer or autumn (*Birak*, *Bunuru* or *Djeran*), to forage for tubers, roots, fruit, seeds, reptiles, amphibians, and small mammals. The explorer Sir George Grey visited the area in December 1838 and was the guest of a large group of Noongar people living around lakes a days' walk north of the survey area (Grey 1841 (vol. 1): 296-303). In April 1839, Noongar people gathering frogs and tortoises and processing zamia nuts at one of the chain of lakes near the survey area, about 30 km north of colonial Perth, cooked some of their harvest for Grey and his party who were starving and dehydrated on another expedition involving shipwreck and a long journey on foot (Grey 1841 (vol. 2):89). Grey attributes the hospitality of the Noongar in part to his having spent some time with them before his journeys away, learning their language, and sharing food. These accounts show that substantial numbers of Aboriginal people occupied the region and enjoyed abundant resources in at least *Birak* (December-January) and *Djeran* (April-May).

Although south-western Australia's Mediterranean-type eco-system is resilient and broadly stable, the environment of the survey area has probably changed significantly throughout the Holocene (i.e. over c.10,000 years), due the rise of sea level, erosion of the coastline and constant dune movement after the end of the last glacial period (Newsome and Pickett 1997). Any yet-undiscovered older sites in the survey area dating from glacial and immediately post-glacial times may be associated with a somewhat different inland environment, e.g. featuring different vegetation, lower water table, and reduced water sources (Pickett 1997).

Regional archaeological research

Current archaeological research helps assess the significance of potential archaeological sites in a survey area. In the Perth metropolitan region, current research includes four main questions (Dortch and Dortch 2019), as follows:

1. What was the timing and the nature of the colonisation of Australia by Aboriginal people?

Sites on the Swan Coastal Plain and in lower south-western Australia provide some of the earliest dates for human occupation of Australia (Pearce and Barbetti 1981, Schwede 1990, Turney et al. 2001, Dortch and Dortch 2019). Alluvial terraces well beyond the survey area provide the oldest of the archaeological evidence in the Perth region, but the Spearwood Dunes still contain important archaeological sites dating from at least 12,000 BP (Clarke and Dortch 1977, Ferguson 1980). Tamala Limestone may contain caves, which contain important archaeological records (e.g. Turney et al. 2001, Monks et al. 2016), including one within 10 km of the survey area at Orchestra Shell Cave (Hallam 1974).

2. What was the nature of past interaction between Aboriginal people and environment on the Swan Coastal Plain?

Such interaction can be analysed by comparison of archaeological and palaeo-environmental records. The location of Swan Coastal Plain sites near wetlands and on fertile alluvial soils attests to early exploitation of coastal plain resources (Clarke and Dortch 1977, Hallam 1987, Pearce 1978). Cores in lakes in both northern and southern suburbs of the Perth metropolitan region provide pollen sequences showing changes in local vegetation (Newsome and Pickett 1993, Pickett 1997). Species-identified charcoal fragments from south-western Australian terrestrial deposits can also demonstrate environmental changes (Dortch 2004). Lastly, the distribution of archaeological sites in relation to natural features, especially lakes and swamps, demonstrates the importance of water sources and nature of land use through time (Hallam 1987, Dortch and Dortch 2019).

3. What is the evidence from stone artefacts (the predominant form of regional archaeological evidence) for change and continuity in Aboriginal economy, society and population?

Archaeologists have investigated variations in stone artefact manufacturing technology and economy to infer changes in past Aboriginal cultures. Artefact studies in regions such as the Darling Scarp (Pearce 1978), south-western Australia (Dortch 2004, Ferguson 1980), and south-eastern Australia (Hiscock 1986, Holdaway *et al*. 2004) help characterise patterns of site occupation. Inferred domestic and economic activities include food preparation and tool maintenance and production.

Hallam (1987) uses artefact assemblage characteristics to infer Aboriginal population changes in different parts of the Swan Coastal Plain and over time. She identifies a four-phase sequence based on raw materials and technology, divided by three events: (1) the blocking of access to fossiliferous chert with sea-level rise by 4,500 BP (Glover 1984, Hallam 1987), (2) the production and abandonment of microliths (small blade-like tools), and (3) the introduction of European glass and ceramics as raw material for making edged tools in the 1800s. Hallam argues that by c.AD 1800, growing Aboriginal populations had intensified the exploitation of plant resources on alluvial deposits below the Darling Scarp and may well have intensified production further (Hallam 1989).

This research is largely supported by more recent research, with the caveat that plant management in south-western Australia may have already been intensive for some time (Lullfitz et al. 2017). Caution is also required for investigating some sand deposits that could have been disturbed by development or by natural erosion (Schwede 1990, Bowdler et al. 1991).

4. What were the intercultural and intracultural relations at the time of European colonisation and afterwards?

The archaeology of Aboriginal-European interaction in the Perth area, well-documented from historical sources (e.g. Green 1979), has been little investigated. Such evidence typically gives insights into hidden histories, i.e. not available from written records, e.g. details of inter-group exchange, cross-cultural interaction, technological adaptation, and domestic economy can be inferred from discarded material culture (Harrison and Williamson 2002). Study of urban fringe camps has shown how Indigenous and other cultural groups colonised unwanted land to maintain independence (Smith and Beck 2003).

There is no written evidence that Aboriginal people camped in the survey area in the historic period. It is possible that Aboriginal people hunted or foraged in the survey area in historic times, but such activities may have left little archaeological evidence. Oral histories would be highly informative on this question.

Previous field surveys in and near the survey area

Previous archaeological field surveys in the survey area can indicate survey conditions and archaeological potential. No published archaeological research refers specifically to the survey area, but two survey reports indicate that parts of the survey area have been archaeologically inspected (O'Connor et al. 1990, Checchi 2013). O'Connor et al. (1990) do not map their sample areas, so it is not possible to determine if they inspected any part of the present survey area. Checchi (2013) only inspected the railway corridor and ancillary areas through the centre of the present survey area. It appears that parts of the survey area may not have been archaeologically assessed before.

The DPLH Register lists 12 heritage assessments involving archaeological and ethnographic fieldwork in or adjacent to the present survey area (Table 3, Appendix 3, Map 3).

Table 3: Previous heritage surveys in or adjacent to the survey area

Proponent	Year	Survey area	Survey type	Heritage places found	Reference
Main Roads WA	1989	Mitchell Freeway corridor SE of present survey area	Archaeological and ethnographic	None	O'Connor et al. 1989
Landcorp	1990	Clarkson, Eglinton and Alkimos residential developments (including the present survey area)	Archaeological and ethnographic	None	O'Connor et al. 1990
Main Roads WA	1997	Mitchell Freeway corridor NE of present survey area	Archaeological	None	Harris 1997
Main Roads WA	1997	Mitchell Freeway corridor NE of present survey area	Ethnographic	None	O'Connor 1997

LWP Property Group	2008	Lot 3 Romeo Road	Archaeological	None	Thomson 2008
LWP Property Group	2008	Lot 3 Romeo Road	Ethnographic	None in present survey area	Coldrick 2008
Public Transport Authority	2013	Railway corridor	Archaeological	Artefact pile – not a site	Checchi 2013
Public Transport Authority	2017	Railway corridor	Ethnographic	DPLH ID 37478	O'Connor 2017a
Public Transport Authority	2017	Railway station area	Ethnographic	DPLH ID 37478	O'Connor 2017b
Main Roads WA	uncertain	Mitchell Freeway corridor SE of present survey area	Archaeological	None in present survey area	Not certain - DPLH did not provide report

None of the above surveys reported any archaeological sites in or near the survey area, apart from an accumulation of possible artefacts thought to derive from modern dumping of artefacts from somewhere else (Map 2; Checchi 2013; Chris Shaw, pers. comm.). The various reports suggest the lack of sites is due to several factors: low ground visibility; lack of water resources in the areas surveyed; limited Aboriginal occupation in the surrounding area. Place ID 37478, the only heritage place identified in the survey area, is an ethnographic site, based on the spiritual and historic associations of a natural feature, the pinnacles.

Heritage places near the survey area

Analysis of recorded places near a given survey area provides important context for a survey. It indicates the probable features of heritage places that may be found within the survey area, and what features make a site significant. Although surveys of areas in and near the present survey area found very few sites, a wider Register search can still provide useful context.

The archaeologist searched the register for heritage places within 5 km of the survey area, identifying 24 heritage places (Table 4). A full listing of these heritage places is given in Appendix 4.

Many heritage places have multiple features (Table 4; Appendix 4). "Closed" site files (not accessible without authority of the traditional owners named in the site file) were not examined here, because none of the “closed” sites intersect the survey area, and the site files and data that are available provide sufficient indication of the potential archaeological values of the survey area and surrounding area.

Table 4: Summary of 24 Aboriginal heritage places within 5 km of the survey area

Features	Number of places with feature	Percent of places
Mythological	14	58%
Natural Feature	12	50%
Other	9	38%
Water Source	5	21%
Camp	3	13%
Artefacts / Scatter	2	8%
Named Place	1	4%
Ceremonial	1	4%

Historical	1	4%
Modified Tree	1	4%
Rockshelter	1	4%
Engraving	1	4%
Arch Deposit	1	4%
Dated	1	4%
Plant Resource	1	4%

Table 4 shows that most places within 5 km of the survey area are mythological sites or natural features, and are identified mainly from cultural knowledge and ethnographic sources (Coldrick and McDonald 2008, O'Connor 2017, Palmer 2021). Common archaeological site types like artefact scatters and modified trees can be hard to locate in urbanised areas, which may be why they are relatively rare within 5 km of the survey area.

The "Other" heritage places listed in Table 4 are also natural features or areas with reported cultural significance, reported by Traditional Owners. There are two main types of significant feature: limestone ridges, and mature trees. Coldrick and McDonald (2008) suggest that Noongar consultants have usually identified these places as important based on a general significance attached to those features, but Palmer (2021) recounts Noongar testimony for the current survey area that indicates there is still a considerable body of knowledge about these features. The limestone pinnacles are regionally significant and have historical associations. Mature trees are also important to Noongar people as living beings creating attractive environments and opportunities to reconnect to country and history (L. and P. Collard, in Palmer 2021).

Returning to the archaeological evidence, artefact scatters, modified trees and other potential site types are summarised as follows:

Artefact scatters Artefact scatters are the most common site type in the state-wide Site Register, but in the survey register search, they are uncommon. An artefact scatter comprises multiple stone artefacts near each other, usually a result of repeated tool-using activities at one location, such as a campsite or work area (Appendix 1). The artefacts may be exposed on the surface or unearthed in excavation. In some regions where there is excellent ground visibility, there are many 'isolated finds' scattered across the landscape (also known as 'background scatter'; Burke and Smith 2004, Isaac 1982). In the present survey area, limited surface visibility and widespread disturbances effectively remove artefacts from view. Hence the significance of any site should be assessed on cultural values and research potential, including preservation and general context, and not just artefact density. Only one artefact scatter has been recorded within 5 km of the survey area (DPLH ID 4404) – it represents artefacts recovered from excavation of a limestone cave (see below).

Modified trees Modified trees have been scarred for territorial or symbolic marking, scarred after removal of bark for hut-building or other purposes, or notched to improve access to animal dens. Modified trees are well-known across south-western Australia (DIA 2002), where they are usually described as large, mature trees showing evidence of scarring or notching with stone tools, and substantial bark overgrowth over the edge of the scar or notch. Scars are usually symmetrical, oval or sub-rectangular, aligned vertically with the trunk, and range between 0.5 and 1.5 m in height, and

0.25 to 0.75 m wide, with much of the scar at chest height. The scar should not reach the ground (scars reaching the ground may be the result of branches ripping from the trunk due to natural processes) and there should be bark overgrowth over the edge of the scar, indicating age. There may be signs of bark removal by a blunt instrument such as a stone axe. Notches usually appear a series of smaller, deeper cuts into the bark that allow a person to scale a tree using the notches as toe-holds. Only one modified tree has been located within 5 km of the survey area (DPLH ID 20598).

No Aboriginal burials were revealed in the Register search. Burials and human skeletal remains are highly significant to Aboriginal people. They may also provide information about past burial practices, cultural and social identity, date of the burial, and circumstances surrounding the life and death of the individual (e.g. Webb 1995). There are 22 burial/skeletal remains sites registered in the Perth metropolitan region. Half are known only from oral or written records and have no known archaeological remains. The rest, with archaeological remains, appear to have been found in the course of excavations for housing developments in calcareous shelly Quindalup sands and in yellow Spearwood sands (Dortch et al. 2007a). Further afield, e.g. in and around Busselton and Geraldton, burials have been unearthed in Quindalup-type dunes (Raaff 1996), partly as a result of development of coastal areas and partly because of coastal erosion. There may also be a tendency for more burials to be preserved in Quindalup dunes, which are less acidic. To date, no work has been done to determine if burial location relates to landscape features such as water sources or soil type that may have influenced population distribution. This makes it difficult to determine if burials are likely to be found in the survey area. However, it would seem possible for Quindalup dunes in the survey area to contain burials.

One place has 'archaeological deposits' and dated material, suggesting potential for obtaining a datable chronological record, but this designation does not mean no other sites have archaeological deposits. The place listed as having archaeological deposits is Orchestra Shell Cave (Place ID 4404), a cave in Tamala Limestone excavated by Hallam (1974). Dates for occupation at this site range from c.6500 to c.1700 years BP. The cave also contains evidence of 'finger-fluting' – grooves made with the fingers in soft deposits on its walls, hence the 'engraving' designation (Table 4). Caves may preserve rich archaeological remains, but none are known to exist in the Tamala Limestone in the survey area.

Methods

Archaeological survey methods included two main tasks: a desktop review of relevant reports and literature, discussed above; and field inspection.

The archaeological field survey comprised pedestrian inspection of the areas to be impacted. The areas walked were plotted using hand-held GPS Garmin units (accurate to 10 m) loaded with an outline of the survey area boundary. Noongar consultants and the archaeologist walked meandering tracks through uncleared open bush and along the accessible firebreaks and vehicle trails.

Some areas were inaccessible due to current large-scale excavations (previously approved) or very thick vegetation. About 92 ha (43%) of the total survey area was within 50 m of the routes taken by the archaeologist and the anthropologist, who carried the GPS units, and all accessible tracks were inspected across the survey area (Map 2). Other team members generally walked up to 50 m from those carrying the GPS. About 35 ha (17% of the entire survey area) of thick vegetation was not inspected. The on-going development takes up an estimated 30% of the survey area. Hence only 10% of the accessible part of the survey area was not inspected. The 43% inspected sample of the survey area includes all parts of the survey area, so is representative of cultural heritage values across the entire area.

Results

Archaeological survey

The survey located no archaeological sites in the survey area. The survey team did identify several natural features with cultural heritage values, as shown in Map 2 and Table 5 (see also Appendix 5, Table 7). Several quartz stones were identified on a track by D. Palmer at 376767 m E, 6501336 m N, but the survey team all agreed that these are not Aboriginal stone artefacts (Map 2; Palmer 2021).

Table 5: Features of potential cultural interest in the survey area

Discussion point	Feature	Location (m E, m N)	Significance
1	Limestone pinnacles	Centre of survey area on both sides of railway corridor	Known values. Limestone pinnacles are known to be culturally significant in and near the survey area. Traditional Owners wish these features to be avoided.
2	Ancient soils (palaeosols)	Across survey area (depth tbd but likely ~0.5 to 1 m and deeper)	Potential values. Spearwood Sands (yellow sands) are old enough to cover earliest occupation of Australia. In Perth they are known to include artefacts dating 10,000-c.35,000 years BP.
3	Mature trees	South-eastern quarter of survey area	Known values. Remnant forest includes culturally significant trees (balga, jijerri, banksias). Mature forest is threatened and valued. Potential for preservation of modified trees.

Cultural heritage values of the survey area

Previous archaeological research and written and oral histories in and near the survey area indicate that the survey area contains demonstrated or potential cultural heritage features such as limestone pinnacles, archaeological deposits, and modified trees, as follows (see also Table 4):

1. Limestone pinnacles in the survey area are significant for the Noongar consultants on the survey for historical and spiritual reasons. This result already suggests the place may qualify as a site under s5 of the Act– the previous survey report (O'Connor and O'Connor 2017a, 2017b) did not provide much detail supporting registration. The pinnacles are also more extensive than mapped by DPLH. Pinnacles were identified 100 m north and 200 m east of the boundary of Place ID 37478 (Photos 1, 2). Thick vegetation surrounding the pinnacles makes it impossible to accurately survey their full extent. Use of a drone, as suggested by Noongar consultants, would help identify pinnacles in areas that could not be inspected. The drone would fly transects over the pinnacles at low altitude and take a series of photographs which could then be geo-referenced enabling an accurate map of this heritage place. Several qualified archaeological drone operators are based in Perth and could perform this task easily.

2. Palaeosols are ancient soils, capped by recent deposits, in this case Quindalup dunes (e.g. Photos 3, 6). Other older deposits also noted in the survey include Spearwood dunes and dune limestone (Photo 2). For example, monitoring of site-works at Fiona Stanley Hospital, followed by archaeological test-excavation, revealed a 33,000 year old stone tool, which is now on display at

the hospital (Dortch and Dortch 2019). Archaeological survey on Rottnest Island, which during Late Pleistocene times of low sea level was a small hill on the coastal plain, discovered artefacts in a palaeosol at c.7 m below surface of Quindalup dunes, immediately below a unit of Tamala limestone dated to c. 27,000 BP (Dortch and Dortch 2019). A site in Spearwood Dunes at Minim Cove, in the suburb of Mosman Park on the Swan River, is dated 10,000 BP (Clarke and Dortch 1977).

Where abundant archaeological remains are preserved in stratigraphic sequences, excavation could potentially identify evidence that would inform understanding of settlement patterns on the Swan Coastal Plain, and the history of technological and economic responses of Aboriginal groups to environmental changes. It appears doubtful that the survey area contains abundant archaeological remains, but small quantities, if identified, could help form a history of the survey area.

3. Noongar people historically exploited balgas, zamias and banksias for food and other resources (Meagher 1974). The woodland containing mature examples of these species in the south-east quarter of the survey area may be areas where people visited and possibly camped (Photos 7-8). A large jarrah (*Eucalyptus marginata*) is probably some centuries old and appears to be demarcated by survey pegs (Map 2). It was particularly noticed in the ethnographic consultations (Palmer 2021).

   No trees inspected in the survey had scars or other modifications, but if any are found in the future, every effort should be made to preserve them, as due to natural ageing and the very small number of people still taking bark for tools, modified trees are a vanishing resource.

The survey area also has some potential to contain burials, although none were found in the present survey. Burials were often made near the occupation sites where the deceased person had died, and these sites were then reputedly avoided for a generation or so (Hassell 1978). The factors affecting burial distribution in the metropolitan area are not sufficiently well understood to assess the probability that burials exist in the survey area, but key factors are likely to include the past settlement pattern (likely to have been influenced by the distribution of productive soils and fresh water: Hallam 1987), the ease of excavating different soil types, and the preservation potential of different soil types.

A final comment on archaeological potential relates to the distance to known water sources and limestone as a natural feature with mythological significance. The distance from the survey area to the nearest mapped water source appears to be more than 800 m. Archaeological evidence and water sources appear to be rare in limestone ridge areas (Table 4). However, some water sources, such as soaks, may be too small to be deemed worthy of mapping. At least one soak was observed in the present survey, in the north-western quarter of the survey area (Photo 4, Map 2). A Noongar informant on a previous heritage survey in a nearby area noted that the water table is high around limestone, and that hollows in surface limestone may retain small quantities of water after rain (Schwede 1988).

This distribution suggests that the present survey area may have a subtle level of cultural significance that is less obvious than the records of concentrated economic activities and aggregations around waterbodies. The few small water sources may have been sufficient for small groups or individuals visiting mythological sites or engaged in other activities away from home bases, such as hunting. As such, the survey area might not contain many artefact scatters or burial sites, but it might contain scarred trees as markers, and mythological sites, which are usually not identifiable archaeologically. Further understanding of these factors requires advice from cultural custodians or other knowledge-holders.

Management of potential archaeological remains

Extensive ground cover reduces ground visibility, and it is possible that some surface archaeological material was not located in the present survey. Sub-surface material may also be present. Previous surveys show that concentrations of stone artefacts are found in some locations near natural water sources; and are generally sparse or absent elsewhere. Sand dunes may also be of archaeological interest. It is suggested above that past occupation in the survey area was probably short-lived or by small groups. If so, archaeological excavation within the survey area to identify sub-surface materials may be inconclusive, because the remains would be too sparse to locate in a practical test sample.

Instead, it would be desirable to monitor proposed land-clearing to identify any archaeological remains that may be inadvertently uncovered by the land-clearing. Monitoring also helps protect cultural materials not protected under the AHA, such as culturally significant tree species. Monitoring is often effective when carried out by Noongar custodians with knowledge of archaeological materials under an Aboriginal Heritage Management Plan. Such a plan also covers protocols for any discoveries of Aboriginal heritage material.

It would be necessary to consult carefully with senior Noongar custodians if any personnel involved in the proposed construction works identify Aboriginal heritage material. Heritage surveys in south-west Western Australia have developed successful protocols for culturally sensitive treatment of archaeological remains (e.g. Fisher *et al.* 2001). In particular, under the *Coroner's Act 1996 (Western Australia)*, discovery of human skeletal remains requires that the personnel involved notify the police. The police may wish to remove such remains immediately, but under the AHA, Aboriginal material is not to be disturbed without permission from Aboriginal community representatives and the Minister for Aboriginal Affairs. Suspected Aboriginal skeletal remains should therefore be professionally assessed, initially without removing them, in consultation with Aboriginal community representatives, the police, and DPLH.

Should material such as skeletal remains or archaeological deposits be identified, consultation could lead to a range of recommended actions, including total protection of the remains in place, selective systematic salvage of artefact scatters or deposits, or full archaeological recovery. Such work should maximise the protection of heritage material remains and recovery of information while keeping in mind the requirements of Noongar custodians and the proponent.

Recommendations

While no archaeological sites are currently evident in the survey area, the survey area holds importance for Noongar custodians in the form of pinnacles and culturally significant plants. In addition, the soils of the survey area may conceal archaeological evidence of Aboriginal occupation.

On this basis, it is **recommended**:

1. The area of the pinnacles should be mapped using aerial photography shot on drone transects, as pedestrian access is impractical due to thick vegetation. With the additional ethnographic commentary recorded in the survey (Palmer 2021), more detailed and accurate heritage information could then be submitted to DPLH for reconsideration of the area of pinnacles as an Aboriginal heritage site.
2. Prior to any ground-disturbing work, DevelopmentWA should consider engaging suitably experienced Noongar people to monitor the works in case sub-surface heritage material is inadvertently unearthed. An archaeologist should also be engaged on a call-out basis should monitors require further assessment of any suspected heritage material.
3. Protection of mature trees is important for Noongar consultants and should be considered wherever possible.
4. An Aboriginal Cultural Heritage Management Plan or similar should be developed, before ground disturbance occurs, to allow for culturally appropriate management of any discoveries of suspected or actual heritage material.
5. The Aboriginal Cultural Heritage Management Plan should include a requirement that staff and contractors should be informed of the legal requirement to avoid disturbance to any Aboriginal site as defined in the *Aboriginal Heritage Act 1972* (Western Australia), whether registered or otherwise, and the view that disturbance of a site includes ground disturbance, souveniring or defacement.

References

Anderson, J. 1984 *Between plateau and plain*. Occasional papers in Prehistory 4. Australian National University Press, Canberra.

Beard, J. 1981 *The Vegetation of the Swan Area. Swan* 1:1 000 000 Vegetation Series. Explanatory Notes to Sheet 7. University of Western Australia Press, Perth.

Berndt, R. 1979 Aborigines of the south-west. In Berndt, R. and Berndt, C.H. Aborigines of the West. University of Western Australia Press. Nedlands, pp 81-89.

Bowdler, S., L. Strawbridge, and M. Schwede 1991 Archaeological mitigation in the Perth Metropolitan Region. *Australian Archaeology* 32:21-25.

Cecchi, J. 2013 Report on an archaeological survey of Butler to Yanchep Railway Alignment. Report prepared for Public Transport Authority by John Cecchi Heritage Management Consultancy, February 2013.

Clarke, J., and C.E. Dortch 1977 A 10,000 year BP radiocarbon date for archaeological finds within a soil of the Spearwood Dune System, Mosman Park, WA. *Search* 8:36-38.

Coldrick, B., and E. McDonald 2008 Report of an ethnographic survey of Lot 3 Romeo Road, Alkimos, Western Australia. Report prepared for LWP Property Group by Ethnosciences Pty Ltd.

Department of Agriculture (DoA) 2003 Soils and landforms of the Perth area (map). DoA, Perth.

Dortch, C.E. 2002 Modelling past Aboriginal hunter-gatherer socio-economic & territorial organisation in Western Australia's lower South-west. *Archaeology in Oceania* 37:1-21.

Dortch, J., and C. Dortch 2019 Late Quaternary Aboriginal hunter-gatherer occupation of the Greater Swan Region, south-western Australia. *Australian Archaeology* 85 (1): 15-29.

Fisher, S., J. Dortch and M. Waite. 2001. Report on a heritage survey of proposed developments for the upgrade of the City Foreshore, Perth WA. Perth, WA. Unpublished report prepared for City of Perth by Fisher Research Pty Ltd.

Ferguson, W.C. 1980 Fossiliferous chert in southwestern Australia after the Holocene transgression: a behavioural hypothesis. *The Artefact* 5:155-169.

Geological Survey of Western Australia 1990 *Geology and Mineral Resources of Western Australia: Geological Survey of Western Australia, Memoir 3*. Department of Mines, Perth.

Glassford & Semeniuk 1990 Stratification and disconformities in yellow sands of the Bassendean and Spearwood Dunes, Swan Coastal Plain, southwestern Australia. *Journal of the Royal Society of Western Australia* 71: 75-93.

Glover, J.E. 1984 The geological sources of stone for artefacts in the Perth Basin and nearby areas. *Australian Aboriginal Studies* 1984(1):17-25.

Green, N. (ed) 1979 *Noongar - the people. Aboriginal customs in the southwest of Australia*. Creative Research Publishers, Perth.

Grey, G. 1841 *Journals of two expeditions of discovery in north-west and Western Australia, during the years 1837, 38 and 39*. Vols 1-2. Boone, London.

Hallam, S.J. 1974 Excavations in the Orchestra Shell Cave, Wanneroo, Western Australia, part I: ethnographic and environmental background; part II: archaeology. *Archaeology and physical anthropology in Oceania* 9:66-84, 134-155.

Hallam, S.J. 1975 *Fire and hearth*. Australian Institute of Aboriginal Studies, Canberra.

Hallam, S.J. 1987 Coastal does not equal littoral. *Australian Archaeology* 25:10-29.

Hammond, J.E. 1980 (1933) *Winjan's People*. Facsimile edition, Hesperian Press, Victoria Park, Western Australia (original published by Imperial Printing Company, Perth).

Harben, S., and L. Collard 2009 Recording Traditional Knowledge - literature review for Avon Basin Noongar heritage and cultural significance of natural resources. Report prepared by Murdoch University for Avon Catchment Council.

Harris, J. 1997 Report on an Archaeological Survey on Proposed Mitchell Freeway Extension, Romeo Road to Perth-Lancelin Road. Report prepared for Main Roads WA by J. Harris, January 1997.

Harrison, R. and C. Williamson (eds) 2002 *After Captain Cook: the archaeology of the recent Indigenous past in Australia*. University of Sydney Archaeological Methods Series 8, Sydney.

Hassell, E. 1975 *My dusky friends*. Published by CW Hassell, Nedlands.

Hiscock, P. 1994 Technological responses to risk in Holocene Australia. *Journal of World Prehistory* 8:267-292.

Holdaway, S., Shiner, J., Fanning P. 2004 Hunter-Gatherers and the Archaeology of Discard Behavior: An Analysis of Surface Stone Artifacts from Sturt National Park, Western New South Wales, Australia. *Asian Perspectives* 43: 34-72.

Lipar, M., and J. Webb 2015 The formation of the pinnacle karst in Pleistocene aeolian calcarenites (Tamala Limestone) in southwestern Australia. *Earth-Science Reviews* 140:182-202.

McArthur, W.M. 1991 *Reference soils of south-western Australia*. Department of Agriculture, Perth.

Meagher, S.J. 1974 The food resources of the Aborigines of the south-west of Western Australia. *Records of the Western Australian Museum* 3(1):3-65.

Monks, C., Dortch, J., Jacobsen, G., Baynes, A. 2016 Pleistocene occupation of Yellabidde Cave in the northern Swan Coastal Plain, southwestern Australia. *Australian Archaeology* 82:275-279.

Moore, G.F. 1884 [1978] *Diary of ten years eventful life of an early settler in Western Australia* (facsimile ed.). UWA Press, Perth.

Nance, J.D., and B.F. Ball 1986 No surprises? The reliability and validity of test-pit sampling. *American Antiquity* 51:457-504.

Newsome, J., and E. Pickett 1993 Palynology and palaeoclimatic implications of two Holocene sequences from southwestern Australia. *Palaeogeography, Palaeoclimatology, Palaeoecology* 101:245-261.

O'Connor, R. 1997 Draft: Report on an Ethnographic Survey of the Proposed Mitchell Freeway Extension from Romeo Road to Perth-Lancelin Road. Report prepared for Main Roads WA by R. O'Connor, March 1997.

O'Connor, R., G. Quartermaine, and C. Bodney 1989 Report on a Survey for Aboriginal Sites on the Proposed Mitchell Freeway Extension, Shenton Avenue to Romeo Road. Report prepared for Main Roads Dept by R. O'Connor, February 1989.

O'Connor, R., G. Quartermaine, and C. Bodney 1990 Report on a survey for Aboriginal sites at the proposed Clarkson, Eglinton and Alkimos housing developments, north-west corridor. Report prepared for Landcorp by R. O'Connor, January 1990.

O'Connor, R., and E. O'Connor 2017a Aboriginal Heritage Survey of Proposed Northern Suburbs Railway Extension Alignment. Report prepared for Public Transport Authority by R& E O'Connor, April 2017.

O'Connor, R., and E. O'Connor 2017b Addendum to report on the Aboriginal Heritage Survey of the Northern Suburbs Railway Extension. Report prepared for Public Transport Authority by R& E O'Connor, June 2017.

Palmer, D. 2021 Alkimos Aboriginal Heritage Survey Cultural survey. Report prepared for Moodjar Consultancy, February 2021.

Pearce, R.H. 1978 Changes in artefact assemblages during the last 8000 years at Walyunga, Western Australia. *Journal of the Royal Society of Western Australia* 61:1-10.

Pearce, R.H., and M. Barbetti 1981 A 38,000-year-old archaeological site at Upper Swan, Western Australia. *Archaeology in Oceania* 16:173-178.

Pickett, E.J 1997 The Late Pleistocene and Holocene vegetation history of three lacustrine sequences from the Swan Coastal plain, Southwestern Australia. Unpublished PhD Thesis, Dept. of Geography, University of Western Australia.

Raaff, P. 1996 A grave look at Western Australian prehistory. Honours thesis, Centre for Archaeology, UWA.

Schwede, M.L. 1988 Survey for Aboriginal sites in the proposed refuse disposal facility at Mindarie, Wanneroo. Unpublished report prepared by Centre for Prehistory, UWA, for City of Wanneroo.

Schwede, M.L. 1990 Quartz, the multi-faceted stone: a regional prehistory of the Helena River Valley on the Swan Coastal Plain of south-western Australia. PhD thesis, Department of Archaeology, UWA, Perth.

Smith, A., and W. Beck 2003 The archaeology of No man's land: Indigenous camps at Corindi Beach, mid-north coast New South Wales. *Archaeology in Oceania* 38: 66-77.

Thomson, J. 2008 Report on an archaeological inspection : Lot 3 Romeo Road, Alkimos, WA, report prepared for LWP Property Group by Thomson Cultural Heritage Management.

Turney, C.S.M., M.I. Bird, L.K. Fifield, R.G. Roberts, M.A. Smith, C.E. Dortch, R. Grün, E. Lawson, G.H. Miller, J. Dortch, R.G. Cresswell, and L.K. Ayliffe 2001 Breaking the radiocarbon barrier and early human occupation at Devil's Lair. *Quaternary Research* 55:3-13.

Webb, S. 1995 *Palaeopathology of Aboriginal Australians: health and disease across a hunter-gatherer continent*. Cambridge University Press, Cambridge.

Appendix 1: Extract from the Aboriginal Heritage Act 1972 (WA)

(Reprinted under the *Reprints Act* 1984 as at 1999)

5. Application to places

This Act applies to —

(a) any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;

(b) any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;

(c) any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State;

(d) any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.

[Section 5 inserted by No. 8 of 1980 s. 2; amended by No. 24 of 1995 s. 6.]

15. Report of findings

15. Any person who has knowledge of the existence of any thing in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved trees, or of any other place or thing to which this Act applies or to which this Act might reasonably be suspected to apply shall report its existence to the Registrar, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place in question to be already known to the Registrar.

[*Section 15 amended by No. 24 of 1995 s. 16.*]

16. Excavation of Aboriginal sites

(1) Subject to section 18, the right to excavate or to remove any thing from an Aboriginal site is reserved to the Registrar.

(2) The Registrar, on the advice of the Committee, may authorise the entry upon and excavation of an Aboriginal site and the examination or removal of any thing on or under the site in such manner and subject to such conditions as the Committee may advise.

[*Section 16 amended by No. 8 of 1980 s. 5; No. 24 of 1995 s. 17.*]

17. Offences relating to Aboriginal sites

A person who —

(a) excavates, destroys, damages, conceals or in any way alters any Aboriginal site; or

(b) in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom, or assumes the possession, custody or control of, any object on or under an Aboriginal site, commits an offence unless he is acting with the authorisation of the Registrar under section 16 or the consent of the Minister under section 18.

[*Section 17 inserted by No. 8 of 1980 s. 6; amended by No. 24 of 1995 s. 18*.]

18. Consent to certain uses

(1) For the purposes of this section, the expression "the owner of any land" includes a lessee from the Crown, and the holder of any mining tenement or mining privilege, or of any right or privilege under the Petroleum Act 1967, in relation to the land.

(1a) A person is also included as an owner of land for the purposes

of this section if -

(a) the person –

(i) is the holder of rights conferred under section 34 of the Dampier to Bunbury Pipeline Act 1997 in respect of the land or is the holder's nominee approved under section 34(3) of that Act; or

(ii) has authority under section 7 of the Petroleum Pipelines Act 1969 to enter upon the land;

or

(b) the person is the holder of a distribution licence under Part 2A of the Energy Coordination Act 1994 as a result of which the person has rights or powers in respect of the land.

(2) Where the owner of any land gives to the Committee notice in writing that he requires to use the land for a purpose which, unless the Minister gives his consent under this section, would be likely to result in a breach of section 17 in respect of any Aboriginal site that might be on the land, the Committee shall, as soon as it is reasonably able, form an opinion as to whether there is any Aboriginal site on the land, evaluate the importance

and significance of any such site, and submit the notice to the Minister together with its recommendation in writing as to whether or not the Minister should consent to the use of the land for that purpose, and, where applicable, the extent to which and the conditions upon which his consent should be given.

(3) Where the Committee submits a notice to the Minister under subsection (2) he shall consider its recommendation and having regard to the general interest of the community shall either -

(a) consent to the use of the land the subject of the notice, or a specified part of the land, for the purpose required, subject to such conditions, if any, as he may specify; or

(b) wholly decline to consent to the use of the land the subject of the notice for the purpose required, and shall forthwith inform the owner in writing of his decision.

(4) Where the owner of any land has given to the Committee notice pursuant to subsection (2) and the Committee has not submitted it with its recommendation to the Minister in accordance with that subsection the Minister may require the Committee to do so within a specified time, or may require the Committee to take such other action as the Minister considers necessary in order to expedite the matter, and the Committee shall comply with any such requirement.

(5) Where the owner of any land is aggrieved by a decision of the Minister made under subsection (3) he may, within the time and in the manner prescribed by rules of court, appeal from the decision of the Minister to the Supreme Court which may hear and determine the appeal.

(6) In determining an appeal under subsection (5) the Judge hearing the appeal may confirm or vary the decision of the Minister against which the appeal is made or quash the decision and substitute his own decision which shall have effect as if it were the decision of the Minister, and may make such order as to the costs of the appeal as he sees fit.

(7) Where the owner of any land gives notice to the Committee under subsection (2), the Committee may, if it is satisfied that it is practicable to do so, direct the removal of any object to which this Act applies from the land to a place of safe custody.

(8) Where consent has been given under this section to a person to use any land for a particular purpose nothing done by or on behalf of that person pursuant to, and in accordance with any conditions attached to, the consent constitutes an offence against this Act.

[*Section 18 inserted by No. 8 of 1980 s. 6; amended by No. 24 of 1995 s. 19 2; No. 58 of 1999 s. 39.*]

Appendix 2: Former Department of Aboriginal Affairs *Notes on Aboriginal Sites*

The former DAA prepared a version of these notes as a guide to the recognition of those sites in the 1980s. Although they are no longer available from DPLH, which now administers the *Aboriginal Heritage Act 1972* (Western Australia), the descriptions are still relevant.

An Aboriginal Site is defined in s5 of the *Aboriginal Heritage Act 1972* (Western Australia) as:

(a) Any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made for or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;

(b) Any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;

(c) Any place which, in the opinion of the Committee is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the state;

(d) Any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.

Habitation Sites

These are commonly found throughout Western Australia and usually contain evidence of tool - making, seed grinding and other food processing, cooking, painting, engraving or numerous other activities. The archaeological evidence for some of these activities is discussed in detail under the appropriate heading.

Habitation sites are usually found near an existing or former water source such as gnamma hole, rock pool, spring or soak. They are generally in the open, but they sometimes occur in shallow rock shelters or caves. It is particularly important that none of these sites be disturbed as the stratified deposits which may be found at such sites can yield valuable information about the inhabitants when excavated be archaeologists.

Seed Grinding

Polished or smoothed areas are sometimes observed on/near horizontal rock surfaces. The smooth areas are usually 25 cm wide and 40 or 50 cm long. They are the result of seed grinding by the Aboriginal women and indicate aspects of a past economy.

Habitation Structures

Aboriginal people sheltered in simple ephemeral structures, generally made of branches and sometimes grass. These sites are rarely preserved for more than on occupation period. Occasionally rocks are pushed aside or were used to stabilise other building materials. When these rock patterns are located they provide evidence of former habitation sites.

Middens

When a localised source of shellfish and other foods have been exploited from a favoured camping place, the accumulated ashes, hearth stones, shells, bones and other refuse can form mounds at times several meters high and many meters in diameter. Occasionally these refuse mounds or middens contain stone, shell or bone tools. These are most common near the coast but examples on inland lakes and river banks are not unknown.

Stone Artefact Factory Sites

Pieces of rock from which artefacts could be made were often carried to camp sites or other places for final production. Such sites are usually easily recognisable because the manufacturing process produces quantities of flakes and waste material which are clearly out of context when compared with the surrounding rocks. All rocks found on sandy coastal plain, for example, must have been transported by human agencies. These sites are widely distributed throughout the state.

Quarries

When outcrops of rock suitable for the manufacture of stone tools were quarried by the Aborigines, evidence of the flaking and chipping of the source material can usually be seen in situ nearby. Ochre and other mineral pigments used in painting rock surfaces, artefacts and body decoration are mined from naturally occurring seams, bands and other deposits. This activity can sometimes be recognised by the presence of wooden digging sticks or the marks made by these implements.

Marked Trees

Occasionally trees are located that have designs in the bark which have been incised by Aborigines. Toeholds, to assist the climber, were sometimes cut into the bark and sapwood of trees in the hollow limbs of which possums and other arboreal animals sheltered. Some tree trunks bear scars where sections of bark or wood have been removed to make dishes, shields, spearthrowers and other wooden artefacts. In some parts of the state wooden platforms were built in trees to accommodate a corpse during complex rituals following death.

Burials

In the north of the state it was formerly the custom to place the bones of the dead on a ledge in a cave after certain rituals were completed. The bones were wrapped in sheets of bark and the skull placed beside this. In other parts of Western Australia the dead were buried, the burial position varying according to the customs of the particular area and time. Natural erosion or mechanical earthmoving equipment occasionally exposes these burial sites.

Stone Structures

If one or more stones are found partially wedged into a position which is not likely to be the result of natural forces, then it is probable that the place is an Aboriginal site and that there are other important sites nearby. There are several different types of stone arrangements ranging from simple cairns or piles of stones to more elaborate designs. Low weirs were built to provide suitable environments in which to trap fish when tides fall are found in coastal areas. Some rivers contain similar structures that trap fish against the current. It seems likely that low stone slab structures in the south - west jarrah forests were built to provided suitable environments in which to trap some small animals. Low walls or pits were sometimes made to provide a hide or shelter for hunting.

Elongated rock fragments are occasionally erected as a sign or warning that a special area is being approached. Heaps or alignments of stones may be naturalistic or symbolic representations of animals, people or mythological figures.

Paintings

These usually occur in rockshelters, caves or other sheltered situations which offer a certain degree of protection from the weather. The best known examples in Western Australia occur in the Kimberley region but paintings are also found throughout most of the state. Several coloured pigments may have been used at a site. Stencilling was a common painting technique used throughout the state. The negative image of an object was created by spraying pigment over the object which was held against a wall.

Engravings

This term describes designs which have been carved, pecked or pounded into a rock surface. They form the predominant art form of the Pilbara region but are known to occur in the Kimberley in the north to Toodjay in the south. Most engravings occur in the open but some are situated in rock shelters.

Caches

It was custom to hide ceremonial objects in niches and other secluded places. The removal of objects from these places, the taking of photographs of these places or objects or any other interference with these places is not permitted.

Ceremonial Grounds

At some sites the ground has been modified in some way by the removal of surface pebbles, or the modelling of the soil, or the digging of pits and trenches. In other places there is no noticeable alteration of the ground surface and Aborigines familiar with the site must be consulted concerning its location.

Mythological Sites

Most sites already described have a place in Aboriginal mythology. In addition there are many Aboriginal sites with no man - made features which enable them to be recognised. They are often natural features in the landscape linked to the Aboriginal account of the formation of the world during the creative 'Dreaming' period in the distant past. Many such sites are located at focal points in the creative journeys of mythological spirit beings of the Dreaming. Such sites can only be identified by the Aboriginal people who are familiar with the associated traditions.

Appendix 3: Aboriginal heritage surveys intersecting the survey area

The surveys summarised in Table 2 are described below in more detail. Text in bold provides the DPLH Report ID, the report title, and the report author. Text in italics is provided by DPLH and describes the survey area for each report. Reports are listed in chronological order.

102568 Report on a Survey for Aboriginal Sites on the Proposed Mitchell Freeway Extension, Shenton Avenue to Romeo Road. Feb.1989. O'Connor, R

Large freeway corridor SE of present Survey Area. A survey of a 1km wide corridor centered upon the proposed Mitchell Freeway extension from Shenton Road, Joondalup to Romeo Road, Carrabooda, as shown in Fig. 1

Ethnographic and archaeological survey was undertaken by O'Connor, Quartermaine and Bodney in February 1989. Several key families and historical sources were consulted. Archaeological survey consisted of driving the 200 m wide corridor for 10 km (Shenton Ave to Romeo Rd), stopping every 200 m to inspect a transect crossing the corridor. Only 'limestone features' were found – none were deemed to be important. About 25% of the area was found to be disturbed. No existing or new ethnographic or archaeological sites were found in the corridor.

104279 Report on a survey for Aboriginal sites at the proposed Clarkson, Eglinton and Alkimos housing developments, north-west corridor. Jan.1990. O'Connor, R

Entire area - coverage uncertain. Proposed Clarkson, Eglinton and Alkimos Housing Developments, North West Corridor. The three areas comprise approximately 247.5 ha, 607.3977 ha, and 865.847 ha respectively as shown in Fig. 1

Archaeological and ethnographic survey for Landcorp was carried out by O'Connor, Quartermaine and Bodney in January 1990. Several key families and historical sources were consulted. Archaeological survey consisted of driving the tracks through the survey area, stopping every 200 m to inspect on foot "at right angles" to tracks. Only "limestone features' were found – none deemed to be important. About 25% of area was inspected. Another 25% of the area was thought to be disturbed through various housing, quarries, tracks, and pasture clearance. No existing or new ethnographic or archaeological sites were identified in the survey area. One isolated fragment (82 x 59 mm) of a grinding stone was found near a track, and not deemed to represent a site (although it is unusual).

104091 Report on an Archaeological Survey on Proposed Mitchell Freeway Extension, Romeo Road to Perth-Lancelin Road. Jan.1997. Harris, J.

Freeway corridor only. Proposed Mitchell Freeway Extension, Romeo Road to Perth - Lancelin Road. A corridor of 200m wide was surveyed as shown in Fig. 1

Archaeological survey of freeway extension was carried out by J. Harris for Quartermaine Consultants on behalf of Main Roads WA in January 1997. The survey area was a 23 km x 200 m freeway corridor from Romeo Road to Perth-Lancelin Road, covered by transects at 50 m spacing where vegetation allowed, otherwise only on exposed ground. No drainage lines or dunes were encountered. The vegetation was all banksia woodland. No sites were found. No water sources were found either – Harris suggests areas closer to lakes would have more archaeological sites. She recommends advising project personnel of obligation to stop work if any heritage material is found through excavation.

104175 Draft: Report on an Ethnographic Survey of the Proposed Mitchell Freeway Extension from Romeo Road to Perth-Lancelin Road. March 1997. O'Connor, R.

Freeway corridor only Proposed Mitchell Freeway Extension from Romeo Road to Perth-Lancelin Road. A survey corridor of 100m either side of the centreline of the proposed road reservation was surveyed as shown in Fig. 1

An ethnographic survey by O'Connor in Jan-March 1997 consulted several key families – three families visited the project area, and the rest were consulted at their homes. No ethnographic sites were identified.

23254 A report on an archaeological inspection : Lot 3 Romeo Road, Alkimos, WA. June 2008. Thomson, Jo

Large area bordering S boundary of present Survey Area. Lot 3 Romeo Road, Alkimos (the Project Area) is located on the Swan Coastal Plain, on the northern edge of the Perth metropolitan area, approximately 40 km north of the Perth CBD. The Project Area is located between Wanneroo Road and the coastline, with…

This report describes archaeological survey by Jo Thomson/ TCHMP for Ethnosciences/LWP Property Group in June 2008. The background section noted that majority of sites within 5 km were mythological or culturally important natural features and there is a general lack of archaeological sites (3 out of 23 sites within a 5 km buffer).

The western portion of survey area is steep dunes covered by heath. The eastern portion is undulating sandy flats covered by low banksia woodland and grasses. There is thick Parrot bush (*Banksia sessilis*) in depressions.

Thomson found no sites or even isolated artefacts. She identified a low level of past Noongar activity in Quindalup sands. Her field survey was limited by dense vegetation reducing ground exposure and by access constraints, resulting in <7% of survey area inspected. She identified some potential for sub-surface material in Quindalup sands and recommended that a Cultural Heriatge Management Plan be put in place to manage any sub-surface material and the survey results be communicated by the proponent to Traditional Owners.

23256 Report of an ethnographic survey of Lot 3 Romeo Road, Alkimos, Western Australia. June 2008. Coldrick, Bryn

Large area bordering S boundary of present Survey Area Lot 3 Romeo Road, Alkimos (the Project Area) is located on the Swan Coastal Plain, on the northern edge of the Perth metropolitan area, approximately 40 km north of the Perth CBD. The Project Area is located between Wanneroo Road and the coastline, with…

Ethnographic survey in June 2008 by Coldrick and McDonald (Ethnosciences) identified the dunes as part of "Waugal run" but they do not think it is a site. Nevertheless, surveys preceding this one identified steep dunes and limestone features as part of Waugal mythology, noting Daisy Bates comment that limestone features may be Waugal excreta. McDonald suggests Bates was referring to Noongar comments about specific places where the Waugal sat down or acted on something, not all limestone features. McDonald agrees that springs in the wider area are important. Previous surveys have also noted Noongar anguish on destruction of natural environment. The survey recommended preservation of steep dunes in the area. Christmas trees were identified in the survey area as culturally important, but not recommended for preservation. The authors note that up to the 1990s survey teams would generally identify specific places, but in the 2000s, a trend has emerged to identify limestone and dune landscape features in general as having 'Waugal' significance. McDonald and colleagues have previously argued this change is problematic – but perhaps the change reflects increasing Noongar confidence in arguing for protection of mythological sites or landscapes (for an example of the McDonald et al. position see McDonald, E., Coldrick, B. 2007 Confidential report of an ethnographic consultation regarding the Aboriginal heritage values of the Alkimos Eglinton Local Structure Plan Area, Alkimos, Western Australia. Unpublished report by Ethnosciences for Woodsome Management Pty Ltd).

200830 Report on an Archaeological Survey of Butler to Yanchep Railway Alignment. February 2013. John Cecchi

Railway corridor only - Butler to Yanchep Railway Alignment

An archaeological survey of railway extension for PTA by John Cecchi in February 2013 inspected 13 km of north-south railway alignment along north-south transects at 40 m intervals or where vegetation permitted. Corridor width and effective coverage (how much land actually inspected given constraints due to vegetation) are not specified. No archaeological sites or isolated artefacts were found.

200673 Aboriginal Heritage Survey of Proposed Northern Suburbs Railway Extension Alignment. April 2017. Rory O'Connor and E. O'Connor

Railway corridor only

Ethnographic survey was carried out for the Public Transport Authority (PTA) in April 2017 by R and E O'Connor and identified pinnacles as important. No other sites were identified. O'Connor suggested removing pinnacles if necessary, which seems to have been accepted by the group although avoidance would probably be preferable. The report critiques the significance of the pinnacles but this significance does seem very clear to at least two of the Noongar consultants (Ron Gidgup and Chris Shaw). This survey only assessed the railway corridor.

200674 Addendum To Report On The Aboriginal Heritage Survey Of The Northern Suburbs Railway Extension. April 2017. Rory O'Connor

Railway ancillary areas

This report extended the April 2017 survey by looking at ancillary facilities for the railway, like car parks. It is not clear what land was actually surveyed.

Appendix 4: Aboriginal heritage places within 5 km of the survey areas

This Appendix lists all the Aboriginal heritage places within 5 km of the Alkimos Central footprint, listed on the Register of Places and Objects, based on a register search performed on 2 February 2021. In Table 6, below, the Status column shows whether site information has been *Lodged* with DPLH or *Registered* or deemed *Not A Site / Stored Data* following ACMC recommendations. Site types are described in Appendix 2. The Restricted column shows places where Aboriginal custodians for the place have requested that access to the detailed records is restricted for cultural reasons. Coordinates (m E, m N) are for the centroids of DPLH polygons defining each place.

Table 6: Aboriginal heritage places within 5 km of the survey area

Place ID	Name	Status	Type	Restricted	m E	m N
1018	Doogarch.	Registered Site	Mythological, Rockshelter, Camp	No	377344	6504300
3366	Dunstan'S Quarry.	Lodged	Artefacts / Scatter, Camp	No	380350	6498291
3509	Karli Spring.	Registered Site	Mythological, Water Source	No	373739	6499949
3693	Lake Neerabup.	Lodged	Named Place	Yes	381922	6495470
4404	Orchestra Shell Cave.	Registered Site	Artefacts / Scatter, Engraving, Arch Deposit, BP Dating: 6500BP to 1730BP, Other: PA 19, NE	Yes	380906	6496886
17450	Nowergup Lake	Registered Site	Mythological	No	379733	6499450
17451	Pipidinny Lake	Registered Site	Mythological	No	375183	6505378
20596	Butler - FS01	Lodged	Ceremonial, Natural Feature, Water Source, Other: Sorry Place / Gnamma Hole	No	377957	6497650
20597	Butler - FS02	Lodged	Mythological	No	377492	6498484
20598	Butler - FS03	Stored Data / Not a Site	Historical, Modified Tree, Camp, Plant Resource, Water Source	No	377461	6499209
20600	Butler - FS04	Lodged	Other: Old Tuarts	No	377031	6499413
20765	SBJ01	Stored Data / Not a Site	Mythological, Natural Feature, Other: Limestone ridge	No	375840	6499642
20766	SBJ05	Stored Data / Not a Site	Natural Feature, Other: Limestone ridge	No	376202	6499320
20768	SBJ08	Stored Data / Not a Site	Mythological, Natural Feature, Other: Limestone Ridge	No	376039	6499691
20769	SBJ09	Stored Data / Not a Site	Natural Feature, Other: Tall Eucalyptus Trees	No	376693	6499728
20770	SBJ10	Stored Data / Not a Site	Natural Feature, Other: Old eucalyptus tree	No	376790	6499388
20771	SBJ07	Stored Data / Not a Site	Natural Feature, Other: Limestone Outcrop	No	376324	6499053
20772	Jindalee	Registered Site	Mythological, Natural Feature, Water Source	Yes	375174	6498529
24404	Swamp	Lodged	Mythological, Water Source	No	374344	6499148
24405	Christmas Tree	Lodged	Mythological, Natural Feature	No	375784	6498201
24406	Dunes	Stored Data / Not a Site	Mythological, Natural Feature	No	375001	6499683
24408	Dunes	Lodged	Mythological, Natural Feature	No	375050	6497881
24409	Dunes	Lodged	Mythological, Natural Feature	No	375942	6498169
37478	Romeo Road Pinnacles	Stored Data / Not a Site	Mythological	No	375994	6501115

Appendix 5: Features of interest in the survey area

This Appendix lists co-ordinates obtained for features of interest to Noongar consultants within the Alkimos Central footprint, based on the survey on 27 and 29 January 2021 (Table 7, Map 2). Coordinates use MGA, GDA94. Only some pinnacles could be accessed, due to very thick vegetation, so aerial photography by drone is recommended to view and map all pinnacles.

Table 7: Co-ordinates for features of interest to Noongar consultants in the survey area

Description	m E	m N
Limestone pinnacle	375983.09	6501195.18
Limestone pinnacle	375990.29	6501204.13
Limestone pinnacle	375996.77	6501217.95
Limestone pinnacle	376019.13	6501188.85
Limestone pinnacle	376017.81	6501179.73
Limestone pinnacle	376016.32	6501169.75
Limestone pinnacle	375714.66	6501135.53
Limestone pinnacle	375727.46	6501168.06
Limestone pinnacles	376252.76	6501135.35
Limestone pinnacles	376245.60	6501181.17
Limestone outcrop	376923.36	6501137.98
Limestone outcrops (general area)	376926.00	6501211.64
Zamias	375965.33	6501323.46
Zamias	375775.82	6501296.79
Large jarrah	376898.05	6501120.38
Dry soak	375675.62	6501902.11

Appendix F

Aboriginal Heritage Survey (Moodjar Consultancy 2021)

Alkimos Aboriginal Heritage Survey

Cultural survey

Written by
Dave Palmer

for Moodjar Consultancy

February 2021

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Disclaimer

The results, conclusions and recommendations contained in this report are based on information available at the time of its preparation. Whilst every effort has been made to ensure that all relevant data has been collated, the authors can take no responsibility for omissions and/or inconsistencies that may result from information becoming available after this report's completion.

February 2021

Acknowledgements

We start by saying:

Nidja Whadjuk Nyoongar boodjar gnulla nyinniny. Nyoongar boordier nidja boodjar kura, yeye, boorda. On behalf of the Development WA and the Moodjar Project Team I would like to respectfully acknowledge that this work was carried out on Whadjuk Nyoongar country.

This Report has been Prepared by Moodjar Consultancy for Development WA, February 2021

The authors would like to thank the following organisations and individuals who helped with the management of this Aboriginal heritage survey:

Nyoongar cultural bosses/consultants

Len Collard

Betty Garlett

Narelle Ogilvie

Freda Ogilvie

Dennis Simmons

Phillip Collard

Faron Garlett

Archaeologist: Dr Joe Dortch

Ethnographer: Dr Dave Palmer
Videographer: Miranda Chirinda

Executive Summary

Project background

Moodjar Consultancy recognises the *Whadjuk* people as the traditional owners of the greater Swan Plain area. For the *Whadjuk* people, these are places that have strong social, spiritual, cultural and historic significance.

The following report provides an account of the *Nyoongar* participants in the survey conducted on the 27th and 29th of January 2021. The purpose of this report is to identify what, according to Nyoongar participants, is significant about the Nyoongar cultural heritage of the Alkimos site. As has been set out in the Archaeological Report, there are no registered Aboriginal sites within the survey area. However Nyoongar custodians and participants in the survey consider the pinnacles area, a small reed area in the northwest corner of the site and the sand dune systems and wooded area on the eastern reaches of the site to be of Nyoongar cultural significance.

Previous research and surveys

A desktop study was designed to identify and review the literature that captured *Whadjuk* and other Nyoongar *people's* knowledge of any cultural significance of the site and areas of proximity.

The evidence indicates that the study area sits within a region that has long been part of a rich broader culture and ecosystem that provides significant spiritual and physical sustenance to *Whadjuk*. Indeed, it is located in between the ocean and major lake and other water systems that have a vital role in the creation of the world for *Whadjuk*, a part of the interconnected movements of the *Waugyl* as it carried out its task of "making of the streams and waterways" in the *nyittiny* (cold times).

Prior to the colonisation of the areas around Perth and the southwest of WA, the region was well watered, fertile and relatively densely populated by some thirteen or fourteen socio-dialectal groups who today self-identify as *Nyoongar*[1], see Figure 1.

The term *Nyoongar* (man or people) describes those of Indigenous Australian descent whose forebears occupied *Nyoongar boodjar* (*Nyoongar* land). *Nyoongar boodjar* extends approximately from south of Geraldton, to *Cooroow*, across to the small Wheatbelt town of *Nyoongah*, towards the southern coast around Esperance.

Knowledge of *Nyoongar boodjar* has, from time immemorial, been passed on across the generations from *deman* (the old people) to *koorlangka* (children). It is well supported by other forms of documented evidence recorded by non-Aboriginal people since their earliest times in the region. *Nyoongar* might say of these accounts: *nidja Nyoongar boodjar were wangkiny* (this is *Nyoongar* land and stories).

[1] *Nyoongar* elders cited in Moodjar Consultancy (2016) *Statements of Significance for the Fremantle Region and Registered Aboriginal Sites – Cantonment Hill, Rocky Bay and Swan River*. City of Fremantle.

Ethnographic survey methods

In order to carry out the cultural/ethnographic elements of the survey the following methodologies were used:

1. Established *Nyoongar* cultural safety protocols with *Moodjar* bosses;
2. Collated a file system to manage literature and other sources;
3. Carried out a search of existing sources, researched cultural history of the area and reviewed themes arising from research;
4. Explored the context, Nyoongar language and place names of key places in the area with *Moodjar* bosses;
5. Made arrangements with Nyoongar cultural bosses/consultants to participate in two day archaeological and ethnographic survey of the site
6. Participated in Nyoongar cultural safety induction carried out by *Moodjar* Director, Professor Len Collard;
7. Joined Dr Joe Dortch and cultural bosses/consultants in site walk and inspection of large areas of the site (excluding areas where major works were being carried out through the railway line and train station areas);
8. Filmed commentary of cultural bosses/consultants while they carried out site walk with archaeologist, stopping for the express purpose of recording;
9. Carried out filming of each cultural boss/consultant to ascertain their family and cultural connection to the site and larger proximity, specific areas of expertise and any observations, accounts related to Nyoongar cultural heritage of the site and any recommendations they had about plans for the site;
10. Draft report preparation and presentation to cultural bosses/consultants; and
11. Final report prepared.

Ethnographic survey results

While the survey work located no archaeological sites in the survey area Nyoongar custodians identified areas they considered to be culturally significant, including (1) the pinnacles in and around Place ID 37478; (2) ancient soils that potentially contain evidence of early Aboriginal occupation; and (3) groves of culturally important plants. This promoted much discussion about what could be called a '*Nyoongar* reading of boodjar (country)'. While these accounts are unlikely to impact DevelopmentWA's compliance obligations under the Aboriginal Heritage Act (1972) this could form the basis of further 'engagement' opportunities where *Nyoongar* cultural experts assist in the design of landscape plans, street naming, interpretive material and trail/walkways.

The proposed development work will involve ground clearing and excavation and therefore could disturb presently concealed cultural material. Therefore, *Nyoongar* cultural monitoring of clearing and ground-disturbing work is recommended.

Recommendations

While no archaeological sites are currently evident in the survey area, a number of *Nyoongar* custodians consider the pinnacles area, the sand dune systems and wooded area to the east of the sand dunes are areas of *Nyoongar* cultural significance.

It is on this basis the following is **recommended**:

1. Proponent staff and contractors should be informed of the legal requirement to avoid disturbance to any Aboriginal site as defined in the *Aboriginal Heritage Act 1972* (Western Australia), whether registered or otherwise, and the view that disturbance of a site includes ground disturbance, souveniring or deface.
2. The area of the pinnacles should be preserved and the subject of further ethnographic and archaeological research, mapped using aerial photography shot on drone transects, as pedestrian access is difficult. More detailed and accurate heritage information could then be submitted to DPLH for reconsideration as an Aboriginal heritage site.
3. As much of the wooded area that has thick *balga*, zamia palms, some jarrah and other flora on the eastern side of the sand dunes should be preserved. Clearing of any wooded areas could be undertaken by a *Nyoongar* business.
4. Prior to any ground-disturbing work, Development WA should consider engaging suitably experienced *Nyoongar* to act as monitors of the works in case sub-surface heritage material is inadvertently unearthed. This work should be carried out in association with a suitably qualified archaeologist and anthropologist. Development WA should see this work as a further opportunity for a *Nyoongar* business to manage this work and/or have a *Nyoongar* with expertise in *Nyoongar* knowledge systems and methodologies.
5. Development WA explores 'engagement' opportunities to undertake work with *Nyoongar* knowledge experts to identify *Nyoongar* interpretive information to be used throughout the site (for example, *Nyoongar* identification and protection of flora and fauna species, *Nyoongar* involvement in the concept planning, interpretive signage, timber harvesting and replanting work, revegetation, street naming, landscape plans for public areas, information for homeowner packs, sand dune walkways or trails).
6. In any future heritage survey work DevelopmentWA make arrangements for a pre-survey planning meeting to bring together the archaeologist, ethnographer, project manager, *Nyoongar* consultants/experts, representatives from the proponent parties. This goal of this meeting will be to brief consultants on the scope, previous heritage work, resolve logistics questions and strengthen opportunities for engagement.
7. That in future Development WA consider ways in which Aboriginal heritage assessment and protection can move beyond a compliance to an engagement approach. For example, work with other partners to undertake a region wide assessment of the Aboriginal heritage values from Alkimos to Moore River. A *Nyoongar* led team should undertake this work in conjunction with: *Nyoongar* knowledge experts, ecologists, hydro geologists, flora and fauna-specialists (as well as archaeologists and ethnographers).

Contents

1.0 Introduction

Moodjar Consultancy recognises the *Whadjuk* people as the traditional owners of the greater Swan Plain area. For the *Whadjuk* people, these are places that have strong social, spiritual, cultural and historic significance.

The following report provides an account of the *Nyoongar* participants in the survey conducted on the 27th and 29th of January 2021. The purpose of this section of report is to identify what, according to *Nyoongar* participants, is significant about the *Nyoongar* cultural heritage of the Alkimos site. As has been set out in the Archaeological Report, there are no registered Aboriginal sites within the survey area. However *Nyoongar* custodians and participants in the survey consider the pinnacles area, a small reeded area in the northwest corner of the site and the sand dune systems and wooded area on the eastern reaches of the site to be of *Nyoongar* cultural significance. Inside the surveyed area the limestone outcrops known in Western Australia as "pinnacles", or limestone root-casts has also been the subject of survey work previously conducted.

> The pinnacles in the survey area are mapped as Place ID 37478 *Romeo Road Pinnacles* "Stored Data / Not a Site" in the Register of Places and Objects maintained by the Department of Planning, Lands, and Heritage (DPLH). Despite this downgrading of protection, Place ID 37478 is reported to have high cultural values and has largely been avoided by previously approved development work within the survey area. (Dortch in this report)

Nyoongar participants had much to say about this area.

Using their knowledge of *Nyoongar* ways of 'reading country' participants also had things to say about the likely use of other areas within the site. This included a small reeded area in the northwest corner of the site and the larger wooded areas east of the sand-dune systems on the site.

In addition, *Nyoongar* participants made remarks about:

> 1) the need for DevelopmentWA to arrange cultural monitoring of areas where major digging and other earth works are being carried out,
>
> 2) opportunities to carry out more rigorous heritage surveys along the northern sections of the coast predicted to be marked for future developments, and
>
> 3) the value of Aboriginal heritage, place-naming and other interpretive work to *Nyoongar* families, local government authorities, tourism ventures and housing developers.

Figure 1: Location of the study area

2.0 Background

The 198ha Alkimos Central project is the centerpiece for Development WA's Alkimos landholding. Plans for this area are aimed at providing key services, an employment focus, a social hub and the amenities for the 57,000 residents of the Alkimos-Eglinton District over the next 25 – 30 years.

According to this project brief:

> Land north of Alkimos Central (beyond the Regional Open Space) is known as Alkimos Vista and is owned by Development WA and being developed (in partnership with Lendlease) for mostly residential purposes. Land to the south is being developed for urban purposes by developer LWP and is known as Trinity estate. The land to the east is vacant but is reserved for the Mitchell Freeway extension. The constructed Marmion Avenue is directly on the western boundary. The northern portion of the land to the west of Marmion Avenue is the Water Corporation waste water treatment plant and associated buffer and south of this, is the estate referred to as Alkimos Beach and is owned by Development WA and is being developed (in partnership with Lendlease) with a mix of residential and retail uses.

Planning for the Alkimos City Centre Activity Centre Plan commenced in 2013 with the Structure Plan being approved by the WA Planning Commission in August 2018. Given the time lapsed since the Structure Plan was designed, the Master plan has been reviewed and updated. The result is a more pedestrian orientated design focusing on developing a walkable city centre core around the train station.

In July 2020 Gundi Consulting was engaged as Aboriginal Development Managers to prepare an Aboriginal Heritage Engagement Strategy, administer engagement with traditional owners and allow for these findings to be incorporated into the design of the public realm at Alkimos Central. Gundi Consulting then visited the site and, after viewing the Pinnacles area adjacent to the proposed rail line and falling within the proposed Romeo Road alignment, made the assessment that the Pinnacles area is an Aboriginal heritage site with significant meaning to local *Nyoongar*.

3.0 Ethnographic methodology

In order to carry out the cultural/ethnographic elements of the survey the following methods were used:

1. Established *Nyoongar* cultural safety protocols with *Moodjar* bosses;
2. Collated a file system to manage literature and other sources;
3. Carried out a search of existing sources, researched cultural history of the area and reviewed themes arising from research;
4. Explored the context, *Nyoongar* language and place names of key places in the area with *Moodjar* bosses;
5. Made arrangements with *Nyoongar* cultural bosses/consultants to participate in two day archaeological and ethnographic survey of the site
6. Participated in *Nyoongar* cultural safety induction carried out by *Moodjar* Director, Professor Len Collard;
7. Joined Dr Joe Dortch and cultural bosses/consultants in site walk and inspection of large areas of the site (excluding areas where major works were being carried out through the railway line and station areas);
8. Filmed commentary of cultural bosses/consultants while they carried out site walk with archaeologist, stopping for the express purpose of recording;
9. Carried out filming of each cultural boss/consultant to ascertain their family and cultural connection to the site and larger proximity, specific areas of expertise and any observations, accounts related to *Nyoongar* cultural heritage of the site and any recommendations they had about plans for the site;
10. Draft report preparation and presentation to cultural bosses/consultants; and
11. Final report prepared.

3.1 *Nyoongar* and heritage work

Before moving onto an examination of previous research in relation to the site area, it is important to make a number of points in relation to the business of ethnographic recording cultural heritage, mapping heritage places and thinking about the *Nyoongar* use of particular sites.

The first point to make is that despite the best endeavours of heritage professionals, it is impossible to know with 'absolute' confidence the extent of *Nyoongar* use of an area. However, given the length of use in the region is likely that at some point *Nyoongar* moved through most tracts of land now the subject of development. The second point to make is that accounts of the heritage of a place are often contradictory, selective and laden with the values and interests of those recording events. Nowhere is this more apparent than in exploration of Aboriginal cultural heritage in Western Australia.

Until recent times the accounts were almost exclusively recorded by non-Aboriginal officials. They largely controlled the 'pens' and record keeping whilst also controlling access to land, planning, and legislating people's movements. The authors of many records were, by and large, people writing about culture, customs, activity and land use that they understood little about. Not surprisingly the available records on *Nyoongar* and other Aboriginal use of places in and around the area studied are strongly shaped and formed by non-Aboriginal professionals, using non-Aboriginal narrative forms and scientific conventions.

It is also worth noting that European cartographic conventions, town planning practices and systems of boundary making are not directly or easily transferrable into *Nyoongar* systems of naming and land use. European mapping practices are usually set out in such a way as to imply that places can be truncated or separated from other places, have fixed names over time, are universally understood and treated, have a principal or fixed sets of land use, and can be understood in isolation. In contrast *Nyoongar* use of *boodjar* (country) is much more relational. Different people will have a different relationship with any given place depending on their family connections, gender, age and knowledge. This means that it is conceivable for different people to have a different connection to the same place. For example, one person may have rights and access to visit a place by virtue of their mother's inheritance; whilst another might have a different set of rights and interests through their grandfather's association. Furthermore, it is impossible to understand any area without reference to its relationship with others. For example, one place may be partially understood as it features in a *Wargal* song, dance or story. This could mean that this place is more deeply connected to other distant sites along the river by virtue of this story.

For *Nyoongar*, any one place may be called several things and be used for different purposes at a number of times throughout the year. For instance, some *Nyoongar* refer to Kings Park as *Karrakatta* (hill of the crabs); *Yongariny* (place for catching kangaroo); *Gennunginy Bo* (the place for looking a long way); or *Karlkarniny* (fire place). All of these names and heritage used are equally correct – depending on the context and time of the year.

For *Nyoongar*, talking about the heritage of a place as if it exists in isolation is akin to talking about a person as if they exist in isolation from their *moort* (family). All of these challenges have been commented upon and noted as part of the State Governments Consultations with stakeholders as part of their proposal to introduce major policy changes to the existing Aboriginal heritage regimes.[2]

A number of those involved in this site survey also had things to say about both the methodologies used for conducting Aboriginal heritage assessment and the methodologies used by proponents for protecting Aboriginal heritage. This included the following observations:

- Aboriginal heritage assessment is structured around an Act that is now almost fifty years old. As a result many of the methodologies adopted by those carrying out survey work are not always consistent with contemporary heritage practice.
- Survey work is often reactive to the needs of a single development and works programmes as set out by proponents rather than shaped by *Nyoongar* interests, and systematic and well-planned heritage research across a region.
- As it stands, what is considered as Aboriginal heritage and significant under the Act does

[2] see WA Government (2019) Review of the Aboriginal Heritage Act 1972: Key themes and summary of issues. https://consultation.dplh.wa.gov.au/heritage/aha-review-phase-two/

not take account of *Nyoongar* knowledge systems nor science beyond archaeology or anthropology. For example, rarely are the insights of ecologists, hydrologists, zoologists and Noongar 'scientists' taken into account.

- Aboriginal heritage survey methodology should take account of proposed changes to the Aboriginal heritage Act, recent emphasis on the impact of Indigenous use of places on the 'social surroundings' in the assessment of Environmental Factors.
- If proponents are interested in moving beyond a compliance approach to an 'engagement' and 'social licence' approach to Aboriginal heritage then it would be wise to involve *Nyoongar* much earlier and across a range of layers of planning and development (ie from concept design, heritage survey studies, works monitoring, landscape and species identification monitoring and protection, production of public and interpretive content).

3.2 *Speaking for boodjar (country)*

Establishing whom in the *Nyoongar* community has authority and capability to speak about boodjar in a particular place is not a simple matter. In other parts of the country these people are variously called 'Traditional Owners', 'Elders', 'Cultural bosses', or 'Senior Law People'. These are often people whose association with particular places is shaped by a combination of place of birth, descent, where one has 'grown up', mother and father's place of birth, gender, seniority in law and culture, regularity of contact with country, or in some areas in Central Australia, place where one's umbilical cord fell off. In much of Australia this has grown more complex due to the history of forced removal, loss of access to language, culture and knowledge. This usually means that a number of individuals act as 'bosses for country'. As Myers (1986, p. 128) says, membership of the 'Traditional Owner' group is often widely extended and "therefore groups are not a given". Rather it involves a set of relationships that can be disputed but shared and demands a level of recognition of others. The process of what Western Desert people call kanyininpa (holding or carrying) country is the product of dynamic negotiation.

In *Nyoongar boodjar* (country) this is often even more complex given the impact of colonisation and the fact that since the earliest of contact time *Nyoongar moort* (family) have been forbidden by law to access much of their boodjar, had many of their children removed, been forced to live on reserves, missions and particular farms and pastoral properties, unable to marry according to traditional kinship rules, and had their associations with *moort* (family) managed by government. This has had a profound impact on the capacity of people to 'hold' or 'carry' their obligations to boodjar and pass along to future generations their knowledge and language (Machin 1993). This can mean that one's relationship with boodjar has become more associated with family labour patterns, movement to take up opportunities in the market economy, health, education and non-Aboriginal justice. Often a 'Cultural boss' or spokesperson will have a long-term association with a place and have or had contact with those who had passed on their knowledge. O'Connor et al (1989) describes these people as of the 'pivotal generation of the culture transmitters'. This often gives them knowledge of the region's ecology, the natural resources of an area, hunting, fishing and camping grounds, water resources and local flora and fauna. Often these people will 'read the country' using *Nyoongar* ontological, epistemological and theoretical lenses (Benterrak, Muecke and Roe 2014).

3.3 Selection of *Nyoongar* for the survey

In line with the terms of the Noongar Standard Heritage Agreement (NSHA) with the Whadjuk people, normally Development WA are required to submit an Activity Notice for the project to the South West Aboriginal Land and Sea Council, so that the Whadjuk working party can select an 8-person survey team. However, at the time of the survey there was no CEO and many of the Director's positions on the SWALSC were vacant. The advice received by Moodjar Consultancy was that the practice for heritage surveys in Whadjuk boodjar was that the team uses their best endeavours to make contact with *Nyoongar* who had previously been involved in heritage surveys in the area. A list of these people were invited to participate in the survey. The following *Nyoongar* took up the invitation and participated:

Dennis Simmons was born on *Whadjuk Nyoongar* boodjar with connections to the *Wardantji, Yuat* and *Wilimen* people. He has studied performing arts, psychology, conservation and land management as well as having qualifications in mining and construction. He is also a grandfather who is leading work with *Nyoongar* young people to 'hold' and pass on culture, ceremony and language. When he was young he often joined his 'Pop' Ken Colbung who had been visiting and "protecting all the sites around this area." Dennis has participated in a range of heritage surveys in the area (including this particular site).

Len Collard was born in Pingelly and spent his early childhood in Brookton to parents Fred Collard and Jean McGuire. The family then moved to White Gum Valley where he finished his schooling. Professor Collard has completed studies at Edith Cowan and Murdoch Universities and now is a tenured Professor of Indigenous Australian Studies at the University of Western Australia. Len's traces his heritage to both Whadjuk and Balardong moort (family) through the Bennell, McGuire and Collard. His grandfather 'Pop' Tom 'Yelakitj' Bennell offered accounts of how in the early years of colonisation 'old grandfather John Mungo Bennell' moved from the Perth area out, along the river, eventually to settle in Brookton and escape the immediate impact of colonisation.

Betty Garlett was born in Brookton and then moved to the Fremantle area. Betty's parents were raised in Brookton but with direct descent to Whadjuk boodjar. Betty spent much of her early life around senior people in Brookton and Fremantle, listening to their accounts of life when they were young. After moving to Perth in the 1960s, Betty's family would regularly move back to the bush during 'holidays' and the shearing season to accompany their father who was a shearing contractor. As a result she spent a great deal of time around senior *Nyoongar* speakers. Betty was a Regional Councillor on the Aboriginal and Torres Strait Islander Regional Council during the 1990s.

Narelle Ogilvie was born in Perth of Whadjuk, Balardong and Nanda heritage. Narelle spent a considerable amount of her younger years growing up in the Kimberley. She described her connection to the area as coming "through my grandmother's side' and her Nanda heritage through her father and grandfather's side from Kalbarri.

Freda Ogilvie describes herself as 'from the McGuire/Bennell line". Her great, great grandmother was born in Fremantle and her Grandmother Jane Shaw was born in the Middle Swan area and removed to New Norcia. Freda is a retired teacher who has worked in the classroom and in policy and leadership for over thirty years. She worked across the state and in the Northern Territory, particularly focusing on early childhood education and cross-cultural content development.

Phillip Collard has family affiliations to the area through his maternal *Nyoongar* lineage and by virtue of the Whadjuk line. He was raised in Kondinin by his parents who were raised in the Central Wheatbelt area and Perth and now lives in the southern suburbs of Perth. As well as working as a

mechanic at one point he ran a nursery and has a lifetime working knowledge of traditional plants and their use.

Faron Garlett has *Nyoongar* connections to this country through his father who has previously participated in heritage survey work in the area. He has also spent time living in the Pilbara and other regions to the north of Perth where he also has family connections.

4.0 Desktop study results

A desktop study was designed to identify and review the literature that captured *Whadjuk* and other *Nyoongar people's* knowledge of any cultural significance of the site and areas of proximity. The research for the desktop study reviewed published and unpublished sources and literature, oral histories, recorded stories, narratives, and commentaries. These stories, narratives and commentaries were incorporated into this report to provide context for the site visit and inspection. The literature review also incorporated previously recorded oral histories of *Whadjuk Nyoongar*, other Aboriginal and non-Aboriginal groups relating to the broad study area.

The desktop research revealed information about a number of Aboriginal sites in the proximity of the study site. Information gathered about the wider Perth area, specifically the northern suburbs areas also identified evidence related to *Nyoongar* use of the site area.

The information gained from the desktop research will be used to augment the knowledge and information contributed by the archaeological survey.

4.1 *Nidja boodjar koorliny*: *Nyoongar* cultural safety

Nyoongar use of *boodjar* (country) is closely tied to old and well-established *Nyoongar* cultural and epistemological frameworks and practices. For example, in *kura* (the past) if, for social, spiritual or economic reasons, a neighbouring *Nyoongar* group was to travel through to the Perth area the onus was on them to comply with certain obligations and regulations. At the same time, local *Nyoongar boordier* (bosses) were responsible for the health and safety of visitors. Part of the obligations of *wam* (outsiders) included the expectation that they announce their arrival; and bring enough *daadja* (meat), *mereny* (food) and goods to exchange for the length of their travels. The expectation has been that visitors must honour and respect *boodjar* (country) and *boordier* (bosses).

It is also important to *Nyoongar* that visitors take instruction from locals on where to safely go and how not to offend *jennark* (spirits) or *Waugal* (the old snake spirits) nor move through country without proper introductions. Failure to do so could have devastating consequences on the health and wellbeing of visitors and custodians. Thus the 'cultural safety' of visitors was tied up with obligations of both locals and visitors.

Presenting on behalf of the Combined *Noongar* Native Title Claim, Palmer explained it thus:

> In Noongar thinking, an owner of country has the right to exclude or grant permission to non-owners to enter and use their land. But he or she also has a duty to share their land with others and a duty to ensure that no harm comes to visitors. The Aboriginal evidence amply demonstrates that *Noongar* people believe that unknown country is potentially dangerous, because *Noongar* land is possessed of spiritual potentialities which must either be avoided or knowledgably managed.

> Ignorance of country is therefore a matter of personal jeopardy. To venture into unknown country is to imperil both yourself and those who depend upon you. This means that, for the most part, Nyungar people regard country that is not their own, and therefore which is unknown to them, as country to be avoided. Based upon Dr Palmer's research data and his own observations, he is of the view that Noongar people recognise a general duty to care for their own country. Looking after country typically requires a personal inspection to check for damage, perform maintenance, and ensure there is no unwelcome or unexpected development.
>
> Another important aspect of "looking after country" and "speaking for country" is to make any representations that might be necessary to ensure that spiritually sensitive places on country are not harmed by development. There were many instances in the Aboriginal evidence where witnesses spoke about the need to be consulted about and to protect, sites and indeed, country generally …
>
> There is also a right and a duty to pass on knowledge about country and about Nyungar ways so as to ensure the continuity of Nyungar tradition over the generations. The passing on of knowledge of country is understood to be a duty of a landowner.[3]

There is considerable evidence that local *Nyoongar* were well acquainted with how to protect themselves and outsiders. For example, Daisy Bates records that in and around the greater Perth area custodial *Nyoongar* would scatter rushes or leaves form *balga* (the grass tree) at a particular spot and say the following before moving past a *Waugal* site:

> *Ngaija noono daranya gonin kalguttuk nganya mamman* (I your bed carry countryman me father)[4]

At some places, other protocols were followed. For example, game might have been killed or it may have been prohibited to cook food near a *Waugal* pool.[5] Before going to some places associated with the *Waugal Nyoongar* sing out:

> *Ngain-ya ye-ya koorliny* (I am coming now). *Nyal winjala nyinde* (Where are you?).[6]

Today *Nyoongar* custodian elders continue to observe these and other protocols to ensure that visitors and newcomers are given the appropriate welcome and permission to enter *boodjar* (country). Colbung spoke of the special rituals that involve speaking to *wardungs* (crows) before approaching *Waugal* sites.[7] To *Nyoongar* responsible for the areas around Perth the *wardung* is regarded as a keeper of country. According to Colbung:

> … that's why you've got to ask the crows' (birds) permission to come. They've got to hear you and if they hear you, you're right! If you couldn't find them here, you couldn't do anything.

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[3] Bennell v the State of WA. Federal Court of Australia (Wilcox J) 19 September 2006 [2006] FCA 1243.

[4] Vinnicombe, P. 1989. *Goonininup: A Site Complex of the Southern Side of Mount Eliza*. Perth: Department of Aboriginal Sites. p. 17.

[5] Vinnicombe 1989, p. 17.

[6] Vinnicombe 1989, p. 17.

[7] Bloor, E. 1987. *Aboriginal usage of Kings Park*. Unpublished report: Department of Aboriginal Sites. Perth: Western Australian Museum.

The late Ken Colbung is also quoted as offering the following welcome to visitors:

> *Baal quabelee wanjoo budjarrah winnaitch budjarrah, kata-tja-nyoon* (we give and receive from you the very best welcome on this sacred earth and we will be at peace with each other).[8]

During the survey work similar processes were observed by all of the cultural bosses/consultants. On the morning of both days Len Collard led a process whereby each boss followed his acknowledgement in *Nyoongar* language. Len sang out:

> Len: *Kaya, Kaya, moortaniny nidjar boodjar. Noonar moortaniny yaalkoorliny yeye. Noonooka katatjin nyuny, genininy nyuny yaalakoorliny. Noonookurt ngenalung kura barlung boodjar nyinalung gnarlung boodjar, gnarling yeye nyininy. Nyung korlanginy geneniny winji noonooka koora baal baranginy jenna koorliny nidja boodjara* …
>
> Hey, hey family of this country. You are my family that goes along and stays here today. Your knowledge I have seen as I go along. You see from a long time ago that this country is given to us so today we can sit here. Since I was a child I have gone along knowing this.
>
> *Bullarung balga, boordier jarrah bullarung bornaworliny nyinalung nidja, Nyung weirn kwop, nyung darlungniny noonar. Nidja moornaniny baalang gnalla koorliny. Noonook daa kwop weirn yaakoorliny. Gnullayiny, yuart barang weirn, nyung barranginy nyung, kwop weirn koorlanginy barranginy nyung yaakoorliny.*
>
> Plenty grass trees, boss jarrah, here there is plenty important timber for sitting. My spirit is good, I hear your tongue. This black person they go along with us. Your tongue is healthy spirit going along. We getting no bad spirits, we get good spirits going along, standing up along.

He then took a mouth full of water and sprayed it out onto country to signify his respect for those who have long passed, making sure they could tell who he is by his body mixing in with the water.

He explained:

> Just to do a translation for the records, basically what I was saying was that we singing out to our ancestors and to our family. They are our relations, we are direct descendants of the people whose land where we are. They have been here in the past and we are here today. And we are letting them know that we know who they are, we are familiar with them and we want to talk to them in the old language so they hear. And we are talking to the country in our language so they hear and acknowledge that we are still connected to our language and our people and to our knowledge. I've asked that the good spirit comes and looks after us as we go on our country. And we are telling the bad spirits to keep away. We come here to look at our country and to learn and get to know more because we know that there is going to be big disruptions here. We are trying to get evidence and information to help us to care as much as we can within the constraints that how the developers do things. That's a task, a job that we take seriously and do our very best to try and protect aspects of the tangible and intangible heritage on this country. I blew some water out as an acknowledgement to the Rainbow Serpent who is one of the main big fullas in our culture and our law and in our language and understanding. And we are basically asking that they look after us as we get around the traps and we don't get tangled up in any negative energy. So I am going to ask

[8] Western Australian newspaper (18/11/1988) p. 52.

> everyone to sing out of your own volition and we can stop for just a minute, listen to the wind blowing and then we can get on with our job. So I want everyone to sing out in a loud voice, doesn't matter what you say, just let em know who you are, that you are looking forward to doing some work today.

Others then took up the invitation to 'sing out to the old people' in the way each felt was comfortable and appropriate. All used *Nyoongar* language (and some *Nyoongar* English) to demonstrate their respect, announce their work and ask the old people to keep them safe.

Dennis Simmons added in *Nyoongar*:

> Just shouting out to *Gtunjatajaara Gnarkiny* or Ken Colbung who has been protecting all the sites around this area. And being with him as a young man for thirty years coming out this way. So I just like to make sure that he is acknowledged through this process.

At the conclusion of the survey on Friday afternoon Len Collard and Dennis Simmons led all in singing out to the 'old people' in recognition of their act of keeping people safe during the survey.

4.2 Understanding *Nyoongar* methods of reading *boodjar*

A range of scholars have contrasted the way that Australian Indigenous groups come to understand the history of Aboriginal land use with 'western' systems of mapping, scientific inquiry and social science knowledge recording. These Indigenous methodologies have been less reliant on literature, abstractive and extractive means of understanding. Rather *Nyoongar* are more reliant on observation, interpretation and 'reading' of the country using a mix of repertoires including *bulla ni* (deep listening), *jenna koorliny* (walking), *nyinniny* (sitting) and *nyarliny* (sweating) so that one's weirn (spirit) can pick up the *keniny* (wind), *djierap* (birds), *kep koorliny* (weather), *boodjar* (country) *moyran* (grandparents). These methods allow those who are 'fluent' in *Nyoongar* knowledge to interpret the history of land use by 'talking back' to the old voices through what Collard and Palmer (2015, p. 190) call the adoption of *Nyoongar* hermeneutic methods.

Collard and Palmer suggest that these styles and methods are often seen as unconventional. However, on both days of the survey *Nyoongar* participants drew on them considerably. As Collard explains elsewhere, people who use these methods:

> draw on the cultural experience and knowledge gained from *koorliny yirra Noongar* (growing up Noongar), *katitjin Noongar wangkiny* (learning to speak the language) and *katitjin Noongar* (interpreting the 'evidence' using Noongar ways of thinking). We have also used the oral accounts of other Noongar as well as material from the written historical record. Some Western-trained historians might not always accept the evidentiary strength of this approach. (Collard and Palmer 2015, p. 191).

As well as working with scientific method Collard led the survey methodology in a way that recognized '*'gulla boodjar ngulla boordier* (our country is our boss and guide). As mentioned earlier this started with *Nyoongar* participants literally singing out to the 'old people' and listening for its response.

As Collard (Collard and Palmer 2015, p. 191) explained that his *konk Whadjuck/Balardong* (*Whadjuck* and *Balardong* uncle) Sealin Garlett reminded one time about his own experiences about

this very matter telling me that:

> my Grandma (*Yurleen*) used to say this was to be passed on to her children and her grannies … there are places where you find serenity; where you find a sense of belonging … that this is a part of our place, this is a part of our area, our culture. *Nitcha boodjar koonyarn nitcha koorl buranginy boodjar karluk maya koonyarn wah*. *Deman deman and maam wiern kia moort koonyarn. Deman and maam noonookurt, boodjar koonyarn karla koorliny. Koorlongka boorda gneenunyiny*. Those words say that this is my country where I belong. This is *deman* and *maam* , my grandmother and grandfather's land, this is their land where their spirits move now. Boorda or later on, this is going to be the responsibility of my children and my children's children, their home and this place will always be linked to their spirit.

This was an important part of methodology to adopt during survey as those present were literally related to country. They and their forebears have long talked with it, walked with it, feed it and get nourished by it. As a consequence country reveals things to them. Following this ontological logic before each participant was born they dwelt within country as spirits. When they pass away they head back to this form. Each tree, animal, rock and piece of vegetation are therefore *moort* (family). This means that they have brothers and sisters that are certain trees, rocks, grandparents that are present, animals that are their parents.

4.3 *Nyoongar* use of *boodjar*

The evidence indicates that the study area sits within a region that has long been part of a rich broader culture and ecosystem that provides significant spiritual and physical sustenance to *Whadjuk*. Indeed, it is located in between the ocean and major lake and other water systems that have a vital role in the creation of the world for *Whadjuk*, a part of the interconnected movements of the *Waugyl* as it carried out its task of "making of the streams and waterways" in the *nyittiny* (cold times).[9]

Prior to the colonisation of the areas around Perth and the southwest of WA, the region was well watered, fertile and relatively densely populated by some thirteen or fourteen socio-dialectal groups who today self-identify as *Nyoongar*[10], see Figure 1.

Figure 1. Aboriginal dialect groups of the south west of Western Australia, based on Tindale (1974). Source: Metropolitan Redevelopment Authority 2016

[9] Laurie. M. (ed.), 2003. 'Interview with Cedric Jacobs', Town of Vincent Local History Collection (oral history collection), Perth, Australia.

[10] *Nyoongar* elders cited in Moodjar Consultancy (2016) *Statements of Significance for the Fremantle Region and Registered Aboriginal Sites – Cantonment Hill, Rocky Bay and Swan River*. City of Fremantle.

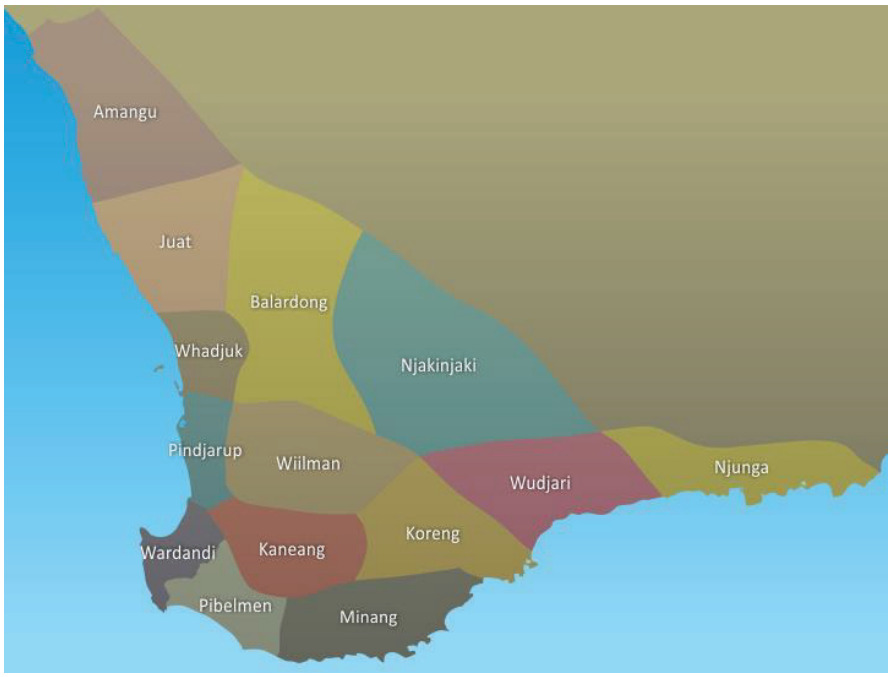

Figure 2: Noongar language groups

The term *Nyoongar* (man or people) describes those of Indigenous Australian descent whose forebears occupied *Nyoongar boodjar* (*Nyoongar* land). *Nyoongar boodjar* extends approximately from south of Geraldton, to Cooroow, across to the small Wheatbelt town of Nyoongah, towards the southern coast around Esperance.[11]

Knowledge of *Nyoongar boodjar* has, from time immemorial, been passed on across the generations from *deman* (the old people) to *koorlangka* (children). It is well supported by other forms of documented evidence recorded by non-Aboriginal people since their earliest times in the region. *Nyoongar* might say of these accounts: *nidja Nyoongar boodjar were wangkiny* (this is Nyoongar land and stories).[12]

To Nyoongar it is impossible to talk about *boodjar* (country) and people as separate entities. As Patricia Baines wrote:

> To look at the land through Nyoongah eyes is to perceive personhood in all life forms. Old trees are parents and seedlings are children. Birds and animals, particularly when one of them behaves in an unusual manner or is distinguished in some way, may be a deceased ancestor. The land is seen as a huge body – most often it is recognized as the body of one's mother. To put a trench through the ground is to scarify the mother's back or dig into her

[11] Collard, L. and S Harben. S. 2009 *Nidja Beeliar Boodjar Noonookurt Nyininy: A Nyoongar Interpretive History Of The Use Of Boodjar (Country) In The Vicinity Of Murdoch University*. Murdoch University.

[12] Collard, L. and Palmer, D. 1998. *Nidja Goordandalup! Noonookurt Nyinniny: A Nyungar interpretive History of the Use of Boodjar (Country) in the Vicinity of the University of Western Australia*. Murdoch: Murdoch University. p. 14-15

guts.[13]

The late Robert Bropho expressed similar sentiments when talking about the relationship between *Nyoongar* and country in an area near *Goonininup* (south of Kings Park). He said:

> Further around the corner you've got the – secret women's spring there – that's the women's business – the water running out of the hill – the white man says it water – but we know its all milk from the mothers' breast in her body – you go onto the Bridge and – it's all important there too – the footprints are under the water there – where they crossed – over to Kennedy Fountain and the Brewery they did things and went up to Kings Park[14]

Nyoongar say that *Nyoongar boodjar* (country), began during the *nyittiny* (cold time), when the world was flat, soft and featureless. During this time (before people) ancestral spirits dwelt and wandered. As Noel Nannup puts it, they drifted in and out of their spirit forms, into the physical and material world.[15]

The *Waarkal* (rainbow serpent) was the first to change from pure spirit form and become "real". This allowed it to move across the unformed land, fashioning hills and valleys, tunneling under the ground and then up again. This is how rivers, lakes, swamps and wetlands came into being[16]. In this way, *Nyoongar* say that the *Waarkal* created the waterways, and acts as the keeper of all fresh water sources. 'Pop' Tom Bennell describes this 'old carpet snake' further:

> The *Waakal* - that's a carpet snake and there is a dry carpet and a wet carpet snake. The old *Waakal* that lives in the water, they never let them touch them. Never let the children play with those. They reckon that is *Nyungar koorlongka warra wirrinitj warbaniny*, the *Waakal*, you're not to play with that carpet snake, that is bad. ... *Nitcha barlup Waakal marbukal nyininy* - that means he is a harmless carpet snake. He lives in the bush throughout *Nyungar budjar*. But the old water snakes; they never let them touch 'em. ... the real water snake oh, he is pretty, that carpet snake. ... the *Nyungar* call *him Waakal kierp wirrinitj*. That means that carpet snake, he belongs to the water. You mustn't touch that snake; that's no good. If you kill that carpet snake *noonook barminyiny* that *Waakal ngulla kierp uart*, that means our water dries up - none. That is their history stories and very true too.[17]

There is not a great deal of evidence of water on the survey site (except for one small area of reeds in the north-west section of the site and some evidence of kangaroos digging for moisture in the western parts of the site) *Nyoongar* participants spoke about the likelihood that this is a recent phenomenon caused by the use of ground water by nearby market gardens and housing development. Others suggested that seasonal water flows fluctuate so that January is the least likely

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[13] Baines, P. 1988. *A litany for land*. In Keen, I. (ed) Being Black: Aboriginal Cultures in 'Settled' Australia. Canberra: Aboriginal Studies. p. 228

[14] Cited in Collard, L. and Palmer, D. 1998. *Nidja Goordandalup! Noonookurt Nyinniny: A Nyungar interpretive History of the Use of Boodjar (Country) in the Vicinity of the University of Western Australia*. Murdoch: Murdoch University. p. 14-15

[15] Nannup, N, 2003 *Carers of Everything* http://www.cockburn.wa.gov.au/documents/AboutCockburn/Sister_Cities/E_Carers_of_Everything.pdf [Accessed 24 October 2016]

[16] Nannup, 2003

[17] Bennell, T. 1978. Oral Interview. Transcribed in 2002.

time to see ground water.

Dennis Simmons had this to say:

> There was more water around here (on the survey site area) but there has been a lot of development around here. Like even this area here (on the west side of the site) was a station so there was definitely water all the way here but development and industry has sucked a lot of water. Plus we know the *Gnangara* Mound, that water source, with industry pulling so much water out of it we got saltwater pushing right back inland and that is killing trees and things like that.

Even so, much of the study area is very close to one of the richest freshwater systems in the southwest with old springs, swamp areas and lakes being approximately a kilometre from the study site. This demonstrates that the site is located very close to a broader area of much significance.

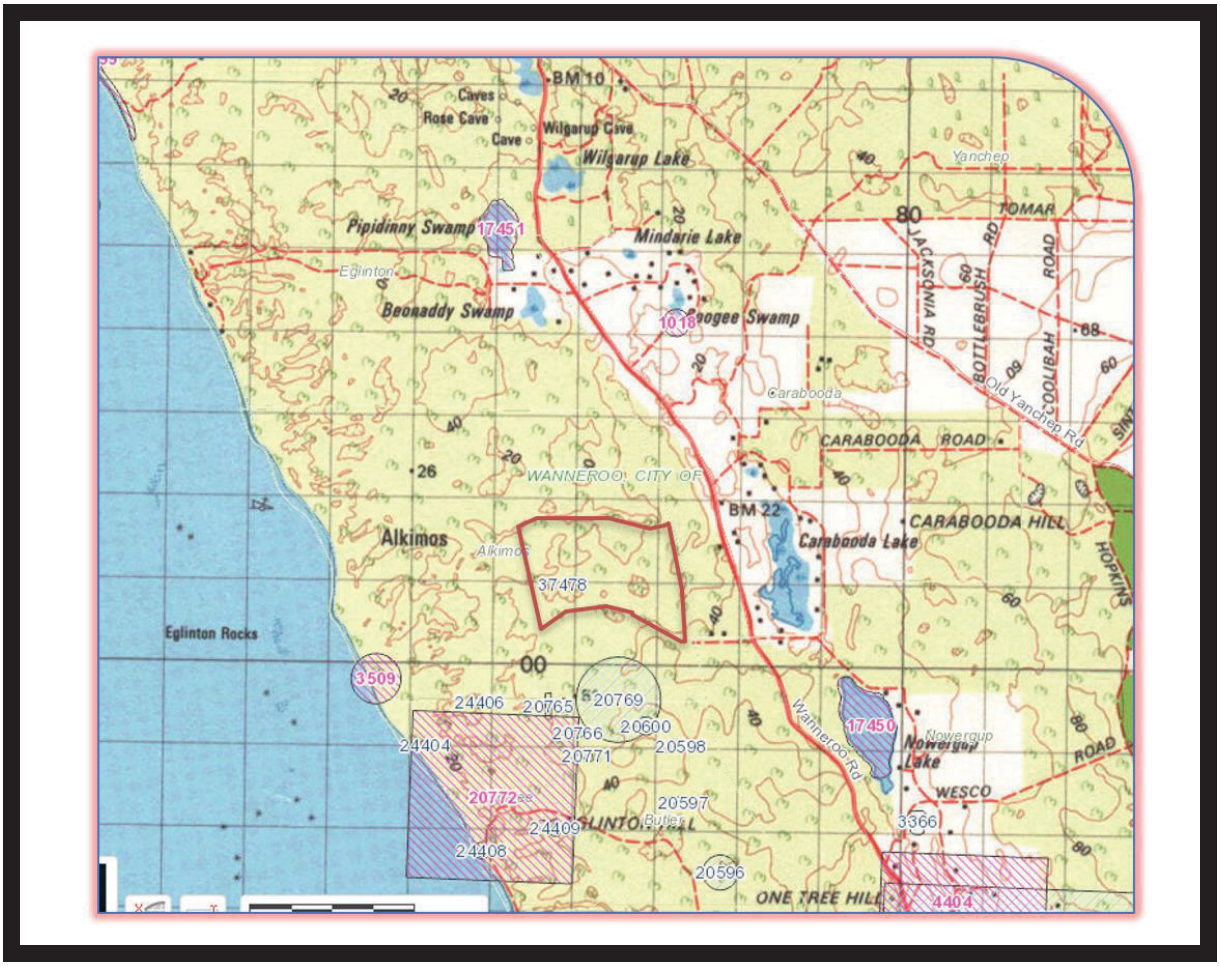

Figure 3: Map of Aboriginal sites in proximity to the study area (registered and listed sites are numbered)

Goode and Harris (2017) observe that near the survey site a vast and extend system of lakes exists from Lake Joondalup to Loch McNess, through to Moore River and surrounding swamps, wetland areas and freshwater springs were used by *Nyoongar* for moving, gathering, camping, food and ceremonial purposes prior to contact with *nyidyung* (white people) and during the early years. The

written record exists since at least George Grey walked through the area during his return journey to Perth from the Murchison. Starving and thirsty he claims to have been treated well and with hospitably by a group of *Nyoongar* who provided a meal of frogs, roasted '*by-yu'* nuts (from the Zamia tree) and a small fresh-water tortoise (Grey 1841).

Yellagonga Regional Park, which was created in 1990 and named after Yellagonga the boordier (boss) of the Mooro group of Whadjuk *Nyoongar*, is part of the system of lakes, springs and swamps. The Park is approximately 13 kms long and includes Lake *Joondalup*, Lake *Goollelal*, *Beenyup* Swamps and *Walluburnup* Swamp (Department of Parks and Wildlife, n.d.). Ethnographic and earlier *nyidyung* (white peiople's) records confirm that that these areas included significant camping places for *Yellagonga* and other *Nyoongar* after colonization. We can then show the connection between this area and the Swan River itself, establishing that prior to camping here, *Yellagonga* had a main camp at *Kattanyininy* (Mt Eliza and Kings Park) meaning 'all sit down place'. When Mt Eliza was no longer available to *Yellagonga*, he clearly moved on to Lake Monger and other northern camps (Goode et al 2017).

Elsewhere *Yellagonga* Regional Park has been described as:

> an important camping area used widely for watering, food-gathering, camping and tool-making, hunting and corroborees, and summer social life… was used as an eastwest staging between the foothills and the ocean and a north-south staging between Mt Eliza and the Moore River, in the Aboriginal seasonal cycle of camp movements (Brittain 1990 cited in DCLM 2013: 3).

Lake *Joondalup*, which has been suggested to mean "place of whiteness or glistening" (Landgate n.d.) is also connected to this region and other places of importance to *Nyoongar*. Indeed there are a number of caves part of a system that has mythological significance. This cave system was described as joining Lake *Joondalup* to the sea by the late Mr K. Colbung (deceased and Mr Simmon's grandfather). Nearby other caves that are located further north of Lake Joondalup and closer to the site near *Neerabup* and *Yanchep* have mythological significance and also contain skeletal material (Site ID 3186 *Yonderup* Caves) and engravings and artifacts (Site ID 4404 Orchestra Shell Cave).

As Bates remarks, these areas are of critical importance to *Nyoongar*:

> All permanent native waters have legends attached to them, legends of the 'dream' time, which go back to the days when birds and animals possessed human attributes, or were human beings, or were groups of which the bird or animal was representative, or were magic animals and birds possessing the power of human speech. The natives cannot say that the 'founders' of the various permanent waters were altogether human, although birds or beasts, or half bird half human, but the bird or animal name only is always given in the legend never a human name.[18]

At the same time, non-Aboriginal science (principally archaeological research) would say that

[18] Bates D. 1966. *The Passing of the Aborigines*. Second Edition. William Heinemann, Melbourne and Sydney. p: 157.

Nyoongar have lived throughout the southwest for at least 40,000 years.[19] Both *Nyoongar* knowledge and archaeology confirm that before contact, Nyoongar often camped in close proximity to *Waarkal* sites near water. Places in and around the study area and throughout the Swan Valley wetlands were clearly important in this regard.[20] As mentioned earlier, much of the areas in proximity to the survey site are built over the footprint of a spring and swamp system close and connected to the Swan River. These swamp systems were said to have been abundant with many foods such as water birds, *koolya* (frogs), *gilgies* (freshwater crayfish), *yaagan* (turtle), and a range of edible plants.

As a consequence of the routine movement between these swamps and lakes and the popularity of the area, there would have been a number of key *bidi*[21] in the area. These *bidi* connected important places in the area called *Mooro*[22] – leading Nyoongar groups from their inland camps and other places of residency to this specific part of the coastal and river area, to conduct ceremonial and cultural business, hunt, camp and fish (particularly during the *Nyoongar* season[23] of *Kambarang*[24]). *Nyoongar* have long moved inland during the season of *Makuru* when cooler winds from the southwest swept across the region. Later, people returned to coastal areas in *Kambarang* with the arrival of warmer weather and as rains decreased. In the 1830s George Grey, described *Nyoongar* use of these wetlands:

> ...swamps producing *yun-jid*, a species of *typha*, served by well-established paths and supporting abundant populations in clusters of well built, clay plastered and turf roofed huts...these superior huts, well-marked roads, deeply sunk wells and extensive *warran* grounds all spoke of a large and comparatively speaking settled resident population.[25]

Over the hot season of *Birak*, controlled burning ensured that the bush had been regenerated so that with the arrival of the season of *Djilba* milder conditions promoted growth.[26]

This means places through the study area would have been adjacent to some of most important *bidi* connecting *Nyoongar* to other *moort* (family) throughout *Whadjuk Nyoongar boodja* (country). This is partly because of the importance of the area as a food source for *Nyoongar maam* (men), *yorgka* (women) and *kullungar* (children). Indeed, at the time of colonisation the largest hunting grounds in

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19 Flood, J 1989, *Archaeology of the Dreamtime*, Collins Australia, Sydney.

20 see Figure 4

21 *Nyoongar* word for track or trail.

22 Green, N. 1981 "Aborigines and White Settlers," in *A New History of Western Australia,* ed. CT Stannage. Nedlands: University of Western Australia Press.

23 http://www.bom.gov.au/iwk/nyoongar/kambarang.shtml

24 During the *Kambarang* season (October/November) we see an abundance of colours and flowers exploding all around us. The yellows of many of the Acacias continue to abound, along with some of the Banksias and many other smaller delicate flowering plants including the Kangaroo Paw and Orchids. Also during this time the Balgas will also start to flower, especially if they've been burnt in the past year or closely shaved. One of the most striking displays of flowers to be seen during this season will be the "Moodja", or Australian Christmas Tree (Nuytsia). The bright orang/yellow flowers serve to signal the heat is on its way.

25 Grey, G. 1841 *Expeditions in Western Australia 1837-1839*. Perth Hesperian. pp. 12-38

26 See City of Perth (2012) *Boodjargabbeelup – Point Fraser Nyungar Cultural Interpretation*. Brochure.

proximity to the Swan existed north of the river.[27]

They used *gidgees* (spears), netting, and hand seizing as techniques to collect food like birds, eggs, fish, frogs, gilgee, coonacs, marron and tortoise.[28] *Yok* (women) were central to this. To catch *djildjit* (fish) *Nyoongar yok* would drive them into shallow water. Two or three would watch the shoal from the shoreline, while twenty or thirty men and women would take boughs and form a semi-circle out in the shallow bay areas. Gradually closing in, they would hedge the *djildjit* in a small space close to the shore, while others got into the water to throw the fish onto the land.[29]

Yok (women) were also active and talented in the art of catching *djildjit* (fish)[30]. Yok had there own methods driving them into shallow water. Two or three women would watch the shoal from the beach, while twenty or thirty men and women would take boughs and form a semi-circle out in the shallow bay. Gradually closing in, they would hedge the fish up in a small space close to the shore, while a few others got into the water in order to throw them out with their hands[31]. Lyon claims to have seen first hand the dexterity of *Nyoongar* skills saying that "half a score of men will spear upwards of 200 fish in two to three hours."[32]

Nyoongar sometimes cooked the *djildjit* by simply broiling them on the fire. At other times they chose a thick, tender piece of paper bark, tore it into an oblong shape and wrapped the *djildjit* in it. It was then tightly wound with strings from string bark or grass was then slowly baked in hot sand covered with ashes. This 'tying up cooking'[33] allowed for the food to be prepared with the paper bark then peeled back and used a serving dish. *Djildjit* cooked in this way produces a succulent juice and gravy.[34]

Places in proximity to the study area, particularly the swamps and springs, would have been filled with marine life readily available to those using *gidgee* (spears). Armstrong describes the use of this Nyoongar technology:

> The spear is their (Nyoongar) great instrument in fishing, as well as in the chase. They use baits, such as crabs broken small and thrown in as ground baits … In fishing for fresh water fish called cobbler, they fix a muscle on the end of a pointed stick, which they present before some hole … where the fish are known to lurk, and as soon as the cobbler, lured from his retreat, approaches the bait, the native makes certain prey of him. Indeed the skills of the

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[27] Williams, A.E. 1984. *From Campsite to City*. Nedlands: City of Nedlands.

[28] See City of Perth (2012)

[29] Hallam, S. 1987. Aboriginal resource usage along the Swan River. In John, J. (Ed) *The Swan River Estuary: Ecology and Management*. Bentley: Curtin University. p. 27. Hallam, S.J. 1975 *Fire and Hearth*. Canberra: Australian Institute of Aboriginal Studies. Meager S.J. & Ride, W.D.L. 1980. Use of natural resources by the Aborigines of South-western Australia. In Berndt R.M. & Berndt, C.H. (Eds.). *Aborigines of the West: Their Past and Their Present*. 2nd. ed. p. 66-80. W.A.: University of Western Australian Press.

[30] Moore, 1884, p. 55-56

[31] Hallam, 1987, p. 27

[32] Lyon 1833

[33] Grey 1841, p. 275-6

[34] Hallam, S. 1987 p. 27.

> coast tribe in spearing under water is truly surprising.[35]

The area would have been rich in *koolya* (frog) and *yaargin* (tortoise). Frogs were cooked on a slow fire of wood ashes. *Yorga* (women) prepared them for eating, holding them in one hand by the hind legs and with an adept pinch of a finger and thumb, remove the lower part of the frog intestine. The rest of the frog was then eaten bit by bit from the head to the toes.[36]

Yorga also possessed the skill and expertise to find and catch freshwater tortoise, available in the dried up swamps and waterways of the area. They would walk through these areas using their toes to detect the breathing holes where the animals lay. Grey describes *yorga* working the dried waterways close to the area:

> The season of the year in which the natives catch the greatest quantity of frogs and freshwater shellfish, is when the swamps are nearly dried up; these animals then bury themselves in holes in the mud, and the native women with their long sticks, and their long thin arms, which they plunge up to the shoulder in the slime, manage to drag them out; at all seasons however they catch some of these animals, but in summer a whole troop of native women may be seen paddling about in a swamp, slapping themselves to kill the mosquitoes and sand flies, and every now and then plunge their arms down into the mud and dragging forth their prey. I have often seen them with ten or twelve pound weight of frogs in their bag.[37]

Nyoongar extensively used flora and fauna resources in areas like the swamplands the study area, carefully following well-established laws and customs to ensure stocks were sustained. Flora and fauna were not only eaten, *Nyoongar* also used them for clothing, tool production, ceremony, and health maintenance. Clothing such as *booka* (cloaks) and *choota* (bags) were made from *yonka* (kangaroo) skins and held together with bone and sinew. At times of ceremony, people were painted up with *wilga* (ochre) and wore headdresses adorned with *koomal* (possum skin) and feathers from emu and cockatoo.[38]

Commenting on *Nyoongar* use of the array of resources George Grey said they knew:

> Exactly what it produces, the proper time at which several articles are in season. According to these circumstances he (sic) regulates his (sic) visits to the different portions of his (sic) hunting ground.[39]

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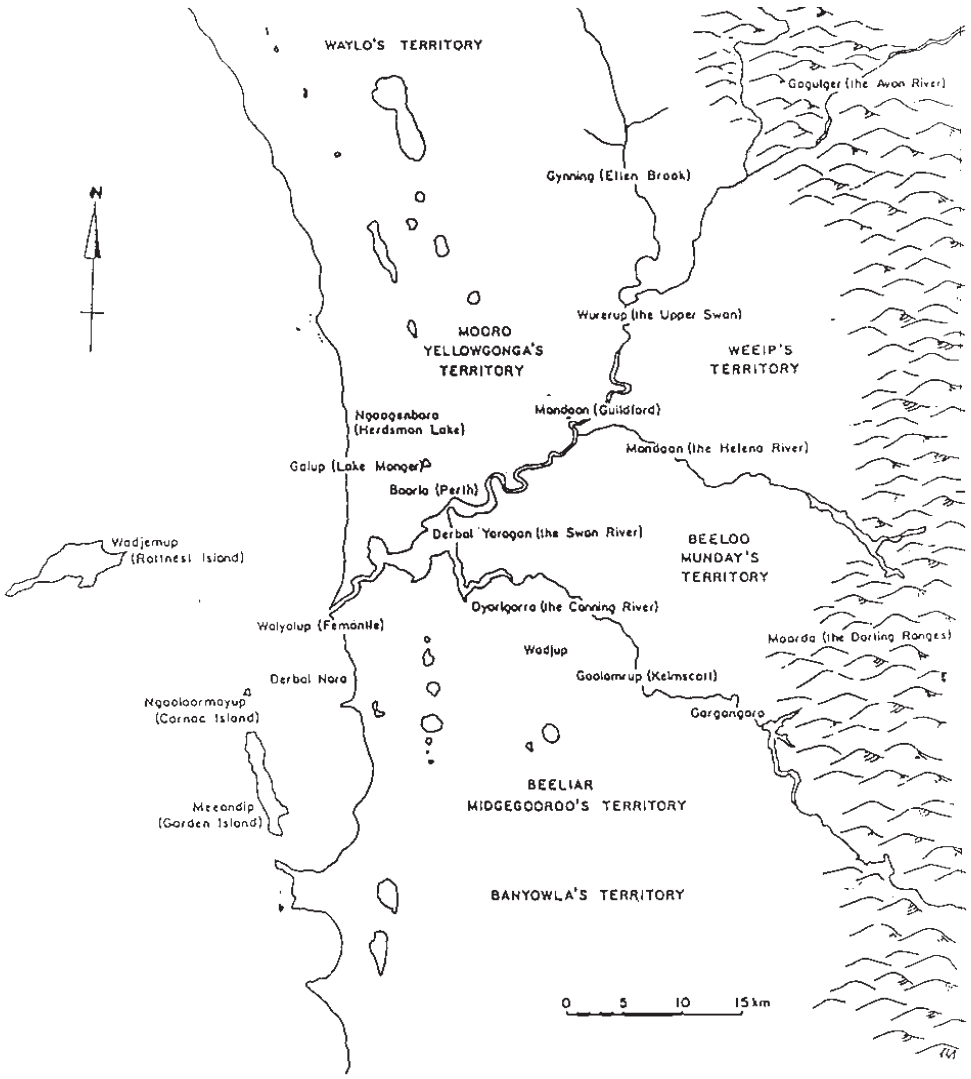
[35] Armstrong, F. 1836. Manners and Habits of the Aborigines of Western Australia. *Perth Gazette, October 1836*. Moore, G.F. 1884. *Diary of ten years eventful life of an early settler in Western Australia, and also a descriptive vocabulary of the language of the Aborigines*. London: Walbrook.
[36] Hallam, S. 1980. Aboriginal women as providers: the 1830s on the Swan. *Aboriginal History, Vol 12-15*. p. 46
[37] Grey 1841 p. 276.
[38] Dale, 1834
[39] Grey 1841.



Nyungar Place Names and Territories: Swan River Coastal Plain
(As told to Robert Lyon by Yagan in 1832)
Source: N. Green, *Broken Spears*, Focus Education Services Perth, 1984, p.50

Figure 4. Noongar territory during early colonial times[40]

Many places adjacent to the study area are also connected to other significant sites further south, such as women's birthing sites at *Matagarup* (Heirisson Island), hunting and ceremonial sites at *Kaarta Gar-up, Kaarta Koomba,* or *Mooro Katta* (Kings Park), and the men's ceremonial ground in the Reabold Hill area.[41]

There is also is a number of significant women's business sites near due to the presence of *wilgi*

[40] Green, N. 1984. *Broken Spears: Aborigines and Europeans in the Southwest of Australia*, Cottesloe.1984, p.50

[41] Jacobs cited in Busher, N. 2016 *Yagan Square Cultural Heritage Management Plan*. University of WA.

garup (ochre deposit) in the vicinity of Perth. *Nyoongar* women were responsible for the *wilgi garup.*[42] *Wilgi* is a vitally important trading commodity for *Nyoongar* and other Aboriginal groups. Indeed, there is evidence that *wilgi* from Perth has travelled as far as the *Yankunytjatjara Pitjantjatjara* country that crosses the border into South Australia and the Northern territory.[43]

The greater Perth area is acknowledged by *Whadjuk Nyoongar* as "a place where 'fair or place of trade occurs'; where families of people gather for kinship and in-law making; where mothers, fathers, and old people get together; and where young men and women whom have 'come of age' meet future husbands and wives.[44]

Another resource exploited by *Nyoongar* was a fermented drink made from the honey nectar of *Mangyt* (banksia flowers). In the eastern sections of the site there are rich stands of banksia that would have been harvested. *Nyoongar* called this process Nyogulang which involved steeping and infusing the flowers in fresh water. Apparently after the drink had fermented it had a rather heady effect on the drinker[45].

Not surprisingly the areas around the lakes systems were also important social and ceremonial gathering places as well. Throughout the *boodja* (area), there were and continue to be important waterways intertwined with the old tracks of other ancestral spirits who travelled across the country. These ancestral spirits encountered each other and in the course of these encounters created the features of the landscape such as hills, lakes, swamps and the stars.[46]

[42] Jacobs cited in Busher, N. 2016.

[43] Collard, L. and Jones, T. 2014 *Karla Yarning: This City is Whadjuk Country*, City of Perth.

[44] Harben, S. Collard, L. Stasiuk, G. Nelson, D. nd. *Recording Traditional Knowledge*, Avon Catchment Council.

[45] Fletcher Moore cited in Hallam, 1987, p. 29

[46] Stocker, L. Collard, L & Rooney, A. 2016) Aboriginal world views and colonisation: implications for coastal sustainability, *Local Environment, 21:7*, 844-865; Vinnicombe, P. 1989 p. 19.

Figure 5. Depiction of *Waugal* by the late Shane Pickett

While it is the case that the landscape around the study area has changed significantly since non-Aboriginal contact, for many *Nyoongar* it continues to be a place associated with the *Waarkal*. *Whadjuk Nyoongar* Cedric Jacobs explains how these kinds of 'water sites' continue to be spiritually and ecologically significant:

> It is through the lake system. There is a water serpent down there below which is extremely important and the water on the surface is really the marks where the *Waugyl* wound his way through and came up after making the streams and the waterways. It's all part of the ecological system to purify the land and the family. Once it was surrounded by waterways and if they fill them up with rubbish then the land begins to die.[47]

As mentioned earlier, *Nyoongar* offer accounts of how the *Waugal* created the *Beeliar* (river) by "making its way down the river, creating the bends at Belmont and Maylands before emerging through the Narrows into Perth Water to create the large expanse of downstream water".[48] Vinnicombe[49] and Bates[50] both observe that the *Waugal* is also believed to have created permanent water sources at places where it rested, and a number of these locations subsequently became important centres for trade and exchange.[51]

The study area sits within proximity to places that are central to *Waugal* narratives. *Whadjuk Nyoongar* people believe that the *Waugal* can be a destructive force if not respected or if its resting place is disturbed, and that if this happens all the water will dry up.[52]

Whadjuk/*Balardong* Elder Dorothy Winmar recounts:

> They reckon without the Waakal around they would have no water. They would not let the kids go and torment the Waakal. They (Nyungar) would drive them away. There is a Waakal in the Swan River and he very rarely shows himself. If the water was muddy, the old grannies used to say don't swim in there, because he is having a feed. Don't swim (warra wirrin or bad spirit); wait until the water is clear then you can go and jump in (kwop wirrin or good spirit). He was very important to their lives, because they believed in having fresh water. They wanted the water, so they wanted the snake to stay alive.[53]

The effect of disturbing areas important to *Waugual* can be devastating to people's health and the

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47 Laurie, M (ed.) 2003, 'Interview with Cedric Jacobs', Town of Vincent Local History Collection (Oral History Collection), Perth, Australia.

48 Australian Interaction Consultants (AIC) Report – City of Fremantle.

49 Vinnicombe 1989, p. 17.

50 Bates 1966

51 Hammond, J.E. 1933 *Winjan's People: The Story of the South West Australian Aborigines*. Perth: Imperial Printing.

52 Armstrong, F.F. 1836. Manners and habits of the Aborigines of Western Australia. *Perth Gazette 1836*. Bates, D. 1985. (Ed. White, I). *The Native Tribes of Western Australia*. Canberra: National Library.

53 Winmar, Dorothy. 2002. Oral Interview. Transcribed in 2002. Cited in Nidja Beeliar Boodjar Noonookurt Nyininy: A *Nyoongar* Interpretive History Of The Use Of Boodjar (Country) In The Vicinity Of Murdoch University. L Collard, S Harben. Murdoch University.

future of a place.[54] For example, *Whadjuk Nyoongar* Elders reported "when C.Y. O'Connor wanted to create Fremantle Port, he used explosives to blow up the [sand] bar [*Yondock's* tail] across the Swan River. This created a salt-water environment in what was once a fresh water environment and caused great distress to the *Nyoongars* at the time".[55] Some suggest that *Nyoongar* then put a curse on him causing him to suffer enormously from poor mental health, eventually causing him to ride into the water near Robb's Jetty and shoot himself.[56]

5.0 The significance of the survey site

As outlined above, there is good evidence that the areas in proximity to the Alkimos site have long been important to *Nyoongar*. In considerable measure this is because of its proximity to the lakes and water sources to the near east, the abundance of food resources, the availability of sheltered camping spots on the east and further to the east of the site and the presence of the symbolic Pinnacles or standing sandstones structures inside the boundaries of the site.

In addition, there is some evidence from previous work and oral evidence from participants in this survey that indicates the survey site includes areas of significance. This evidence has so far not been strong enough to trigger requirements for action under the current Aboriginal Heritage Act. However, it is important to note the observations of *Nyoongar* participants as:

> 1) Development WA has already indicated a willingness to respect some of the recommendations of earlier *Nyoongar* survey teams in respect of the area known as Pinnacle; and
>
> 2) Development WA may wish to move beyond compliance with the Aboriginal Heritage Act for engagement, cultural interpretive, naming and other planning purposes.

5.1 The Pinnacles

The area initially visited as part of the walking elements of the survey is known as the 'pinnacles' or Romeo Road Pinnacles. These limestone casts of remnant tree roots have been the subject of previous heritage surveys. In the 2017 O'Connor (2017) survey Mr Shaw stated that the pinnacle outcrops are "believed by the Whadjuk representatives to be of spiritual significance to our ancestors." Goode and Harris's study (2019, p. 5) concluded that this area be treated as important to Whadjuk people's heritage and recommended that in relation to proposed extensions of Romeo Road "Main Roads investigate ways to avoid the standing limestone rocks located within Place ID 37478 (Pinnacles)."

Indeed after a previous heritage survey a submission was made to have this area registered as an Aboriginal heritage site. This was rejected by the Aboriginal Cultural Materials Committee instead opting to map it as Place ID 37478 *Romeo Road Pinnacles* "Stored Data / Not a Site" in the Register of Places and Objects. This area is close to the boundary of the works for the extension of the railway

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[54] Palmer, Kingsley (1976). Aboriginal oral tradition from the south west of Western Australia. *Folklore, No. 87*. pp. 76-80.

[55] Collard, L., L. Stocker, and A. Rooney. 2013. *Nyoongar Wardan Katitjin Bidi - Derbal Nara*. Australia: City of Cockburn and Curtin University Sustainability Policy (CUSP) Institute.

[56] Len Collard, personal communication, February 17 2016.

line and had previously been on the proposed route for the Romeo Road extension. Technically assessing this area in this way of protection means that Development WA has not obligations under the Aboriginal Heritage Act. Goode and Harris (2019) conclude of the Pinnacles area:

> Place ID 37478 Romeo Road Pinnacles is located 340m to the east of the roundabout at Marmion Avenue and has a 700m x 700m extent that overlay the proposed extension of Romeo Road. This place will be directly affected by the road works required to extend Romeo Road to Marmion Avenue, however as the area was assessed by the ACMC as stored data Main Roads has no further obligations under the AHA to proceed.

However, those involved in the two-day survey carried out by Moodjar confirm the view of some earlier *Nyoongar* consulted that the Pinnacles have high cultural values. Mr Simmons had the most to say about their cultural significance:

> The Pinnacles here … when I was about 17 out at the Gnangara Community, where Ken Colbung, Pop *Nyanjen* was … he brought some old people down from the Pilbara and they were showing him these Pinnacles and places and telling him they still had stories for them … and he kind of already knew that … there was this specific place in Clarkson where they used to come and sit and they showed him … all these Pinnacles go all the way through to *Yamatji* country … all the way through … so it's a marker for the people coming down and they sit just off the coast and go through in to the Clarkson area.

Furthermore during the archaeological survey (see previous comments) other examples of these limestone pinnacles were observed throughout the survey area well beyond the previously small rectangular mapped area. Mr Simmons made this clear:

> Dennis: The map is the *Wadjela* concept … when we say that this is a pinnacle area we are not just talking about here, it goes all the way right through (points north), all the way down to Clarkson (points south). This is the pinnacle area. It cuts right across there (points east across the railway line works). Even though they now might have a boundary or a road it doesn't separate the pinnacles. It is all one part of a very big area.
>
> Len: Dennis, how far have you observed the Pinnacles going back towards the east?
>
> Dennis: At least a kilometre east. Back where they have housing development they would have been there as well. As we start to go back a few years there was not much regulation and support for culture.
>
> When I was 17 and old Pop *Nyanjen* first brought me out he was with old people from the Pilbara with him. They still had stories for this place … 37 years ago when we came out to this place. We know that this is a significant area and so this should be researched properly.

It is also important to note that Mr Simmons, Mr Garlett and Professor Collard all observed damage to one of the pinnacles in close proximity to the western side of the fenced off area for the works of the railway line. Adjacent to the remains of the damaged pinnacle broken fragments lie in a section of bush damaged by a vehicle.

Mr Simmons had this to say about the extent of the Pinnacles:

> The Pinnacles were right through this area. The Pinnacles were all the way across and all the way back down to Clarkson and all the way back through to where the Pinnacles are just out of *Yuat* country (*Nambung* National Park) are all significant and are all part of the same story. The old people that used to come from the Pilbara used to talk about these places as markers for them as well. Because from here, from the *Wardanji*, from the ocean straight across these hills, straight through is Yanchep or *Yanjet*. That National park was a holding place that sits right on the edge of *Wadjuk* country and *Yuat* country and it was a holding place for the old people coming from the Pilbara. Because from here there was a big food source, lots of water, lots of plants, lots of stuff they could use for making tools. But then just from there, just along these dunes way down here is the *Warduntji* (ocean). A lot of the Pilbara people were saltwater people so from there they could come down and hunt in the salt water. Just at the back of *Yanchep* was a big corroboree ground. And so the *Nyoongar* used to put the Pilbara people there. So from there not only did they have the fresh water, a big massive watercourse that is all swampy but they had the ocean just here.
>
> These Pinnacles are all part of that story. When we first came out here and I showed them the Pinnacles here before they had this road in the contractors were a little bit arrogant about it. They said 'we got to bulldoze through here, we got to put this railway line in'. They weren't as open as they should be to the significance of the area.
>
> Pop *Nyanjen* and the old people brought me out the first time when I was 17 and they were talking about these Pinnacles then.

5.2 Other signs of *Nyoongar* use of the site

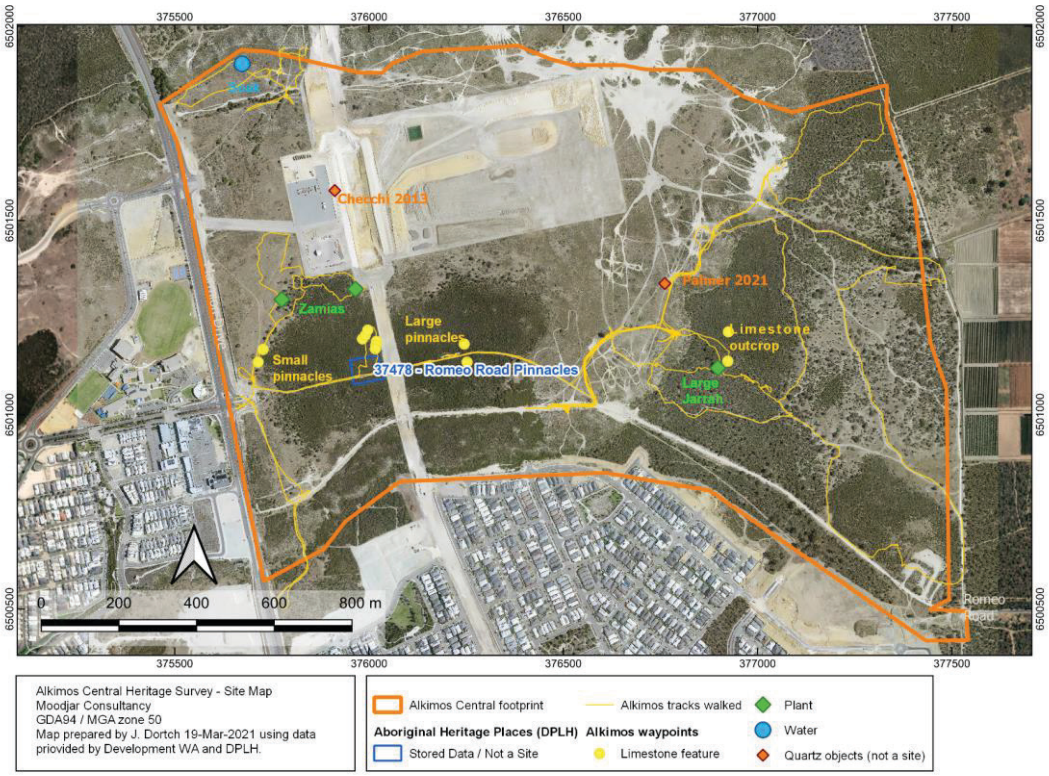

Figure 6: Map of key areas in the site

A previous heritage survey recorded the presence of quartz on the survey site. On October 2017 as part of a larger survey of the 'Northern Suburbs Railway Extension' *Nyoongar* participants and anthropologist Rory O'Connor visited the site of the proposed Alkimos Station. They walked to the areas of the proposed car park adjacent to the proposed railway station and carried out an on-the-ground inspection. Here pieces of quartz were found. This survey report noted "Dennis Simmons and Chris Shaw identified some isolated pieces of quartz scattered about an area measuring four metres by four metres at 375912E 6501577N" (O'Connor 2017, p. 4). It is estimated that this area was somewhere south of the soak marked on Figure 6.

O'Connor observed that as there are no naturally occurring quartz outcrops in this immediate area this was significant. Furthermore three of the pieces showed "signs of having been worked, with an evident bulb of percussion and fashioned edge" (O'Connor, 2017 p. 4). He formed the view, along with the Whadjuk representatives, that these isolated items did not constitute an Aboriginal site. However, he further stated that "they do however, point to former Aboriginal occupation and justify the request of the Whadjuk representatives to have monitors present when the land is being cleared for station construction." (O'Connor 2017, p. 4).

On the afternoon of the 27th of January a small scatter (five) of quartz was found near the top of the one of the highest sand hills in the survey site a considerable distance from the area where O'Connor's team had found quartz 4 years earlier.

The method of 'reading country' provided some insights into *Nyoongar* use of the site. Using the *Nyoongar* methodology of '*jenna, jen, jen koorliny wer weirn'* (walking along with spirit) Len and Phil Collard walked together making observations about the fauna, talking to one another and 'the old people' about places they considered to be most likely camping zones and listened back to the responses in the wind, the presence of certain birds and what would then reveal itself in the form of gullies, large trees and, in this case old and large *balga* trees. At one point after talking about the old grandparents Len and Phil Collard came across two Boobook Owls nestled deeply and unobtrusively under a *balga* tree that is estimated to be between 3-400 years old. (This was within close proximity where the Large Jarrah is marked on Figure 6.)

Len observed:

> Len: These are the two old law people sitting there and looking after this place. Our old grandfathers taught us that it was very rare to see these owls in the day and when you did you ought to come straight home. For us this is a very important sign that we are being looked at and that the old people have long been in this place.

'Reading the boodjar (landscape)' revealed to Dennis Simmons that the dune system separating the western scrubland from the eastern timber and zamia/*balga* forrest (represented by the green line of vegetation to the west of the Large Jarrah marked on Figure 6) is a place of importance:

> Dennis: So these particular places that sit up high, nice and flat, even though non-Aboriginal people have been involved in this area, you can still see that it is still nice and flat and it overlooks the *boodjarda* country here and it faces towards the sun so the *ngank ngarda* where the sun rises where we do ceremony and the *ngank ngarda* sets behind us at the *Warandji*. So there particular places here you can see are significant ceremonial places for corroboree and *kenni*. So here and you got your little spaces down in there (points west) where people can get ready and prepare (he turns towards the top of the dune system) and then here the ceremonial space overlooking the country, facing and waiting for the sun to come up. So these are very significant places. There are a few of them here. There is one here and one further towards Yanchep as well. And it is no accident that coming from Yanchep to these ceremonial grounds all the way back down to the *Wardanji* to the ocean, so significant places.

Independently Freda Ogilvie came to similar conclusions about the importance of this particular area using a similar method of 'reading country' as she stood on top of a sand dune system on the seaward side of the site and pointed east down the edge of the dune system. This sand dune system separates the dense shrubby *kwongan* heathland that is a feature of the western side of the site from a rich *balga*, firewood banksia and eucalyptus woodland with a small stand of jarrah. Freda pointed out that the change in ecology would have corresponded with a change of use by *Nyoongar*. (Where the dune system ends and the woodland area begins can be clearly seen where the green vegetation line ends to the west of the Large Jarrah marked on Figure 6).

> Freda: Yeh here there is a good windbreak just right behind here and then you go into a gully. So the old people would have camped on that side (points to east) if it was windy or if the rain was coming and then they would head further east for safety (from the weather).

Coming to conclusions in a similar way Len observed:

> Len: So to highlight that further east there is a big chain of lakes over there. The Yanchep

> Lakes. There is a whole string of them. So here is the edge of the ecology where it is changing from good country so to speak to country that is a bit scratchy and scrapy.

Another important feature of this process of 'reading country' is that it is passed along from one generation to another, making it important to include young people in the work. This happened during the survey. For example, Len and Phil Collard found a place they considered a *nyinninup* (sitting place). (This area is marked on Figure 6 as the Large Jarrah). Later they discussed this place with the group:

> Len: *Nyoongar* would often cut the trees and make scars. Maybe these scars are cut or not. They would take the wood from trees to make *miros* (spear throwers). I once went to a place were the people had stripped trees to make *miros*. The other thing is these scars can be signs, signs put there to tell people whether they are a man's site or a woman's site. So there is a range of different rationales for why these trees are scarred. For example, back down at home there at Davilak Lake, if you wanna go and see signs on all those Tuart trees they are wicked. And what they are saying is that there is a site here to do with either men's things or women's things. So there are like sign-posts, stop, go, beware. So there are all these readings that *Nyoongar* used trees and signage for. We are bringing Narelle today as a younger one to remind her about her connection to country and about some of the things that she needs to be aware of in the future. The same as Faron. So in the future, when Archaeologists or Ethnographers bring you out you are going as informed people. You are not *dwangaburt, kaat wara Nyoongar* you are going as an informed person who can look for the signs of our people's tracks and trail and impact on country, so you know what you are looking at.

Dennis Simmons noted the subtle but important sign of *Nyoongar* use of the site by noting important gullies that ran adjacent to the pinnacles (100 feet south west of the area marked on Figure 6 as Large Pinnacles):

> These gullies here are really important because the old people use to sit in there, they used to camp in there because it is low and it stops the wind coming from the *Wardantji* (ocean). But also when they were hunting the young fellas would be pushing the *yongas* (kangaroos) over the hill and bringing them down and the old people would be waiting in those gullies for them with their spears and spearing them as they flight on down the hills and staggering and going on. The gullies are significant and most *Nyoongar* s know this.

Again 'reading country' as he had been taught as a young man Len Collard made observations about the likely importance of the wooded area on the east side of the dune system (the green vegetation area in proximity to the area marked as Large Jarrah in Figure 6).

> (As we were walking down from the sand dune) I was talking to Phil Collard as we stood on top of the escarpment looking down (east) into this valley and there is a clear demarcation from the west to here. One of the first things we saw was these big *jarrahs*. They have got a natural attraction that you just want to come down and see what was going on. So to me, if I for example was saying to you fellas 'tomorrow I'll meet you in this valley' my feeling would be without even saying that people would come here and just wait at these trees. We are standing here in the afternoon, probably about three o'clock, beautiful breeze from the southwest is blowing, the canopy from the tree is really cooling the site down. So for me it

> seems like it is a natural spot for people to come and sit or wait or meet. It hasn't be cleared or burnt for goodness knows how long. This area has beautiful big jarrahs that may be two hundred years old. A nice feel, got a great attraction, a big lot of *balgas* (grass trees) around here that must be hundreds of years old. There is zamia palms, the *gilget*, there are banksias, a whole bunch of stuff. To me it's a natural spot where people would meet.

Phil Collard shared Len's conclusions about the likelihood of this area being important for camping and resting: "Looking at the trees … plenty of grass trees … they are pretty old". He later observed of a particular *balga* (grass tree) near this area, "last weekend we celebrated Australia day and this grasstree here is a lot older than the first Australia Day. He'd be over three hundred years old." (this is approximately 50 metres east of the area marked as Large Jarrah in Figure 6)

6.0 Recommendations

While no archaeological sites are currently evident in the survey area, a number of *Nyoongar* custodians consider the pinnacles area, the sand dune systems and wooded area to the east of the sand dunes are areas of *Nyoongar* cultural significance.

It is on this basis the following is **recommended**:

1. Proponent staff and contractors should be informed of the legal requirement to avoid disturbance to any Aboriginal site as defined in the Aboriginal Heritage Act 1972 (Western Australia), whether registered or otherwise, and the view that disturbance of a site includes ground disturbance, souveniring or deface.
2. The area of the pinnacles should be preserved and the subject of further ethnographic and archaeological research, mapped using aerial photography shot on drone transects, as pedestrian access is difficult. More detailed and accurate heritage information could then be submitted to DPLH for reconsideration as an Aboriginal heritage site.
3. As much of the wooded area that has thick *balga*, zamia palms, some jarrah and other flora on the eastern side of the sand dunes should be preserved. Clearing of any wooded areas could be undertaken by a *Nyoongar* business.
4. Prior to any ground-disturbing work, Development WA should consider engaging suitably experienced *Nyoongar* to act as monitors of the works in case sub-surface heritage material is inadvertently unearthed. This work should be carried out in association with a suitably qualified archaeologist and anthropologist. Development WA should see this work as a further opportunity for a *Nyoongar* business to manage this work and/or have a *Nyoongar* with expertise in *Nyoongar* knowledge systems and methodologies.
5. Development WA explores 'engagement' opportunities to undertake work with *Nyoongar* knowledge experts to identify *Nyoongar* interpretive information to be used throughout the site (for example, *Nyoongar* identification and protection of flora and fauna species, *Nyoongar* involvement in the concept planning, interpretive signage, timber harvesting and replanting work, revegetation, street naming, landscape plans for public areas, information for homeowner packs, sand dune walkways or trails).

6. In any future heritage survey work Development WA make arrangements for a pre-survey planning meeting to bring together the archaeologist, ethnographer, project manager, *Nyoongar* consultants/experts, representatives from the proponent parties. This goal of this meeting will be to brief consultants on the scope, previous heritage work, resolve logistics questions and strengthen opportunities for engagement.
7. That in future Development WA consider ways in which Aboriginal heritage assessment and protection can move beyond a compliance to an engagement approach. For example, work with other partners to undertake a region wide assessment of the Aboriginal heritage values from Alkimos to Moore River. A *Nyoongar* led team should undertake this work in conjunction with: *Nyoongar* knowledge experts, ecologists, hydro geologists, flora and fauna-specialists (as well as archaeologists and ethnographers).

7.0 Key References

Abbott, I. (2009). Aboriginal names of bird species in south-west Western Australia, with suggestions for their adoption into common usage. Conservation Science W. Aust, 7 (2), 213–278.

Armstrong, F. 1836. Manners and Habits of the Aborigines of Western Australia. *Perth Gazette, October 1836*. Moore, G.F. 1884. *Diary of ten years eventful life of an early settler in Western Australia, and also a descriptive vocabulary of the language of the Aborigines*. London: Walbrook.

Baines, P. 1988. *A litany for land*. In Keen, I. (ed) Being Black: Aboriginal Cultures in 'Settled' Australia. Canberra: Aboriginal Studies. p. 228

Bates, D. M. (n.d.). Geographical notes. Additional S.W. Information. Journal.

Bates, D. M. (1909). Oldest Perth. The days before the white men won. Western Mail 25 December 1909 , pp. 16-17.

Bates D. 1966. *The Passing of the Aborigines*. Second Edition. William Heinemann, Melbourne and Sydney.

Bennell v the State of WA. Federal Court of Australia (Wilcox J) 19 September 2006 [2006] FCA 1243.

Brad Goode & Associates Pty Ltd (2019) *Report of an Aboriginal Heritage Survey of Mitchell Freeway Extension – Hester Avenue to Romeo Road, City of Wanneroo: Western Australia*. Main Roads, Western Australia.

City of Joondalup (nd) *Joondalup Mooro Boodjar: Aboriginal Culture Within Mooro Country*. City of Joondalup pamphlet.

City of Joondalup (nd) *Plants and People in Mooro Country: Noongar Plant Use in the Yellagonga Regional Park*. City of Joondalup.

City of Wanneroo (2016) *Local Heritage Survey 2016*. City of Wanneroo.

Collard, L. and S Harben. S. 2009 *Nidja Beeliar Boodjar Noonookurt Nyininy: A Nyoongar Interpretive History Of The Use Of Boodjar (Country) In The Vicinity Of Murdoch University*. Murdoch University.

Collard, L. and Palmer, D. 1998. *Nidja Goordandalup! Noonookurt Nyinniny: A Nyungar interpretive History of the Use of Boodjar (Country) in the Vicinity of the University of Western Australia*. Murdoch: Murdoch University. p. 14-15

Collard, L. and Palmer, D. (2015) Ngulla wangkiny, ni, katatjin Noongar nyidyung koorliny, kura, yeye, boorda: A dialogue about Noongar and non-Aboriginal people going along together. In *Konishi, S., Nugent, M. and Shellam, T. (Eds) Indigenous Intermediaries: New Perspectives on Exploration Archives. p. 189-205. Canberra: ANU.*

Collard, L., L. Stocker, and A. Rooney. 2013. *Nyoongar Wardan Katitjin Bidi - Derbal Nara*. Australia: City of Cockburn and Curtin University Sustainability Policy (CUSP) Institute.

Darby, R. (2017) *South Alkimos Local Structure Plan*. Landcorp.

Flood, J 1989, *Archaeology of the Dreamtime*, Collins Australia, Sydney.

Green, N. 1981 "Aborigines and White Settlers," in *A New History of Western Australia,* ed. CT Stannage. Nedlands: University of Western Australia Press.

Grey, G. 1841 *Expeditions in Western Australia 1837-1839*. Perth Hesperian. pp. 12-38.

Hallam, S. 1980. Aboriginal women as providers: the 1830s on the Swan. *Aboriginal History, Vol 12-15*. p. 46.

Hallam, S. 1987. Aboriginal resource usage along the Swan River. In John, J. (Ed) *The Swan River Estuary: Ecology and Management*. Bentley: Curtin University. p. 27. Hallam, S.J. 1975 *Fire and Hearth*. Canberra: Australian Institute of Aboriginal Studies. Meager S.J. & Ride, W.D.L. 1980. Use of natural resources by the Aborigines of South-western Australia. In Berndt R.M. & Berndt, C.H. (Eds.). *Aborigines of the West: Their Past and Their Present*. 2nd. ed. p. 66-80. W.A.: University of Western Australian Press.

Hammond, J.E. 1933 *Winjan's People: The Story of the South West Australian Aborigines*. Perth: Imperial Printing.

Lyon, Robert (1833). A glance at the manners, and language of Western Australia; with a short vocabulary, Perth Gazette and Western Australian Journal; 6/4/1833, p. 56; 13/4/1833, p. 59-60; 20/4/1833, p. 63-64.

McDonald, E., Coldrick, B. and Villiers, L. (2005) *Study of groundwater-related cultural values of the Gnangara Mound*, Western Australia. WA Department of Environment.

McDonald, E., Coldrick, B. and Christensen, W. (2008). The Green Frog and Desalination: A Nyungar Metaphor for the (Mis)Management of Water resources: Swan Coastal Plain, Western Australia. Oceania; Mar 2008; 78, 1; pg. 62.

Moore, G.F. (1884). Diary of Ten Years Eventful Life of an Early Settler in Western Australia; and also A Descriptive Vocabulary of the language of the Aborigines . M. Walbrook, London.

O'Connor, R. (2012) *Desktop Aboriginal Heritage Study of Proposed Northern Suburbs Railway Extension Alignment*. East Perth: Public Transport Authority. July 2012.

O'Connor, R. (2017) *Aboriginal Heritage Survey of Proposed Northern Suburbs Railway Extension Alignment*. East Perth: Public Transport Authority. April 2017.

O'Connor, R. (2017) *Addendum to Report on the Aboriginal Heritage Survey of Proposed Northern Suburbs Railway Extension Alignment*. East Perth: Public Transport Authority. October 2017.

Palmer, Kingsley (1976). Aboriginal oral tradition from the south west of Western Australia. *Folklore, No. 87*. pp. 76-80.

Robertson, F., Stasiuk, G., Nannup, N., & Hopper S. D. (2016). Ngalak koora koora djinang (looking back together): a Nyoongar and scientific collaborative history of ancient Nyoongar boodja. Australian Aboriginal Studies, 1, 40-54.

Stocker, L. Collard, L & Rooney, A. 2016) Aboriginal world views and colonisation: implications for coastal sustainability, *Local Environment, 21:7*, 844-865;

Vinnicombe, P. 1989. *Goonininup: A Site Complex of the Southern Side of Mount Eliza*. Perth: Department of Aboriginal Sites. p. 17.

WA Government (2019) Review of the Aboriginal Heritage Act 1972: Key themes and summary of issues. https://consultation.dplh.wa.gov.au/heritage/aha-review-phase-two/

Williams, A.E. 1984. *From Campsite to City*. Nedlands: City of Nedlands.

Winmar, Dorothy. 2002. Oral Interview. Transcribed in 2002. Cited in Nidja Beeliar Boodjar Noonookurt Nyininy: A Nyoongar Interpretive History Of The Use Of Boodjar (Country) In The Vicinity Of Murdoch University. L Collard, S Harben. Murdoch University.

Appendix G

Acoustic Assessment (Herring Storer Acoustics 2021)

DEVELOPMENT WA

ALKIMOS CENTRAL PRECINCT PLAN

SPP 5.4 NOISE ASSESSMENT

OCTOBER 2021

OUR REFERENCE: 26007-7-20170

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:
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DOCUMENT CONTROL PAGE

NOISE ASSESSMENT
CENTRAL ALKIMOS

Job No: 20170

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FOR

DEVELOPMENT WA

DOCUMENT INFORMATION			
Author:	Paul Daly	**Checked By:**	Tim Reynolds
Date of Issue:	07 July 2020		

REVISION HISTORY

Revision	Description	Date	Author	Checked
1	Revised LSP Plan	07/07/2021	PLD	
2	Client Comments	17/09/2021	PLD	
3	Final Design	08/10/2021	PLD	
4	Clarifications - Client	15/10/2021	PLD	
5	Note regarding Romeo Road	18/10/2021	PLD	
6	Updated Land Use and Density Plan	8/11/2021	PLD	

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CONTENTS

APPENDICES

1. INTRODUCTION

Herring Storer Acoustics was commissioned by Cossill & Webley on behalf of Development WA to undertake a road and rail traffic noise assessment for the proposed development of Alkimos Central.

The purpose of this assessment was to assess noise received within the development from vehicles travelling along Marmion Avenue and the Mitchell Freeway (Proposed) for the future traffic volumes; and passenger rail associated with the northern suburb passenger railway line. Previously, an acoustic assessment, (reference *HSA 14882-2-12067*) was conducted for the overall development, including the proposed Alkimos Central area. The purpose of this current acoustic assessment is to provide additional, detailed acoustic advice for the updated Precinct Plan, and to update the information contained within the study to reference the latest version of State Planning Policy 5.4, which was released in September 2019.

The traffic noise assessment has been carried out in accordance with the WAPC State Planning Policy 5.4 *"Road and Rail Noise"* which identifies road and rail noise sources requiring assessment. For this project, it is noted that Romeo Road is not considered under this policy as a trigger road source for assessment.

For information, the Precinct Plan is attached in Appendix A.

2. SUMMARY

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 *"Road and Rail Noise"* (SPP5.4), the appropriate criteria for assessment for this development are as listed below for "Noise Limits".

EXTERNAL

$L_{Aeq(Day)}$ of 55 dB(A); and
$L_{Aeq(Night)}$ of 50 dB(A).

INTERNAL

$L_{Aeq(Day)}$ of 40 dB(A) in living and work areas; and
$L_{Aeq(Night)}$ of 35 dB(A) in bedrooms.

Noise received at an outdoor area should also be reduced as far as practicable, with an aim of achieving an L_{Aeq} (night) of 50 dB(A).

MARMION AVENUE

From the modelling undertaken for the future Marmion Avenue, noise received at the development would exceed the above criteria. Inclusion of a noise wall for the entire length of the development is not practical, therefore to comply with the requirements of SPP 5.4 "Quiet House" design is required.

The main affected lots adjacent to Marmion Ave would require Quiet House design in the form of Package B and notification of noise on the titles. Appendix C details the Quiet House Design Packages required for each individual Lot, with Appendix D containing the deemed to satisfy constructions.

Due to the orientation of the lots, the outdoor living areas would be situated behind the houses, away from the Marmion Avenue, therefore providing a barrier to noise level, hence compliance is achieved with the L_{Aeq} (night) of 50 dB(A).

MITCHELL FREEWAY

From the modelling undertaken for the future Mitchell Freeway, noise received at the development would exceed the above criteria. As the design of the freeway is unknown, it is likely a wall or barrier will be included in the road design, to comply with the requirements of SPP 5.4. However, for this initial stage of the LSP, a conservative approach has been taken with no barrier included in the assessment. As such, "Quiet House" design is required for the northern lots in the form of package A or B and notification of noise on titles. Appendix C details the Quiet House Design Packages required for each individual Lot, with Appendix D containing the deemed to satisfy constructions.

NORTHERN SUBURBS PASSENGER RAIL LINE

Noise modelling indicates that noise received at the closest residence to the extension of the Northern Suburbs Passenger Railway Line would comply with the above criteria, however some lots are on the margin of 55 dB(A) and these Lots would require notifications on titles relating to rail noise. Appendix C details the individual lots requiring notifications.

The traffic noise assessment has been carried out in accordance with the WAPC State Planning Policy 5.4 *"Road and Rail Noise"* which identifies road and rail noise sources requiring assessment. For this project, it is noted that Romeo Road is not considered under this policy as a trigger road source for assessment.

We note that alternative constructions as to those listed in Appendix D, are acceptable, provided they are supported by an assessment undertaken by a suitably qualified acoustic consultant.

3. ACOUSTIC CRITERIA

3.1 ROAD AND RAIL TRAFFIC NOISE

The Western Australian Planning Commission (WAPC) released on 6th September 2019 State Planning Policy 5.4 *"Road and Rail Noise".* The requirements of State Planning Policy 5.4 are outlined below.

POLICY APPLICATION (Section 4)

When and where it applies (Section 4.1)

SPP 5.4 applies to the preparation and assessment of planning instruments, including region and local planning schemes; planning strategies, structure plans; subdivision and development proposals in Western Australia, where there is proposed:

*a) noise-sensitive land-use within the policy's trigger distance of a transport corridor as specified in **Table 1**;*

*b) New or major upgrades of roads as specified in **Table 1** and maps **(Schedule 1,2 and 3);** or*

*c) New railways or major upgrades of railways as specified in maps (**Schedule 1, 2 and 3);** or any other works that increase capacity for rail vehicle storage or movement and will result in an increased level of noise.*

Policy trigger distances (Section 4.1.2)

***Table 1** identifies the State's transport corridors and the trigger distances to which the policy applies.*

*The designation of land within the trigger distances outlined in **Table 1** should not be interpreted to imply that land is affected by noise and/or that areas outside the trigger distances are un-affected by noise.*

*Where any part of the lot is within the specified trigger distance, an assessment against the policy is required to determine the likely level of transport noise and management/ mitigation required. An initial screening assessment (**guidelines: Table 2: noise exposure forecast**) will determine if the lot is affected and to what extent."*

TABLE 1: TRANSPORT CORRIDOR CLASSIFICATION AND TRIGGER DISTANCES

Transport corridor classification	***Trigger distance***	***Distance measured from***
Roads		
Strategic freight and major traffic routes *Roads as defined by Perth and Peel Planning Frameworks and/or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume*	*300 metres*	*Road carriageway edge*
Other significant freight/traffic routes *These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meet the criteria of either >=23,000 daily traffic count (averaged equivalent to 25,000 vehicles passenger car units under region schemes)*	*200 metres*	*Road carriageway edge*
Passenger railways		
	100 metres	*Centreline of the closest track*
Freight railways		
	200 metres	*Centreline of the closest track*

Proponents are advised to consult with the decision making authority as site specific conditions (significant differences in ground levels, extreme noise levels) may influence the noise mitigation measures required, that may extend beyond the trigger distance.

POLICY MEASURES (Section 6)

The policy applies a performance-based approach to the management and mitigation of transport noise. The policy measures and resultant noise mitigation will be influenced by the function of the transport corridor and the type and intensity of the land-use proposed. Where there is risk of future land-use conflict in close proximity to strategic freight routes, a precautionary approach should be applied. Planning should also consider other broader planning policies. This is to ensure a balanced approach takes into consideration reasonable and practical considerations.

Noise Targets (Section 6.1)

***Table 2** sets out noise targets that are to be achieved by proposals under which the policy applies. Where exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.*

In the application of the noise targets the objective is to achieve:

- *indoor noise levels as specified in **Table 2** in noise sensitive areas (for example, bedrooms and living rooms of houses, and school classrooms); and*

- *a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and child care centres the design of outdoor areas should take into consideration the noise target.*

It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets. Where transport noise is above the noise targets, measures are expected to be implemented that balance reasonable and practicable considerations with the need to achieve acceptable noise protection outcomes.

TABLE 2: NOISE TARGETS

Proposals	***New/Upgrade***	***Noise Targets***		
		Outdoor		***Indoor***
		Day (L_{Aeq}(Day) dB) (6 am-10 pm)	***Night (L_{Aeq}(Night) dB) (10 pm-6 am)***	***(L_{Aeq} dB)***
Noise-sensitive land-use and/or development	*New noise sensitive land use and/or development within the trigger distance of an existing/proposed transport corridor*	*55*	*50*	*L_{Aeq} (Day) 40(Living and work areas)* *L_{Aeq} (Night) 35 (bedrooms)*
Roads	*New*	*55*	*50*	*N/A*
	Upgrade	*60*	*55*	*N/A*
Railways	*New*	*55*	*50*	*N/A*
	Upgrade	*60*	*55*	*N/A*

Notes:

- *The noise target is to be measured at one metre from the most exposed, habitable façade of the proposed building, which has the greatest exposure to the noise-source. A habitable room has the same meaning as defined in State Planning Policy 3.1 Residential Design Codes.*

- *For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (as amended) for each relevant time period.*

- *The 5dB difference in the criteria between new and upgrade infrastructure proposals acknowledges the challenges in achieving noise level reduction where existing infrastructure is surrounded by existing noise-sensitive development.*

- *Outdoor targets are to be met at all outdoor areas as far as is reasonable and practical to do so using the various noise mitigation measures outlined in the guidelines. For example, it is likely unreasonable for a transport infrastructure provider to achieve the outdoor*

targets at more than 1 or 2 floors of an adjacent development with direct line of sight to the traffic.

Noise Exposure Forecast (Section 6.2)

*When it is determined that SPP 5.4 applies to a planning proposal as outlined in Section 4, proponents and/or decision makers are required to undertake a preliminary assessment using **Table 2**: noise exposure forecast in the guidelines. This will provide an estimate of the potential noise impacts on noise-sensitive land-use and/ or development within the trigger distance of a specified transport corridor. The outcomes of the initial assessment will determine whether:*

- *no further measures is required;*
- *noise-sensitive land-use and/or development is acceptable subject to deemed-to- comply mitigation measures; or*
- *noise-sensitive land-use and/or development is not recommended. Any noise-sensitive land-use and/ or development is subject to mitigation measures outlined in a noise management plan."*

4. MODELLING

4.1 ROAD TRAFFIC NOISE

Modelling of noise received within the development from the Marmion Avenue and the Mitchell Freeway was carried out using SoundPlan, using the Calculation of Road Traffic Noise (CoRTN) algorithms. The input data for the model included:

- Increased traffic volume, assuming 2% growth over 20 years.
- Other traffic data as listed in Table 4.1.
- A +2.5 dB adjustment to allow for façade reflection.

The traffic data is as listed in Table 4.1.

TABLE 4.1 - SUMMARY OF TRAFFIC DATA

Parameter	Marmion Avenue	Mitchell Freeway
Future Traffic Flow (vpd)	35,000	60,000
Percentage Heavy Vehicles (%)	3%	6%
Speed (km/hr)	70	110
Surface Type	Dense Graded Asphalt	Dense Graded Asphalt

For this project, monitoring of the existing road network is not possible due to either the number of vehicles not being representative of future traffic flows (Marmion Ave), or the road does not currently exist (Freeway). Therefore, as referenced in State Planning Policy 5.4, Appendix 2 Noise Assessment Methodology, under the section Acceptable Methodologies, the DEFRA publication has been used to establish the difference between the $L_{A10,18h}$ and the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$. This is calculated as 10 and 2.5 dB(A) respectively with the formula provided in Table 4.2. It was assumed that these differences would apply in the year 2040.

It is noted that the DEFRA publication is the Method for converting the UK Road Traffic Noise Index $L_{A10,18hour}$ to the EU Noise Indices for Road Noise Mapping, hence is not used to calibrate the modelled noise levels, but rather provide the most critical time period of day or night for the assessment.

Table 4.2 – Non Motorway Roads – Converting LA18hr to LAeq Values

Indices	*Formula*	*Value dB*	*Difference $L_{A1018hr}$ to L_{Aeq}*
L_{A10}	*Based on Soundplan calculated value at façade of Pipidinny development for future traffic volumes*	*62.9*	
$L_{12hr,day}$ (0700 to 1900)	*$=0.95*L_{A10,18hr}+1.44$*	*61.2*	
$L_{4hr,evening}$ (1900 to 2300)	*$=0.97*_{LA10,18hr}-2.87$*	*58.1*	
$L_{8hr,night}$ (2300 to 0700)	*$=0.9*L_{A10,18hr}-3.77$*	*52.8*	*-10.1*
$L_{Aeq,16hr}$ (0700 to 2300)	*$=10*log(1/16)*((12*(10^(L_{Day}/10)))+(4*(10^(L_{evening}/10))))$*	*60.6*	*-2.3*

Notes:

1. As noise monitoring of existing road traffic noise emanating from Marmion Avenue or the Mitchell Freeway is not possible at this time, as outlined in the Implementation Guidelines, the standard correction of -1.7 dB has been applied to the noise model.

2. We also note that with the difference between the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$ being greater than 5 dB(A), achieving compliance with the day period criteria will also achieve compliance with the night period criteria. Therefore, noise modelling was only undertaken for the day period and the results are shown graphically in Appendix B.

Noise modelling for road noise was undertaken for the following scenarios:

R1 Noise emissions from Marmion Avenue (Future traffic flows) without noise amelioration for front facing lots and a 1.8m wall for side facing lots, but with future residential buildings.

R2 Noise emissions from Mitchell Freeway (Future traffic flows) without noise amelioration for front facing lots and a 1.8m wall for side facing lots, but with future residential buildings.

The 1.8m wall for the side facing lots has been assumed to be a Colorbond or equivalent .

For the noise modelling of future traffic, it has been assumed that the percentage of future heavy vehicles remains the same as for the current traffic flows. In this case, we believe that this is a conservative approach, as we believe that the percentage of heavy vehicles would fall over time.

4.2 NORTHERN SUBURBS PASSENGER TRAIN NOISE

Noise modelling for the passenger train was carried out based on the number of train movements as summarised in Table 4.3. We understand that these movements were used to model noise emissions from other section of the Northern Suburbs Passenger Railway Line.

TABLE 4.3 – TRAIN MOVEMENTS

Parameter	Train Movements (per hour)	
	Day	Night
North Bound		
3 Car Set (75 metres long)	5.0	0.75
4 Car Set (100 metres long)	0.5	0
6 Car Set (150 metres long)	0.4	0
South Bound		
3 Car Set (75 metres long)	5.4	0.9
4 Car Set (100 metres long)	0.5	0
6 Car Set (150 metres long)	0.4	0

Based on the above number of train movements, once again if compliance is achieved with the day period criteria, compliance will also be achieved with the night period criteria. Therefore, noise modelling was only undertaken for the day period.

Noise modelling for rail was undertaken for the following scenario:

T1 Noise emissions from proposed northern suburbs railway, without noise amelioration.

5. ASSESSMENT

In accordance with the WAPC Planning Policy 5.4, an assessment of the noise that would be received within the development from vehicles travelling on Marmion Avenue, Mitchell Freeway and the Passenger Rail Line has been undertaken.

In accordance with the Policy, the following would be the acoustic criteria applicable to this project:

External

Day	Maximum of 55 dB(A) L_{Aeq}
Night	Maximum of 50 dB(A) L_{Aeq}
Outdoor Living Areas (Night)	Maximum of 50 dB(A) L_{Aeq}

Internal

Sleeping Areas	35 dB(A) $L_{Aeq(night)}$
Living Areas	40 dB(A) $L_{Aeq(day)}$

Noise received at an outdoor area should also be reduced as far as practicable with an aim of achieving an $L_{Aeq\ (night)}$ of 50 dB(A).

MARMION AVENUE

From the modelling undertaken for the future Marmion Avenue, noise received at the development would exceed the above criteria. Inclusion of a noise wall for the entire length of the development is not practical, therefore to comply with the requirements of SPP 5.4 "Quiet House" design is required.

The main affected lots adjacent to Marmion Ave would require Quiet House design in the form of Package B and notification of noise on the titles. Appendix C details the Quiet House Design Packages required for each individual Lot, with Appendix D containing the deemed to satisfy constructions.

Due to the orientation of the lots, the outdoor living areas would be situated behind the houses, away from the Marmion Avenue, therefore providing a barrier to noise level, hence compliance is achieved with the L_{Aeq} (night) of 50 dB(A).

MITCHELL FREEWAY

From the modelling undertaken for the future Mitchell Freeway, noise received at the development would exceed the above criteria. As the design of the freeway is unknown, it is likely a wall or barrier will be included in the road design, to comply with the requirements of SPP 5.4. However, for this initial stage of the LSP, a conservative approach has been taken with no barrier included in the assessment. As such, "Quiet House" design is required for the northern lots in the form of package A or B and notification of noise on titles. Appendix C details the Quiet House Design Packages required for each individual Lot, with Appendix D containing the deemed to satisfy constructions.

NORTHERN SUBURBS PASSENGER RAIL LINE

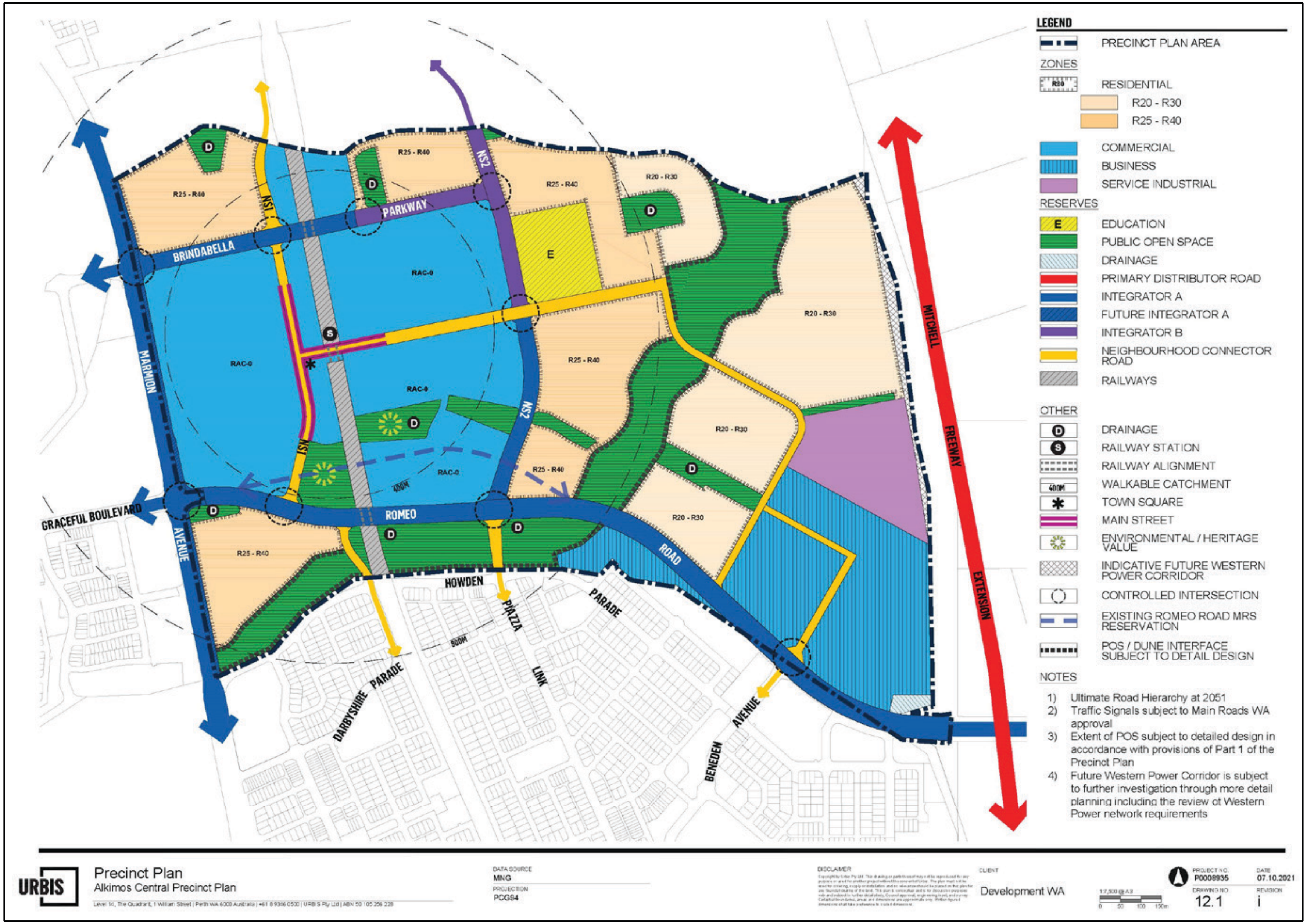
Noise modelling indicates that noise received at the closest residence to the extension of the Northern Suburbs Passenger Railway Line would comply with the above criteria, however some lots are on the margin of 55 dB(A) and these Lots would require notifications on titles relating to rail noise. Appendix C details the individual lots requiring notifications.

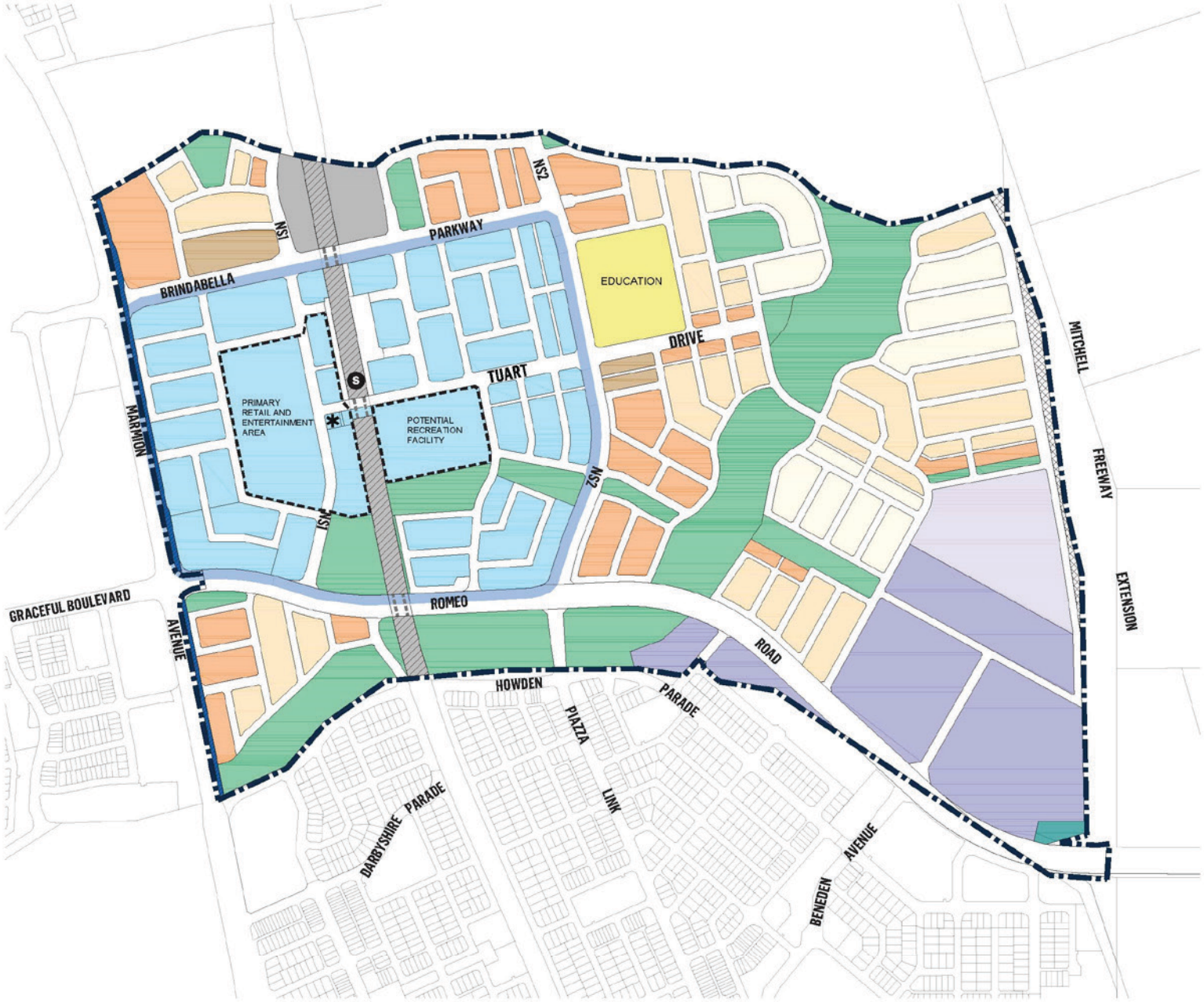
The traffic noise assessment has been carried out in accordance with the WAPC State Planning Policy 5.4 *"Road and Rail Noise"* which identifies road and rail noise sources requiring assessment. For this project, it is noted that Romeo Road is not considered under this policy as a trigger road source for assessment.

We note that alternative constructions as to those listed in Appendix D, are acceptable, provided they are supported by an assessment undertaken by a suitably qualified acoustic consultant.

APPENDIX A

ALKIMOS CENTRAL PRECINCT PLAN


LEGEND
PRECINCT PLAN AREA
ZONES
RESIDENTIAL
R20 - R30
R25 - R40
COMMERCIAL
BUSINESS
SERVICE INDUSTRIAL
RESERVES
EDUCATION
PUBLIC OPEN SPACE
DRAINAGE
PRIMARY DISTRIBUTOR ROAD
INTEGRATOR A
FUTURE INTEGRATOR A
INTEGRATOR B
NEIGHBOURHOOD CONNECTOR ROAD
RAILWAYS
OTHER
DRAINAGE
RAILWAY STATION
RAILWAY ALIGNMENT
WALKABLE CATCHMENT
TOWN SQUARE
MAIN STREET
ENVIRONMENTAL / HERITAGE VALUE
INDICATIVE FUTURE WESTERN POWER CORRIDOR
CONTROLLED INTERSECTION
EXISTING ROMEO ROAD MRS RESERVATION
POS / DUNE INTERFACE SUBJECT TO DETAIL DESIGN
NOTES
1) Ultimate Road Hierarchy at 2051
2) Traffic Signals subject to Main Roads WA approval
3) Extent of POS subject to detailed design in accordance with provisions of Part 1 of the Precinct Plan
4) Future Western Power Corridor is subject to further investigation through more detail planning including the review of Western Power network requirements
MITCHELL FREEWAY EXTENSION
MARMION AVENUE
GRACEFUL BOULEVARD
BRINDABELLA
PARKWAY
NS1
NS2
ROMEO ROAD
HOWDEN PARADE
PIAZZA LINK
DARBYSHIRE PARADE
BENEDEN AVENUE
RAC-0
R25 - R40
R20 - R30
URBIS
Precinct Plan
Alkimos Central Precinct Plan
DATA SOURCE
MNG
PROJECTION
PCG94
CLIENT
Development WA
PROJECT NO.
P0008935
DATE
07.10.2021
DRAWING NO.
12.1
REVISION
i



LEGEND

- PRECINCT PLAN AREA
- CITY CENTRE CORE

INDICATIVE LAND USE & DENSITIES

- RESIDENTIAL - R20
- RESIDENTIAL - R25
- RESIDENTIAL - R30
- RESIDENTIAL - R40
- COMMERCIAL (RAC-0)
- BUSINESS
- SERVICE INDUSTRIAL
- PUBLIC PURPOSE
- PUBLIC OPEN SPACE
- DRAINAGE
- PTA CARPARK

OTHER

- RAILWAYS
- FUTURE WESTERN POWER CORRIDOR
- TOWN SQUARE
- FUTURE MARMION AVENUE ROAD WIDENING
- INDICATIVE ROAD LAYOUT
- RAILWAY ALIGNMENT
- ALKIMOS TRAIN STATION

NOTE

1) R-Code densities are indicative. Refer to Plan 1 in Part 1
2) For land within RAC-0 built form controls are guided by the provisions of Part 1
3) Land uses within the Commercial Zone shall be in accordance with the land use permissibility in DPS2 (including a mix of retail, commercial, entertainment, food and beverage, recreational, civic, cultural and some residential land uses)

URBIS

Indicative Land Use & Density Plan

Alkimos Central Precinct Plan

Level 14, The Quadrant, 1 William Street | Perth WA 6000 Australia | +61 8 9346 0500 | URBIS Pty Ltd | ABN 50 105 256 228

DATA SOURCE: MNG

PROJECTION: PCG94

CLIENT: Development WA

1:7,500 @ A3

0 50 100 150m

PROJECT NO. P0008935

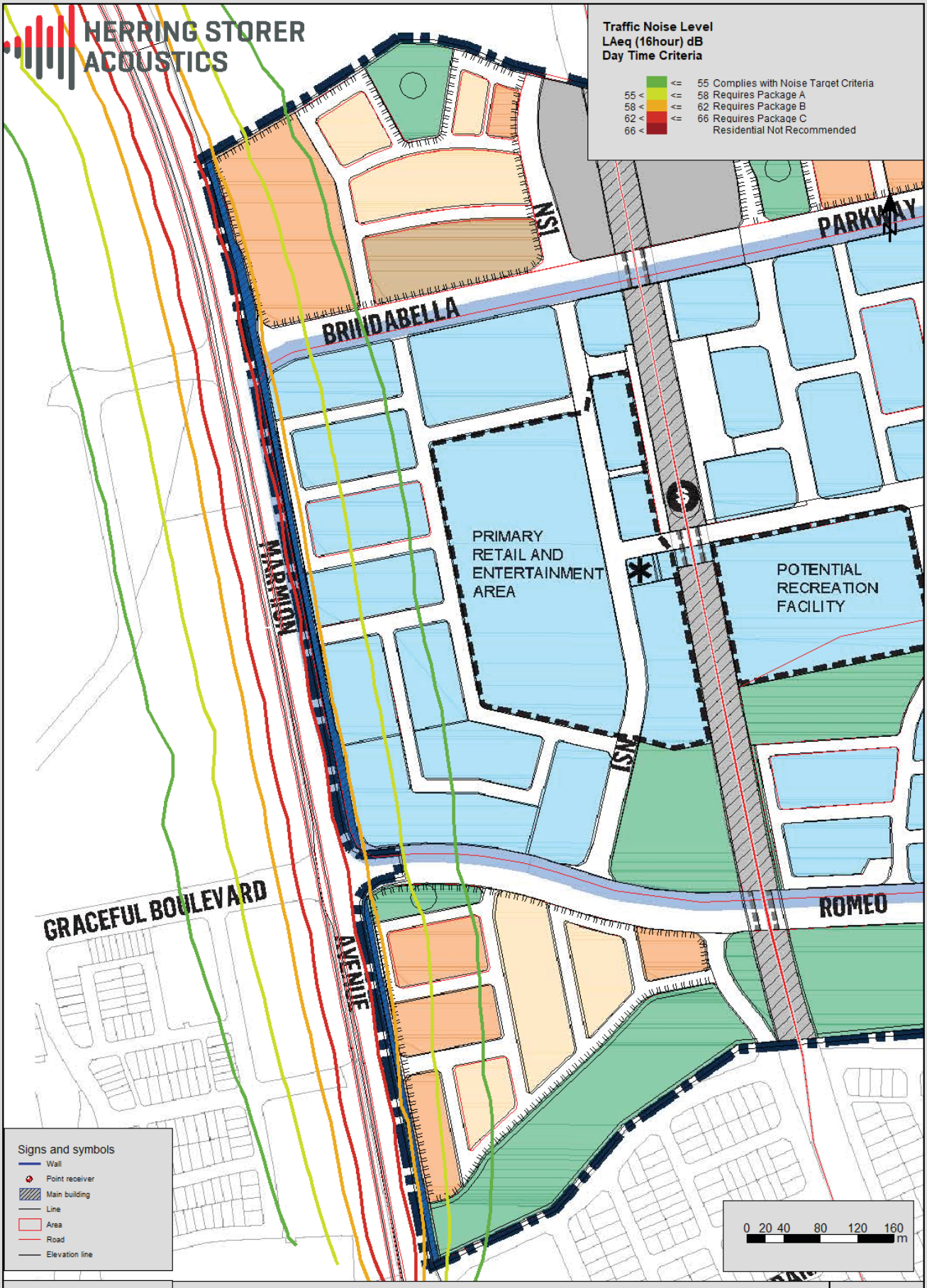
DATE 26.10.2021

DRAWING NO. 12.3

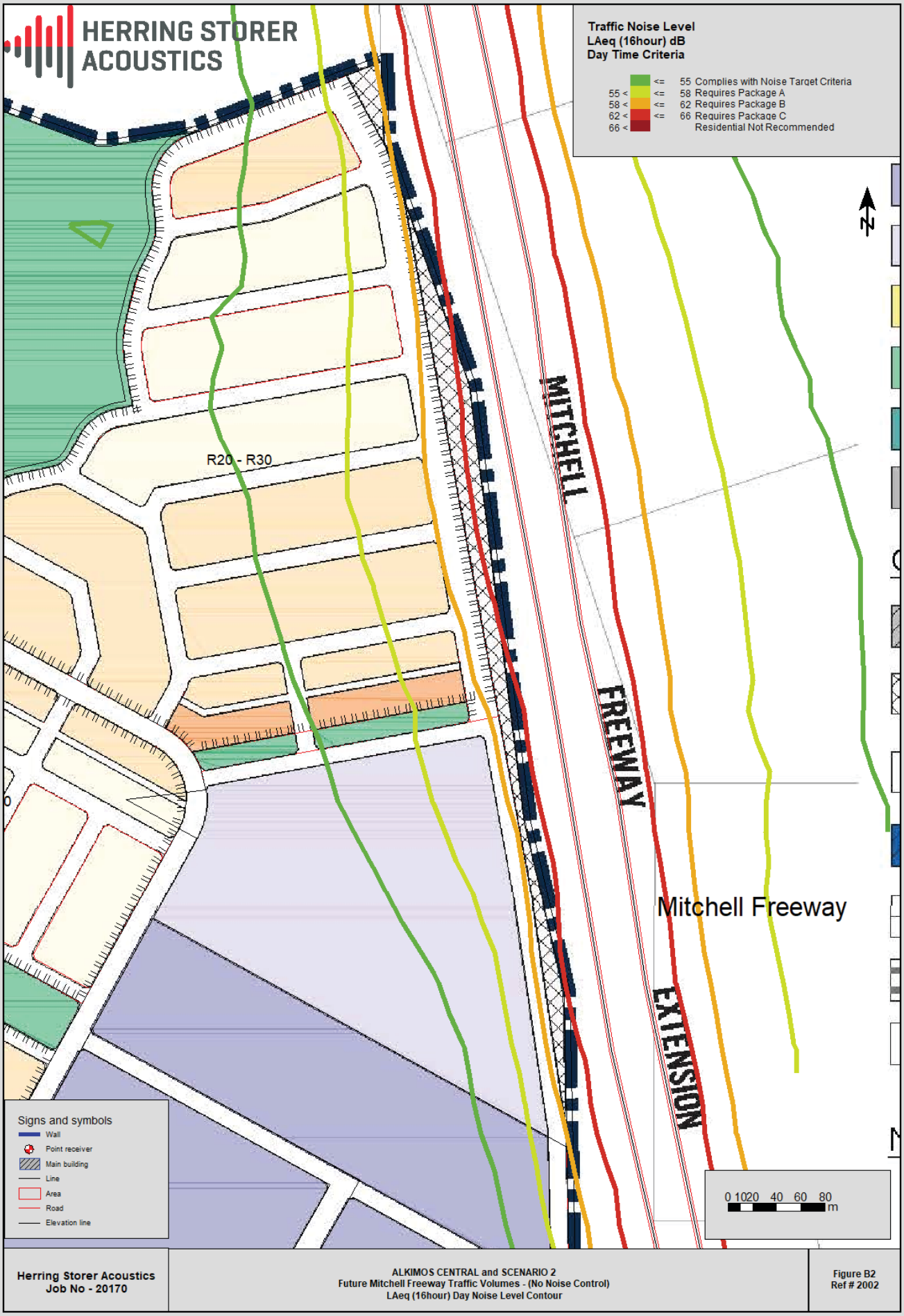
REVISION j

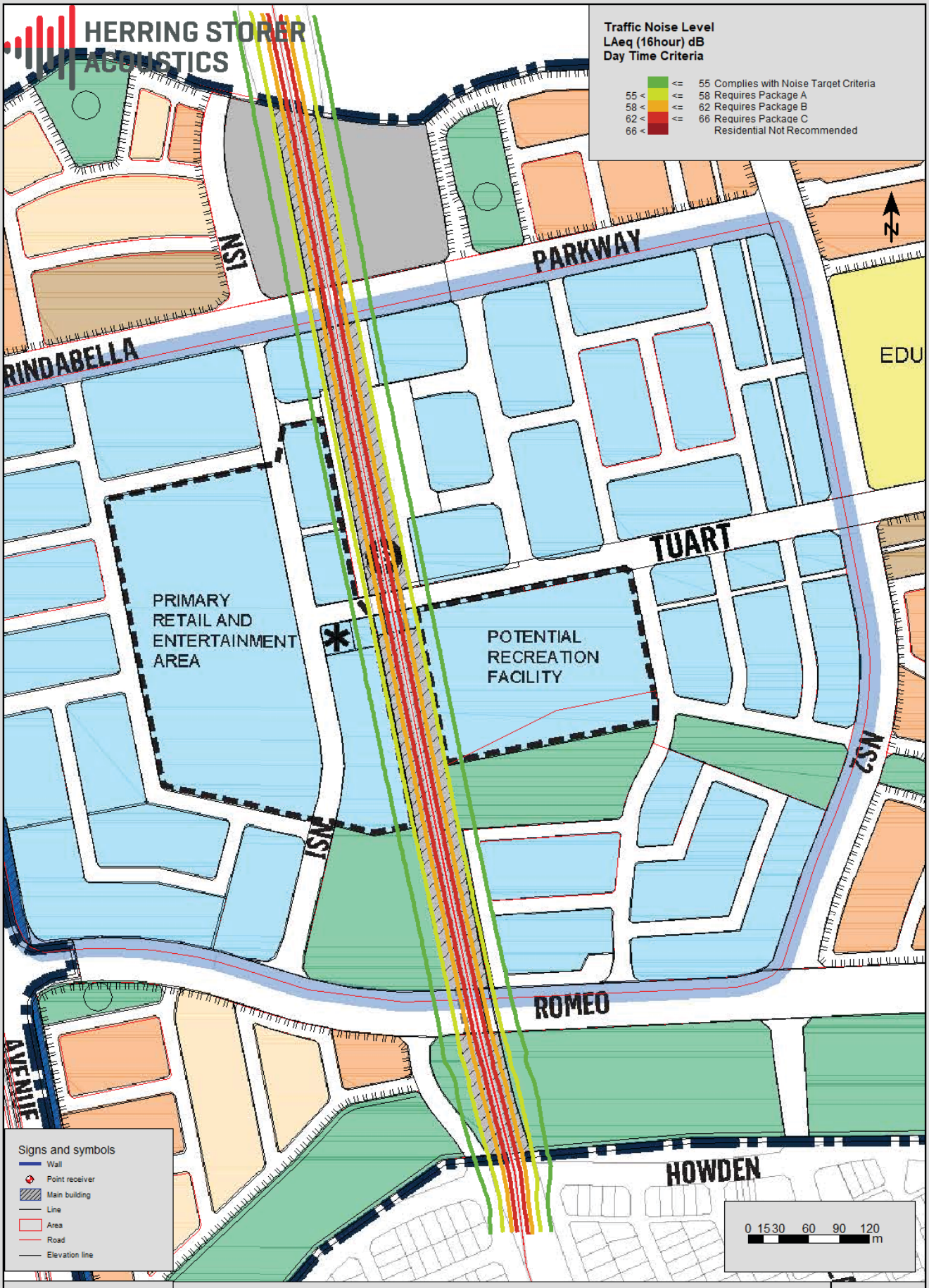
APPENDIX B

NOISE CONTOUR PLOT



Herring Storer Acoustics **Job No - 20170**	**ALKIMOS CENTRAL and SCENARIO 1** **Future Marmoin Avenue Traffic Volumes - (No Noise Control)** **LAeq (16hour) Day Noise Level Contour**	**Figure B1** **Ref # 2002**


HERRING STORER ACOUSTICS
Traffic Noise Level
LAeq (16hour) dB
Day Time Criteria
<= 55 Complies with Noise Target Criteria
55 < <= 58 Requires Package A
58 < <= 62 Requires Package B
62 < <= 66 Requires Package C
66 < Residential Not Recommended
N
R20 - R30
MITCHELL
FREEWAY
EXTENSION
Mitchell Freeway
Signs and symbols
Wall
Point receiver
Main building
Line
Area
Road
Elevation line
0 10 20 40 60 80
m
Herring Storer Acoustics
Job No - 20170
ALKIMOS CENTRAL and SCENARIO 2
Future Mitchell Freeway Traffic Volumes - (No Noise Control)
LAeq (16hour) Day Noise Level Contour
Figure B2
Ref # 2002



Herring Storer Acoustics
Job No - 20170

ALKIMOS CENTRAL and SCENARIO 3
Future Passenger Rail Traffic Volumes - (No Noise Control)
LAeq (16hour) Day Noise Level Contour

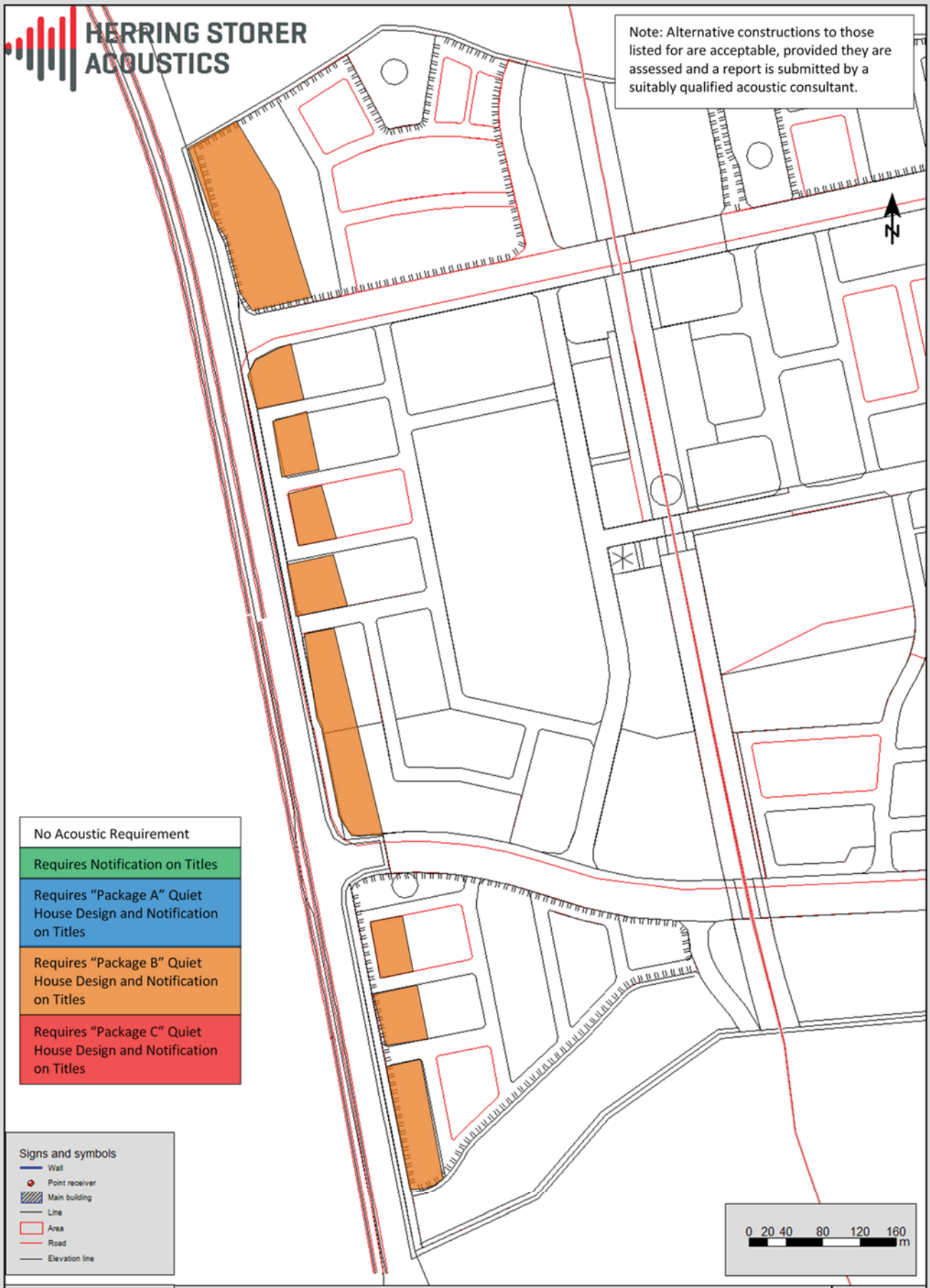
Figure B3
Ref # 008

APPENDIX C

Quiet House Design – Individual Area Requirement

HERRING STORER ACOUSTICS

Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.



No Acoustic Requirement

Requires Notification on Titles

Requires "Package A" Quiet House Design and Notification on Titles

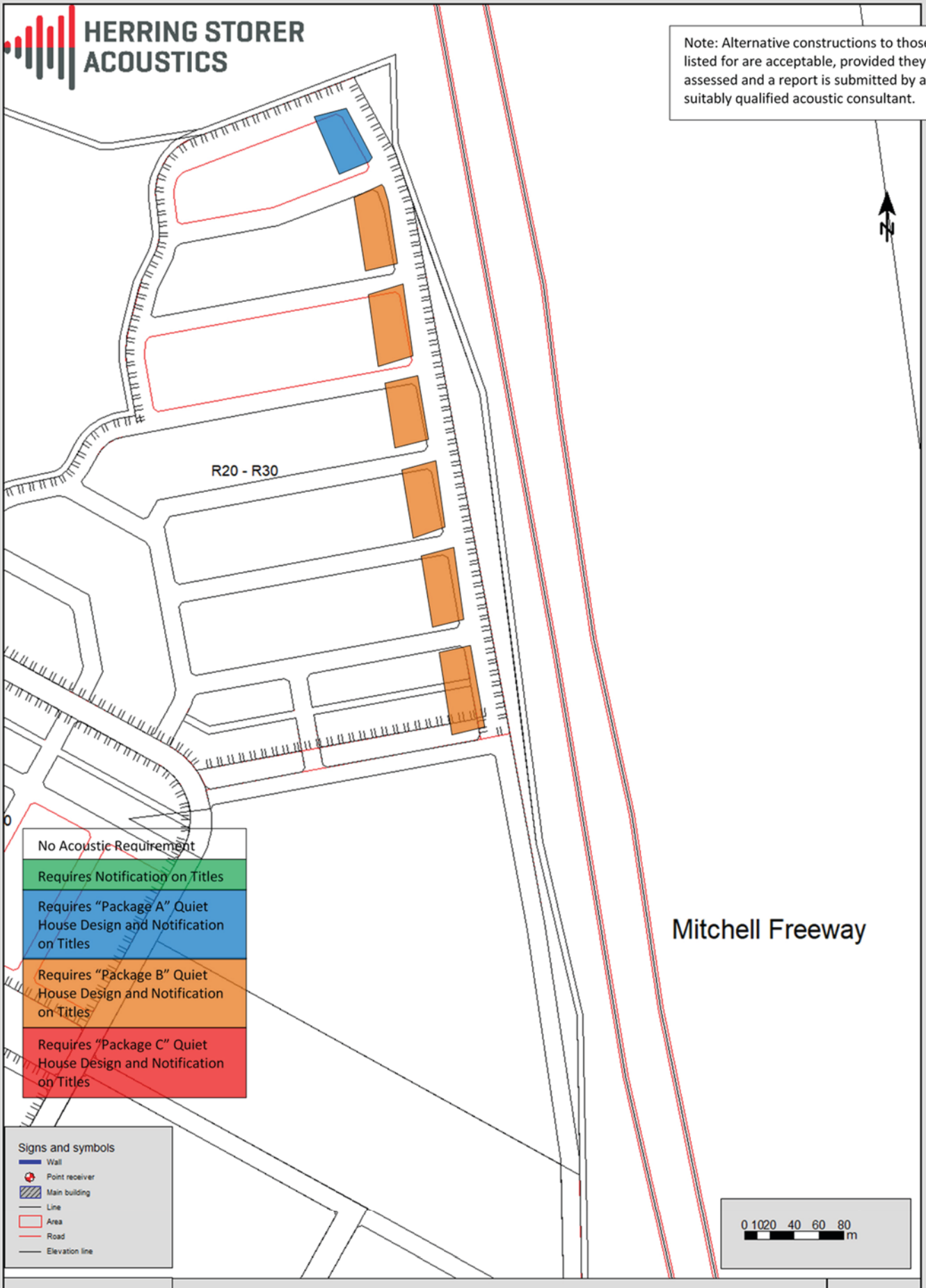
Requires "Package B" Quiet House Design and Notification on Titles

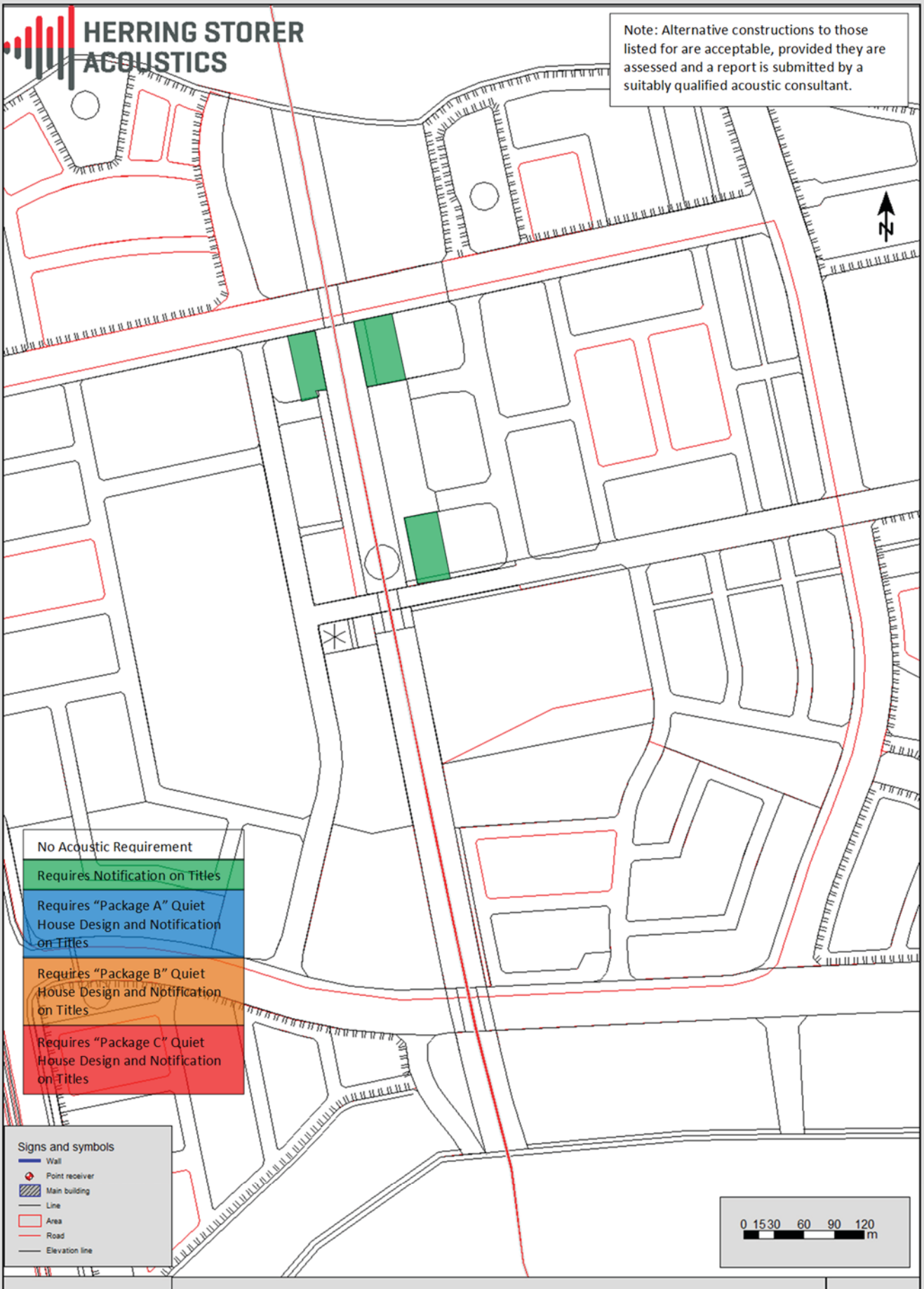
Requires "Package C" Quiet House Design and Notification on Titles

Signs and symbols
- Wall
- Point receiver
- Main building
- Line
- Area
- Road
- Elevation line

0 20 40 80 120 160 m

Herring Storer Acoustics **Job No - 20170**	**ALKIMOS CENTRAL and SCENARIO 1** **Future Marmoin Avenue Traffic Volumes - QHD Requirements** **LAeq (16hour) Day Noise Level Contour**	**Figure C1** **Ref # 2002**


HERRING STORER ACOUSTICS
Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.
N
R20 - R30
No Acoustic Requirement
Requires Notification on Titles
Requires "Package A" Quiet House Design and Notification on Titles
Requires "Package B" Quiet House Design and Notification on Titles
Requires "Package C" Quiet House Design and Notification on Titles
Mitchell Freeway
Signs and symbols
Wall
Point receiver
Main building
Line
Area
Road
Elevation line
0 10 20 40 60 80 m
Herring Storer Acoustics
Job No - 20170
ALKIMOS CENTRAL and SCENARIO 2
Future Mitchell Freeway Traffic Volumes - (No Noise Control)
QHD Requirements
Figure C2
Ref # 2002



Herring Storer Acoustics **Job No - 20170**	**ALKIMOS CENTRAL and SCENARIO 3** **Future Passenger Rail Traffic Volumes - (No Noise Control)** **QHD Requirments**	**Figure C3** **Ref # 008**

APPENDIX D

QUIET HOUSE DESIGN GUIDELINES

Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	
A **Quiet House A**	**Facing**	**Bedroom and Indoor Living and work areas to Rw + Ctr 45dB** **Stud Frame Walls** ➢ One row of 92mm studs at 60mm centres with: ➢ Resilient steel channels fixed to the outside of the studs; and ➢ 9.5mm hardboard or 9mm fibre cement weatherboards or one layer of 19mm board cladding fixed to the outside of the channels; and ➢ 75mm glass wool (11kg/m3) or 75mm polyester (14kg/m3) insulation, positioned between the studs; and ➢ -Two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs. **Brick Walls** ➢ Single leaf of 150mm brick masonry with 13mm cement render on each face: **OR** ➢ Double brick: two leaves of 90 mm clay brick masonry with a 20mm cavity between leaves.	**Bedrooms**: ➢ Fully glazed hinged door with certified **R_w+C_{tr} 28dB** rated door and frame including seals and 6mm glass **Indoor Living and work areas:** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulted glazing (**R_w+C_{tr} 28 dB**). Sealed awning or casement windows may use 6 mm glazing instead**: OR** ➢ Up to 60% floor area: as per above but must be sealed awning or casement type windows (**R_w+C_{tr} 31dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (**R_w+C_{tr} 25dB**)**: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr28 dB : OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (**R_w+C_{tr} 31 dB**).	**To R_w+C_{tr} 35dB** ➢ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling	➢ At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum **2 metres** height above ground level	➢ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of **Rw 40dB** into sensitive spaces ➢ Evaporative systems require attenuated ceiling air vents to allow closed windows ➢ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements ➢ Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable
	Side On		As per "Facing" above, except R_w+C_{tr} values may be 3dB less, e.g. glazed sliding door with 10 mm glass and weather seals for bedrooms	As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%			
	Opposite		No specific requirements	No specific requirements			

Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	
B **Quiet House B**	**Facing**	**Bedroom and indoor living and work areas to R_w+C_{tr} 50dB** **Single leaf of 90 mm clay brick masonry with:** ➢ A row of 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres; ➢ A cavity of 25 mm between leaves; ➢ 50 mm glass wool or polyester cavity insulation (R2.0+) insulation between studs; and ➢ One layer of 10mm plasterboard fixed to the inside face ➢ Single leaf of 220mm brick masonry with 13mm cement render on each face ➢ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face **Double brick: two leaves of 90mm clay brick masonry with:** ➢ A 50mm cavity between leaves ➢ 50mm glass wool or polyester cavity insulation (R2.0+) ➢ Resilient ties where required to connect leaves **Double brick: two leaves of 110mm clay brick masonry with** ➢ 50mm cavity between leaves and R2.0+ cavity insulation	**Bedrooms** ➢ Fully glazed hinged door with certified **R_w+C_{tr} 31dB** rated door and frame including seals and 10mm glass **Indoor Living and work areas** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor areas: Fixed sash, awning or casement with minimum 6mm single or 6mm-12mm-6mm double insulted glazing (**Rw+Ctr 31dB**). ➢ Up to 60% floor area: as per above but must be minimum10mm single or 6mm-12mm-10mm double insulated glazing (**Rw+Ctr 34dB**) **Indoor Living and work areas** ➢ Up to 40% floor area; Sliding or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (R_w+C_{tr} 28dB). Sealed awning or casement windows may use 6mm glazing instead. **: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**R_w+C_{tr} 31dB**). **: OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (**R_w+C_{tr} 34dB).**	**To R_w+C_{tr} 35dB** ➢ Concrete or terracotta tile sarking and at least 10mm plasterboard ceiling, R3.0+ insulation **OR** ➢ Metal sheet roof, sarking and at least 10mm plasterboard ceiling, R3.0+ insulation	➢ At least one outdoor living area located on the opposite side of the building from the corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum **2.4 metres** height above ground level	➢ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of **Rw 40dB** into sensitive spaces ➢ Evaporative systems require attenuated ceiling air vents to allow closed windows ➢ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements ➢ Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable
	Side-On		**Bedrooms**: ➢ Fully glazed hinged door with certified **R_w+C_{tr} 28dB** rated door and frame including seals and 6mm glass **Indoor Living and work areas:** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulted glazing (**R_w+C_{tr} 28 dB**). Sealed awning or casement windows may use 6 mm glazing instead. **: OR** ➢ Up to 60% floor area: as per above but must be sealed awning or casement type windows (**R_w+C_{tr} 31dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (**R_w+C_{tr} 25dB**). **: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr28 dB**) **: OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (**R_w+C_{tr} 31 dB**).			
	Opposite		As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%	As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%			

Road Traffic and Passenger Rail
Quiet House Requirements
(*Based on Table 3 of State Planning Policy 5.4 2019*)

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					
		Walls	**External doors**	**Windows**	**Roofs and ceilings of highest floors**	**Outdoor Living areas**	**Mechanical ventilation/air conditioning considerations**
C **Quiet House C**	**Facing**	**Bedroom and indoor living and work areas to R_w+C_{tr} 50dB** **Single leaf of 90 mm clay brick masonry with:** ➢ A row of 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres; ➢ A cavity of 25 mm between leaves; ➢ 50 mm glass wool or polyester cavity insulation (R2.0+) insulation between studs; and ➢ One layer of 10mm plasterboard fixed to the inside face ➢ Single leaf of 220mm brick masonry with 13mm cement render on each face ➢ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face **Double brick: two leaves of 90mm clay brick masonry with:** ➢ A 50mm cavity between leaves ➢ 50mm glass wool or polyester cavity insulation (R2.0+) ➢ Resilient ties where required to connect leaves **Double brick: two leaves of 110mm clay brick masonry with** ➢ 50mm cavity between leaves and R2.0+ cavity insulation	**Bedrooms** ➢ External doors to bedrooms facing the corridor are not recommended. **Indoor Living and work areas** ➢ Fully glazed hinged door with certified **Rw+Ctr 31dB** rated door and frame including seals and 10mm glass**: OR** 40mm solid core timber frame and door (without glass or with glass inserts not less than 6mm), side hinged with certified **Rw 32dB** acoustically rated door and frame system including seals	**Bedrooms**: ➢ Total external door and window system area up to 20% of room floor area: Fixed sash, awning or casement with minimum 6mm single or 6mm-12mm-6mm double insulted glazing (**R_w+C_{tr} 31dB): OR** ➢ Up to 40% floor area; as per above but must be minimum 10mm single or 6mm-12mm-10mm double insulted glazing (**R_w+C_{tr} 34dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (**R_w+C_{tr} 31dB**). Sealed awning or casement windows may use 6mm glazing instead**: OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr 34dB)**	**To R_w+C_{tr} 40dB** ➢ To al bedrooms, 2 layers of 10mm plasterboard, or one layer 13mm high density sealed plasterboard (minimum surface density of 12.5 kg/m2), affixed using steel furring channels beneath ceiling rafters/supports**: and** ➢ R3.0+ insulation batts laid in cavity **: and** ➢ Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibre insulation between steel sheeting and roof battens	➢ At least one outdoor living area located on the opposite side of the building from the corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum **2.4 metres** height above ground level	➢ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces. ➢ Evaporative systems require attenuated ceiling air cents to allow closed windows. ➢ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements ➢ Openings such as eaves, vents and air inlets must be acoustically treated, close or relocated to building sides facing away from the corridor where practicable.
	Side-on		**Bedrooms** ➢ Fully glazed hinged door with certified **R_w+C_{tr} 31dB** rated door and frame including seals and 10mm glass **Indoor Living and work areas** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals				
	Opposite		**Bedrooms**: ➢ Fully glazed hinged door with certified **R_w+C_{tr} 28dB** rated door and frame including seals and 6mm glass **Indoor Living and work areas:** ➢ 35mm solid core timber hinged door and frame system certified to **Rw 28dB** including seals**: OR** ➢ Glazed sliding door with 10 mm glass and weather seals	**Bedrooms**: ➢ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulted glazing (**R_w+C_{tr} 28 dB**). Sealed awning or casement windows may use 6 mm glazing instead**: OR** ➢ Up to 60% floor area: as per above but must be sealed awning or casement type windows (**R_w+C_{tr} 31dB**). **Indoor Living and work areas** ➢ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulted glazing (**R_w+C_{tr} 25dB): OR** ➢ Up to 60% floor area: As per Bedrooms at up to 40% area (**Rw+Ctr28 dB : OR** ➢ Up to 80% floor area: As per Bedrooms at up to 60% area (**R_w+C_{tr} 31 dB**).			

Note: The above treatments are a deemed to satisfy construction. Alternative designs are acceptable, provided they are certified by a suitable qualified acoustic consultant.