Natural Area
CONSULTING MANAGEMENT SERVICES

Mr I Yujnovich

Environmental Review Document – Lot 123 Mortimer Road Casuarina

V1 – 15 October 2019

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Version No.	Date	Changes	Prepared by	Approved by	Status
V1	15 October 2019	New document	SB	BC	Final

Executive Summary

Mr Ivan Yujnovich has owned Lot 123 Mortimer Road Casuarina (Figure 1) within the City of Kwinana for more than 60 years, after it was purchased as an investment property with the aim of it contributing to his superannuation. The site has remained in a vegetated state since its purchase and represents a legacy site from an environmental approval's perspective as values of the site have a greater significance today than at the time the Lot was purchased.

Background and Context

Mr Yujnovich has expressed an interest in selling the Lot to a developer, and to assist with that process is attempting to quantify the environmental impacts associated with development of the site for urban purposes (the proposal) to provide a measure of 'certainty' in terms of approvals processes for any future owner/developer. Accordingly, this environmental review document (ERD) has been prepared to present sufficient information to enable the initial subdivision of the Lot into two Lots in the first instance, and also to enable consideration of the environmental values that will be impacted on when further subdivision occurs. It is recognised that the strategic planning activities that have occurred for the broader Casuarina area and Lot being within a portion of that area that is zoned urban development, there is a tacit recognition that there is a level of acceptance that there will be impacts to the environmental values within site.

This document has been prepared in accordance with the *Environmental Impact Assessment Administrative Procedures* 2016 (Government of Western Australia, 2016) and the *Instructions on How to Prepare an Environmental Review Document* (Environmental Protection Authority, 2018).

The proposal was referred to the Department of the Environment and Energy in December 2018 (referral 2018/8379) due to the presence of matters of national environmental significance as per Section 87 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), with the decision that the proposed development will be a controlled action. The preferred assessment method is a for a joint assessment with the State of Western Australia under the bilateral agreement.

Overview of the Proposal

This proposal relates to the preparation of a local structure plan that describes the subdivision of Lot 123 Mortimer Road Casuarina within the City of Kwinana into two Lots in the first instance (Figure 2), with further subdivision required in the future to support urban development. Preliminary subdivision design work indicates that a minimum area of 35.5 ha would be cleared as a result of the project (Figure 3), with the maximum potentially being the entire site (45 ha). Thus, the information provided in this document considers the potential worst-case scenario of clearing the entire site, allowing consideration of the various environmental values at an early stage of the process.

It is the owner's preference that the Lot be sold, and the future urban development be undertaken by others. This initial local structure plan will serve as the mechanism to enable consideration of the environmental values associated with the site and to provide an indication of environmental approval conditions to potential purchasers of the Lot to facilitate the sale process. If the Lot is not sold, the outcomes

of the assessment process will inform the owner of obligations that need to be adhered to in the event he chooses to progress the development. Key project characteristics are provided in Table ES1.

Table ES1: Key project characteristics

Item	Description
Proposal title	Urban Development of Lot 123 Mortimer Road, Casuarina
Proponent name	Mr I. Yujnovich
Short description	The development of Lot 123 relates to the proposed clearing of a minimum of 35.5 ha and a maximum of 45 ha of native vegetation for urban purposes, including residential, commercial and areas of public open space

Summary of Potential Impacts, Proposed Mitigation and Outcomes

A summary of the potential impacts, proposed mitigation measures and expected outcomes associated with the urban development of Lot 123 is provided in Table ES2, with detailed discussion of each provided in Section 4.0.

Table ES2: Summary of potential impacts, proposed mitigation and outcomes

Aspect	Description
Key Environmental Factor 1 – Flora and Vegetation	
EPA objective	To protect flora and vegetation so that biological diversity and ecological integrity are maintained
Policy and guidance	▪ *Environmental Factor Guideline – Flora and Vegetation* (EPA, 2016a) ▪ *Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA)*, (EPA, 2018a) ▪ *Instructions on how to prepare an Environmental Review Document* (EPA, 2018b) ▪ *Perth and Peel @3.5 Million – Environmental Impacts, Risks and Remedies* (EPA, 2015) ▪ *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b) ▪ *Statement of Environmental Principles, Factors and Objectives* (EPA, 2018c).
Potential impacts	Depending on the final design for the development, the proposal will result in the following: ▪ direct clearing of between 35.5 and 45 ha of native vegetation ▪ direct clearing of up to 38 ha of the endangered ecological community Banksia Woodland of the Swan Coastal Plain listed under the EPBC Act 1999 (Cwlth); this community is listed as Priority 3 under the Biodiversity Conservation Act 2016 (WA) ▪ no impact to threatened or priority flora listed under the *Biodiversity Conservation Act 2016* (WA) ▪ no impact to threatened flora listed under the EPBC Act 1999 (Cwlth) ▪ fragmentation

Aspect	Description
	▪ cumulative impacts.
Mitigation	Unavoidable loss of between 35.5 and 45 ha of native vegetation
Outcomes	▪ Residual impact associated with the loss of between 35.5 and 45 ha of native vegetation ▪ Retention of similar vegetation type in 10 Bush Forever sites within 5 km of Lot 123 ▪ Offset site or conservation covenant is the likely outcome.
Key Environmental Factor 2: Terrestrial Fauna	
EPA objective	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained
Policy and guidance	▪ *Environmental Factor Guideline – Terrestrial Fauna* (EPA, 2016c) ▪ *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna* (EPA, 2016d) ▪ *Technical Guidance – Terrestrial Fauna Surveys* (EPA, 2016e) ▪ *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species: Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo* (Department of Sustainability, Environment, Water, Population and Communities, 2012).
Potential impacts	As clearing occurs to support the planned urban development, the fauna species supported by the vegetation will be directly impacted via: ▪ clearing of between 35.5 and 45 ha of native vegetation that provides a range of habitats for fauna ▪ fragmentation of habitat ▪ injury or mortality of species during clearing, presence of an increased number of vehicles, and/or the increased presence of predators.
Mitigation	▪ Unavoidable loss of between 35.5 and 45 ha of native vegetation that is good quality habitat for threatened fauna species. ▪ Site assessment activities indicated that usage by threatened black cockatoo species was limited despite the presence of hollows that were probably large enough to be used for nesting and flora species that were preferred by the Carnaby's Cockatoo and/or the Forest Red-tailed Black Cockatoo.
Outcomes	▪ Residual impact associated with the loss of between 35.5 and 45 ha of native vegetation that is good quality habitat for threatened fauna species ▪ Retention of similar vegetation type in 10 Bush Forever sites within 5 km of Lot 123 ▪ Offset site or conservation covenant is the likely outcome.
Key Environmental Factor 3: Inland Waters (Wetlands)	
EPA objective	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected

Aspect	Description
Policy and guidance	▪ *Environmental Factor Guideline – Inland Waters* (EPA, 2018f) ▪ *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ, 2000).
Potential impacts	Proposed urban development activities have the potential to impact on hydrological processes and inland waters via: ▪ loss of designated wetlands due to clearing of native vegetation from the site ▪ increased runoff during rainfall events associated with the creation of impervious surfaces for roads, footpaths, and buildings that could impact of wetlands and groundwater ▪ decreased depth to groundwater due to removal of native vegetation ▪ movement of contaminants within stormwater that could result in water quality declines ▪ use of phosphorus based fertilisers in turfed areas, landscaped parkland areas and gardens.
Mitigation	▪ Dependent on how the wetland areas are viewed, with the potential options being the clearing of all designated wetland areas within Lot 123 (worst-case scenario), with the other extreme being the retention of all designated wetland areas on site. ▪ A strong case has been presented by Bioscience (2011) suggesting that the designated wetlands are no longer present, hence the level of impact and associated mitigation will need to be discussed and negotiated. ▪ Several wetland areas are recognised outside of Lot 123. ▪ Design of an appropriate urban water management and stormwater management system.
Outcomes	▪ Unavoidable clearing of between 35.5 and 45 ha of native vegetation, some of which may include some or all of the designated wetland areas. ▪ The continued presence of several wetlands within 5 km of Lot 123. ▪ Depending on how the designated wetlands are considered in light of the argument presented by Bioscience (2011) is considered, if any wetland areas are lost, then the most likely outcome will be an offset site and/or a conservation covenant.

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1.0 Introduction

Mr Ivan (John) Yujnovich is proposing to subdivide Lot 123 Mortimer Road Casuarina within the City of Kwinana into two Lots in the first instance (Figure 1), with subdivision to urban residential expected at some future stage, either by the owner or potentially by others.

1.1 Purpose and Scope

The purpose of this environmental review document is to present an assessment of potential impacts that could expected when the site is developed for urban purposes, either by Mr Yujnovich or by another developer, in support of the structure planning and environmental approvals processes. The Lot has been in the ownership of Mr Yujnovich for more than 60 years and represents a 'legacy site' in terms of the environmental values that are present, and which need to be considered from an approvals process today, in contrast to when the Lot was purchased back in the late 1950's. Given the size of the site (45 ha) and the several environmental values present, the need for protection of these values has the potential to place a disproportionate burden of protection on Mr Yujnovich and uncertainty in relation to development (Environmental Protection Authority, 2015) due to the vegetated nature of the site with some development having occurred on neighbouring and other properties in proximity to Lot 123.

Mr Yujnovich has expressed an interest in selling the Lot to a developer, and to assist with that process is attempting to quantify the environmental impacts associated with development of site for urban purposes to provide a measure of 'certainty' in terms of approvals processes for any future owner/developer. Accordingly, the major objective of this environmental review document (ERD) is to present sufficient information to enable the initial subdivision of the Lot into two Lots in the first instance, and also to enable consideration of the environmental values that will be impacted on when further subdivision occurs. Preliminary indicative subdivision design indicates that a minimum of 35.5 ha and a maximum of 45 ha (the entire Lot) will need to be cleared to accommodate the proposed future urban development, with the expectation that the actual will be somewhere in between. Information provided in this document considers the potential worst-case scenario of clearing the entire site, allowing consideration of the various environmental values at an early stage of the process.

Environmental values within Lot 123 include:

- the presence of the ecological community Banksia Woodlands of the Swan Coastal Plain
- the presence of habitat suitable for use by threatened black cockatoos, with evidence of foraging by the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)
- a conservation category wetland within the northern portion of the Lot
- portions of two resource enhancement wetlands along the western boundary
- sightings of the priority 4 (P4) listed bandicoot (*Isoodon fusciventer*) diggings
- the opportunistic sighting of the P4 listed Western Brush Wallaby (*Macropus irma*).

Additionally, the following environmental values are present within 5 km of Lot 123:

- several other resource enhancement and conservation category wetlands
- ten Bush Forever Sites

- a Tumulus Mound Spring threatened ecological community approximately 3 km to the south east.

This document has been prepared in accordance with the *Environmental Impact Assessment Administrative Procedures* 2016 (Government of Western Australia, 2016) and the *Instructions on How to Prepare an Environmental Review Document* (Environmental Protection Authority, 2018).

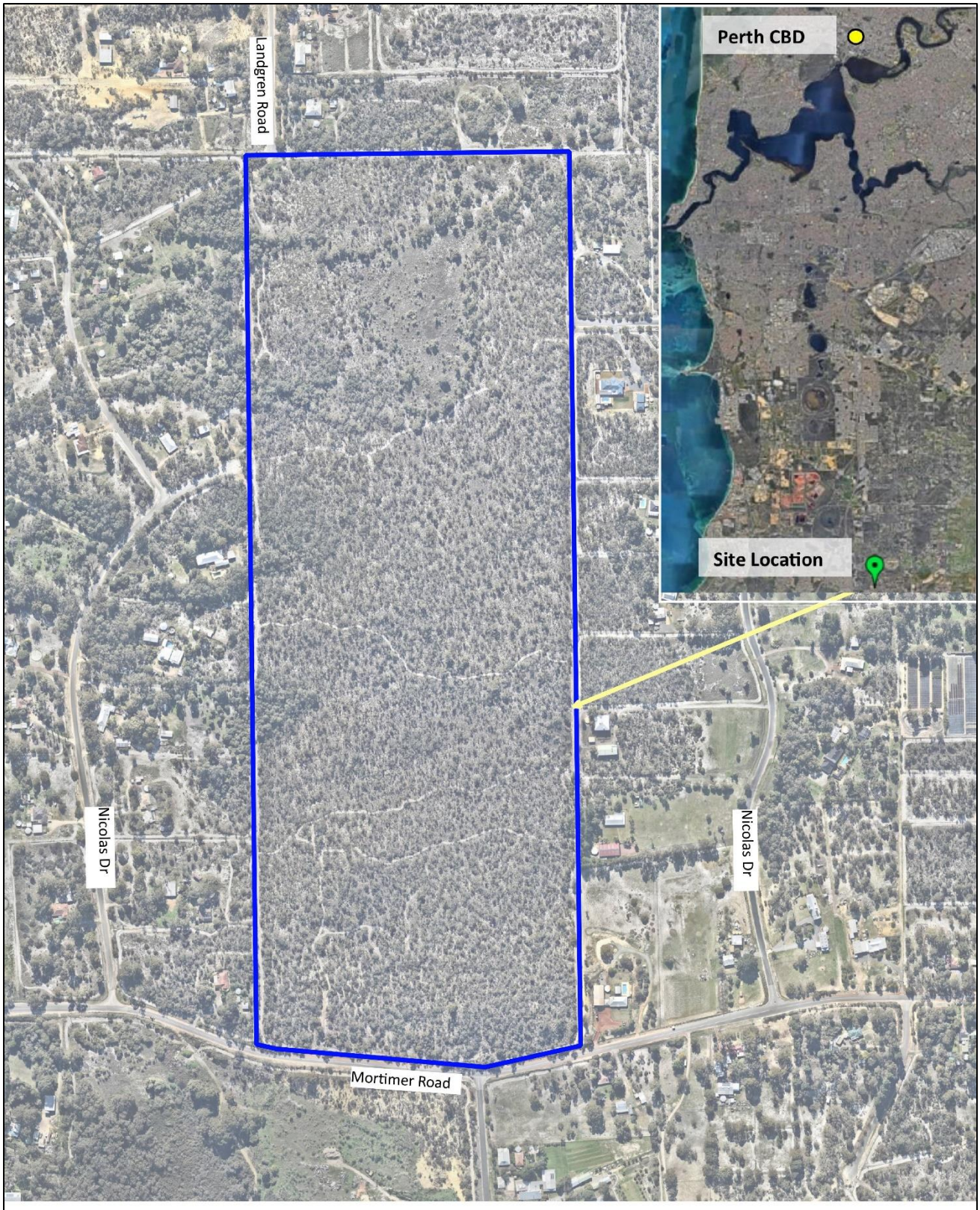

Figure 1:
Location,
Lot 123 Mortimer Rd, Casuarina

1.2 Proponent

The proponent for this proposal is:

Mr Ivan (John) Yujnovich
398 Oxford Street
Mount Hawthorn WA 6016.

The key contact for this proposal is:

Ms Sue Brand
Senior Environmental Scientist
Natural Area Consulting Management Services
Unit 1/164 Barrington Street
Bibra Lake WA 6164
Email: sue.brand@naturalarea.com.au

1.3 Assessment Process

Key approval legislation relevant to the site includes:

- *Environmental Protection Act 1986* (WA)
- *Biodiversity Conservation Act 2016* (WA)
- *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
- *Planning and Development Act 2005* (WA)

1.3.1 *Environmental Protection Act 1986* (WA)

The primary environmental protection legislation in Western Australia is the Environmental Protection Act 1986. This Act provides for the impact assessment of proposals through Division 1 of Part IV, and the impact of planning schemes through Division 3 of Part IV. The need to refer a proposal is related to the likely to result in significant environmental impacts if it proceeds. The purpose of the environmental review document is to assess the likely impacts of the proposal on the key environmental values present within the proposed development site. The EIA process is subject to public review, with details of the proposal being made available with invitations to comment. At the appropriate time, the EPA will prepare its report and recommendations for the Minister for the Environment.

1.3.2 *Biodiversity Conservation Act 2016* (WA)

The *Biodiversity Conservation Act 2016* replaces the *Wildlife Conservation 1950* and provides for the ongoing protection of Western Australian flora, fauna and ecological communities, including those that are listed as threatened or priority species. Several of the environmental values present within Lot 123 relate to the presence of threatened and priority listed fauna and ecological communities.

1.3.3 *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)

The *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) provides for the protection of matters of national environmental significance (MNES), such as significant impacts to nationally listed endangered flora, fauna and/or ecological communities. Lot 123 includes evidence of feeding by the critically endangered Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Vulnerable Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*). A flora and vegetation survey undertaken in 2018 by Natural Area

Consulting Management Services confirmed the presence of the ecological community Banksia Woodlands of the Swan Coastal Plain which is listed as critically endangered.

Details of the proposal were referred to the Department of the Environment and Energy in December 2018 (referral number 2018/8379), with the decision notice indicating the proposal is a controlled action was issued on 02 April 2019. The DoEE have indicated that the assessment approach is to be agreed and have indicated a preference for a bilateral assessment approach with the State of Western Australia.

1.3.4 *Planning and Development Act 2005* (WA)

The *Planning and Development Act 2005* (WA) includes provisions in several Parts and Divisions, including Section 81 of Division 3 of Part 5 – Local Planning Schemes, for proposed schemes or scheme amendments to be referred to the EPA. As a legacy site in private ownership for more than 60 years, consideration of the environmental values on Lot 123 has not previously been considered by the EPA or any other state agency.

According to the Department of Planning, Lands and Heritage (2019a), Lot 123 is located in an area that was included in an application to rezone the area from rural to urban deferred as part of Amendment 1117/33. The amendment was referred to the EPA in February 2006, with the March 2006 decision being that the amendment would not be formally assessed with advice given that the following environmental factors would require attention at appropriate stages of the planning process:

- drainage (management of water quality and quantity)
- special catchment requirements – Peel Harvey Catchment
- wetlands
- remnant vegetation
- fauna
- soil and groundwater contamination
- emissions impacting on adjoining land uses
- noise and vibration.

The initial subdivision of Lot 123 will be into two Lots, with a view that the Lot(s) will be further subdivided to for urban purposes at a future point in time. This environmental review document will consider these factors on the basis of the current subdivision plan and for the expected future urban development, adopting a worst-case scenario approach of the need to clear the entire 45 ha of Lot 123.

1.4 Other Approvals and Regulations

The primary decision-making authority relating to environmental approvals associated with Lot 123 will be the Minister for the Environment as it relates to Division 3 of Part IV of the *Environmental Protection Act 1986* (WA). Other decision-making authorities will include:

- City of Kwinana – planning aspects of the proposal
- Western Australian Planning Commission – planning aspects of the proposal.

As a minimum, advice in relation to the proposal is expected from:

- Department of Water and Environmental Regulation – water aspects of the project
- Department of Biodiversity, Conservation and Attractions – presence of conservation significant species and ecological communities, wetlands.

2.0 The Proposal

Lot 123 Mortimer Road is located in Casuarina within the City of Kwinana. It is a 45 ha area located to the east of the Kwinana Freeway, and is bounded by existing rural residential properties to the north, south, east and west (Figure 1). This proposal relates to the preparation of a local structure plan that describes the subdivision of Lot 123 Mortimer Road Casuarina within the City of Kwinana into two Lots in the first instance (Figure 2), with further subdivision required in the future to support urban development; an indicative concept plan is provided in Figure 3, noting that it does not represent the final design. Accordingly, Figure 3 represents the minimum area (35.5 ha) that would be cleared as a result of the project, with the maximum potentially being the entire site (45 ha) (worst-case scenario).

It is the owner's preference that the Lot be sold, and the future urban development be undertaken by others. This initial local structure plan will serve as the mechanism to enable consideration of the environmental values associated with the site and to provide an indication of environmental approval conditions to potential purchasers of the Lot to facilitate the sale process. If the Lot is not sold, the outcomes of the assessment process will inform the owner of obligations that need to be adhered to in the event he chooses to progress the development.

The proposal was referred to the Department of the Environment and Energy in December 2018 (referral 2018/8379) due to the presence of matters of national environmental significance as per Section 87 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), with the decision that the proposed development will be a controlled action. The preferred assessment method is a for a joint assessment with the State of Western Australia under the bilateral agreement.

2.1 Justification

Lot 123 was purchased as an investment property by the owner, Mr Yujnovich, more than 60 years ago, with a view to it being or contributing to his superannuation. In its undeveloped state, Lot 123 has several financial costs associated with it, including various taxes and maintenance activities, representing a cost impost to the owner with no real opportunity for it to 'pay its way'.

In 2006, zoning of the Lot was changed from Rural to Urban Deferred. Lot 123 is currently zoned Residential Development, as per the *City of Kwinana Town Planning Scheme No. 2* (City of Kwinana, 2019) and *Local Planning Policy 6 – Guidelines for Structure Planning in the Casuarina Cell* (City of Kwinana, 2018). This zoning is consistent with the Metropolitan Regional Scheme, which indicates that Lot 123 is zoned Urban (Department of Planning, Lands, and Heritage, 2019b), as well as the *South Metropolitan Peel Sub-regional Planning Framework* (Department of Planning Lands and Heritage and the Western Australian Planning Commission, 2018).

Development of the site is also consistent with the interim advice contained in *Perth and Peel @ 3.5 Million – Environmental Impacts, Risks and Remedies* (Environmental Protection Authority, 2015), which recognises the need to balance environmental values with urban development requirements. This advice also recognises the potential for some owners having a disproportionate environmental burden associated with development activities. As the Lot has been retained in private ownership as remnant bushland, the

environmental values have ‘increased’ since its original purchase as knowledge, policies and legislation have changed.

Accordingly, development of the site for urban purposes is consistent with current zoning and longer-term strategic planning for the Casuarina Cell. It will result in a mix of residential Lots, commercial activities, and public open space. A high school site identified during higher level planning processes may or may not be required by the Department of Education; if not required, that area will be used for residential purposes.

Figure 2: Proposed initial subdivision plan

Figure 3: Indicative concept plan – future subdivision

2.1.1 Proposal Benefits

In addition to the creation of additional residential and commercial sites with Lot 123, the following benefits of the proposal will be generated:

- increased revenue through rates to the local government authority that will contribute to the provision of services and infrastructure within its boundaries
- additional employment opportunities during the construction phase, as well as within the businesses that utilise the commercial sector of the proposed development
- the potential for sand extraction from portions of the site, such as the south-eastern section, that will provide a saleable raw material and contribute to civil engineering works ahead of urban development
- decreased usage of the site by trail and quad bikes, reducing the potential for dust generation and noise being a nuisance to neighbouring properties.

2.1.2 Alternative Options

As the site has been in private ownership for more than 60 years, its current value to the owner is for its projected development consistent with the current strategic planning for the site. While there are several environmental values associated with the site, retaining it as bushland in the longer term means several outgoings that represent a large financial burden on an annual basis for the owner with little or no potential for a return on the investment.

2.2 Proposal Description

The proposal relates to the urban development of Lot 123; key project characteristics are provided in Table 1. The development will connect with existing rural residential properties to the north, west and east, as well as future urban development in those locations. Figure 3 provides an indicative concept plan that outlines a possible mix of urban land uses that could be supported within Lot 123, with the actual being subject to further detailed design. Development activities will include civil engineering, water and drainage network that will connect to Water Corporation infrastructure, road network, electrical and communications infrastructure, and areas of public open space.

Table 1: Proposal summary and key characteristics

Item	Description
Proposal title	Urban Development of Lot 123 Mortimer Road, Casuarina
Proponent name	Mr I. Yujnovich
Short description	The development of Lot 123 relates to the proposed clearing of between a minimum of 35.5 ha and a maximum of 45 ha of native vegetation for urban purposes, including residential, commercial and areas of public open space

2.3 Current Site Characteristics

2.3.1 Regional Context

Perth is located within the Swan Coastal Plain region of the Interim Biogeographical Regionalisation of Australia (IBRA). The Swan Coastal Plain comprises of two major divisions, namely Swan Coastal Plain 1 – Dandaragan Plateau and Swan Coastal Plain 2 – Perth Coastal Plain. Lot 123 Mortimer Road is located in the Perth Coastal Plain subregion, which is broadly characterised as including areas of Jarrah and Banksia

woodlands on sandy soils in a series of sand dunes, along with wetland areas, often within the interdunal swales (Mitchell, Williams and Desmond, 2002). According to Mitchell, Williams and Desmond (2002) the Perth metropolitan area comprises approximately 20% of the Swan Coastal Plain Subregion and was the subject of a comprehensive assessment to determine reservation status and protection requirements as part of Bush Forever.

2.3.2 Climate

The climate experienced in the area is Mediterranean, with dry, hot summers and cool, wet winters. According to the Bureau of Meteorology (Perth Airport, Station ID 009021, 2019; Figure 4):

- average rainfall is 765.3 mm pa, with the majority falling between May and August;
- average maximum temperature ranges from 18.0 °C in winter to 31.9 °C in summer, with the highest recorded maximum being 46.7 °C;
- average minimum temperatures range from 8.0 °C in winter to 17.5 °C in summer, with the lowest recorded minimum being -1.3 °C; and
- predominant wind directions include morning easterlies and westerly sea breezes during summer months, with an average wind speed of 16.6 km/h and gusts of more than 100 km/h.

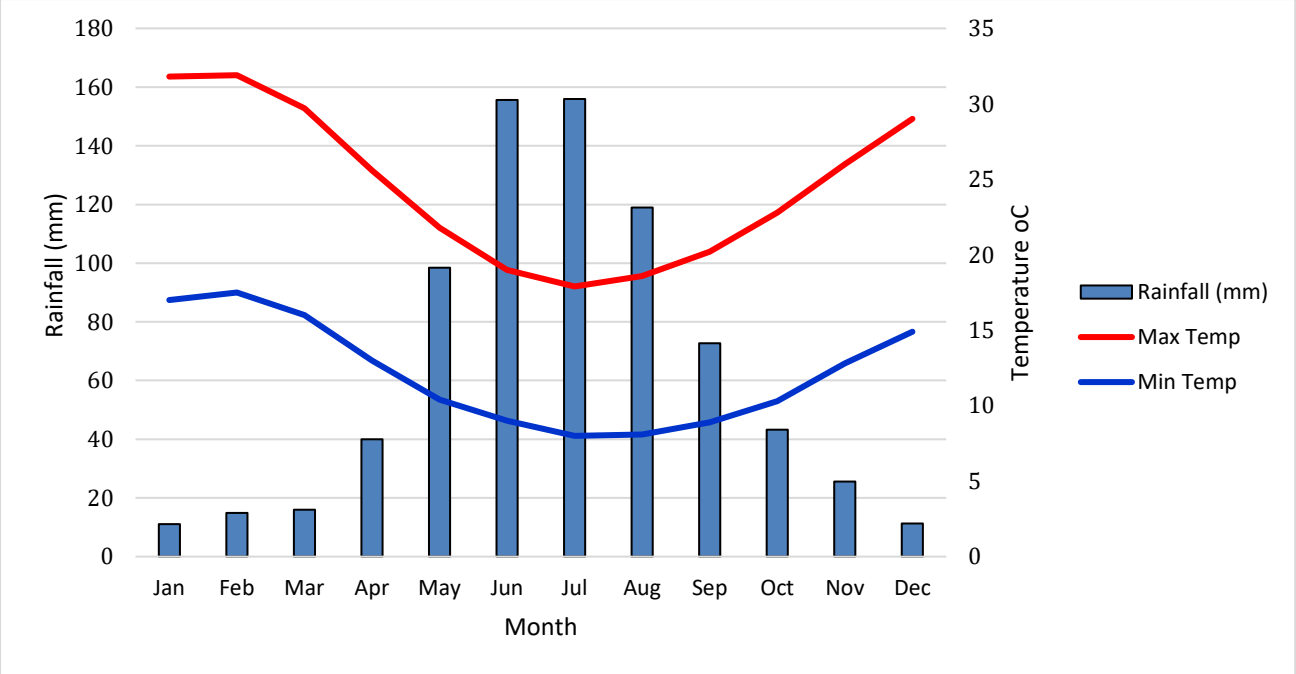

Figure 4: Rainfall, maximum and minimum temperatures, Perth Airport, Station ID 009021 (1944 – 2019)

2.3.3 Current Land Use

The current land use within Lot 123 is a 45-ha area of remnant bushland (Figure 5) dominated by Banksia Woodland. A review of aerial imagery held by Landgate (2019) indicates that a house constructed on the south-west portion of the site during the 1960's was demolished sometime between 1985 and 1989 (previous land use).

Current landuse Remains of dwelling demolished in mid-late 1980s

Figure 5: Current and previous land use

2.3.3 Topography

Lot 123 is located on the Bassendean Dune System within the Swan Coastal Plain. This system is characterised by undulating land associated with sand dunes, interdunal swales and sandplains with pale, deep sand, semi-wet and wet soils (Department of Primary Industries and Regional Development, 2019).

The site ranges in height from 18 m AHD in the north to 38 m AHD in the south-east, with some higher areas around the centre of the site (Figure 6). Accordingly, slope across the site is currently variable, and will be modified when development progresses and engineering works are carried out.

2.3.4 Soils

According to NRInfo (Department of Primary Industries and Regional Development, 2019), two soil types are present within Lot 123 (Figure 7):

- Bassendean B1 Phase (212Bs_B1) – Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2m; Banksia dominant
- Bassendean B3 Phase (212Bs_B3) – Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with iron-organic hardpan 1-2 m or clay subsoils. Surface soils are dark grey sand or sandy loam.

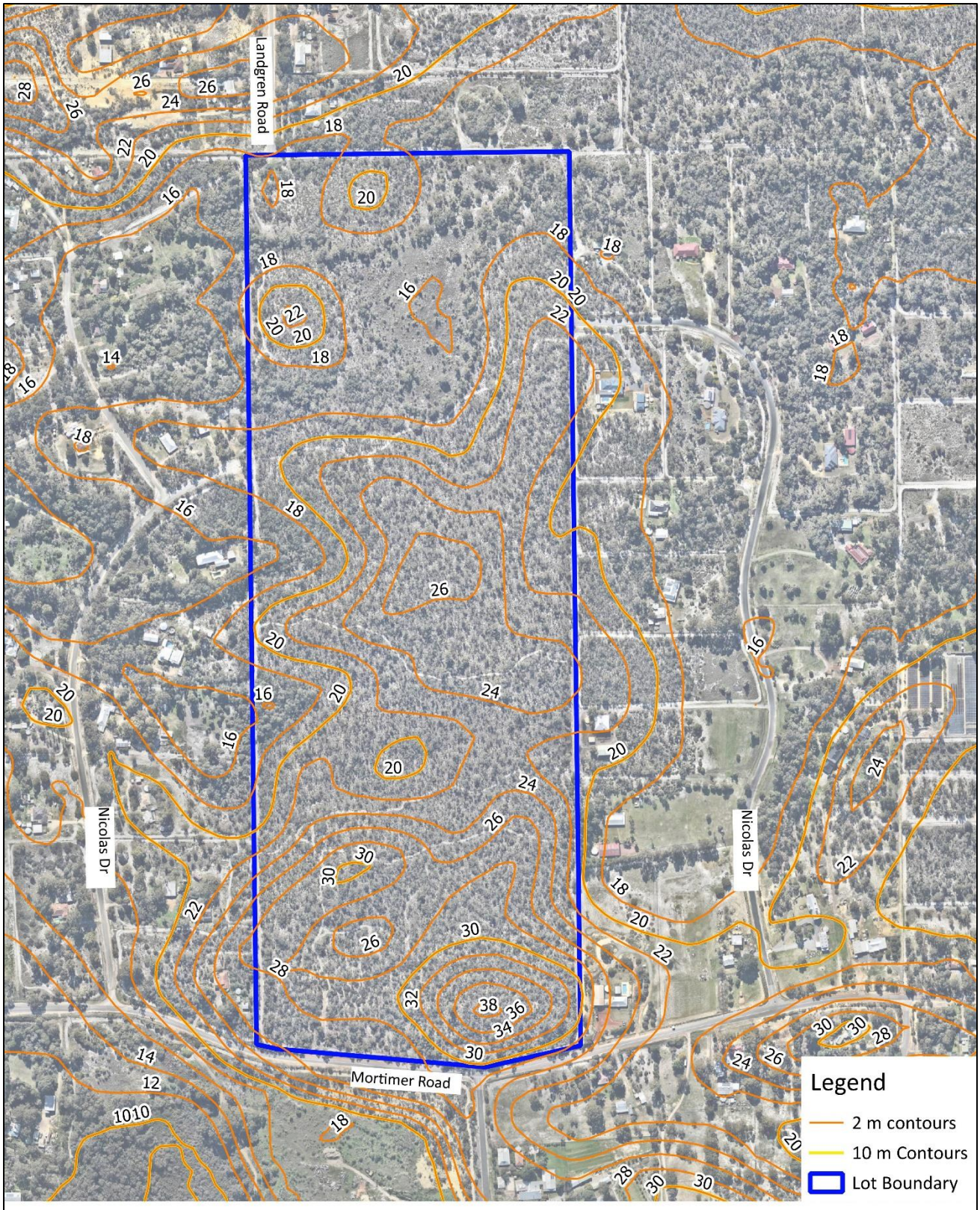

Figure 6:
Site Contours
Lot 123 Mortimer Rd, Casuarina

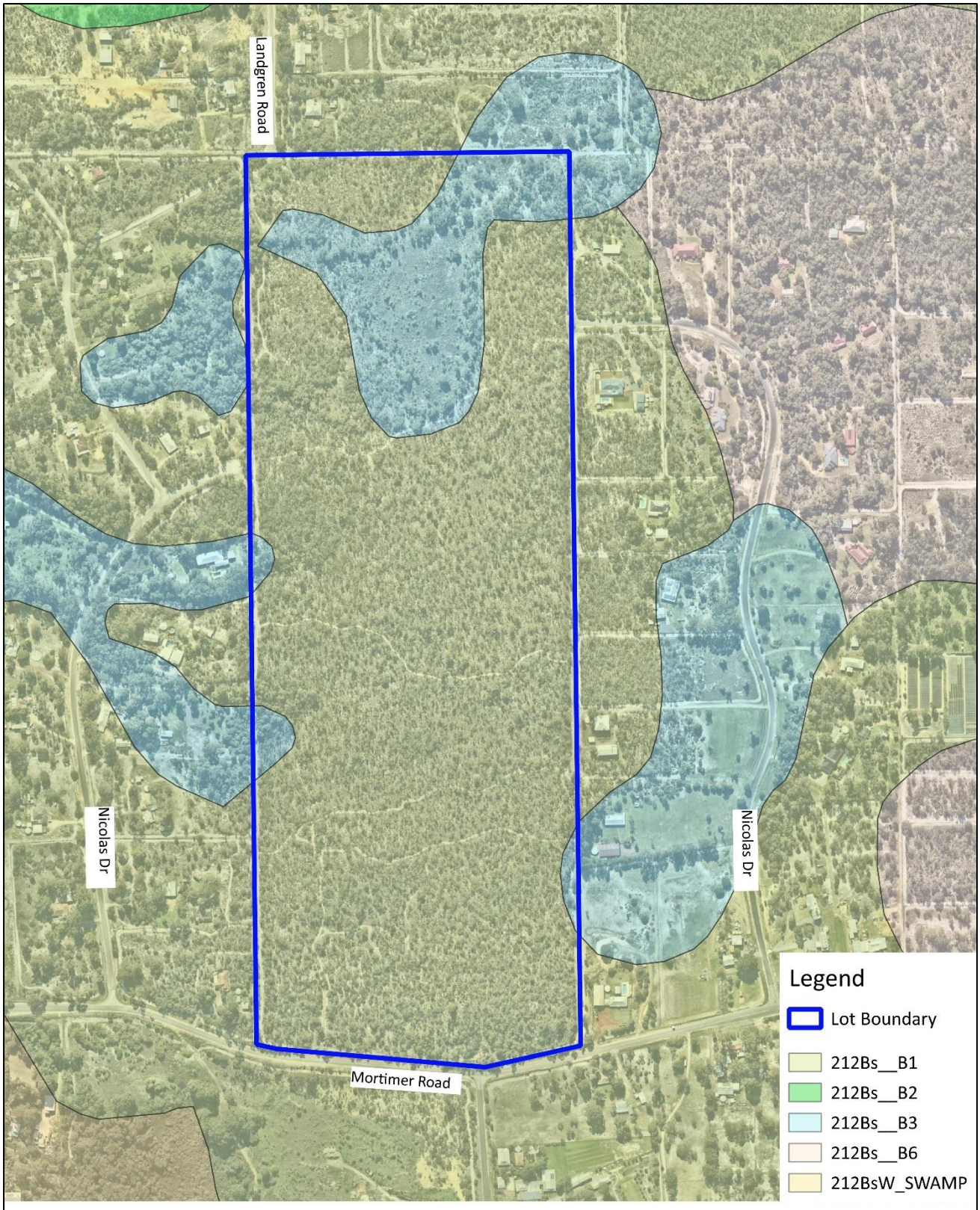

Figure 7:
Soils
Lot 123 Mortimer Rd, Casuarina

2.3.5 Wetlands

Wetlands on the Swan Coastal Plain were identified, mapped, classified and assessed over several years, with outcomes of that process becoming the basis of the Geomorphic Wetlands of the Swan Coastal Plain Dataset maintained by the Department of Biodiversity, Conservation and Attractions. The identification and assessment process included desktop review activities of aerial imagery that included the presence of vegetation typically associated with wetland areas (Hill, Semeniuk, Semeniuk and Del Marco, 1996).

This process defined the wetlands on Lot 123 as damplands, which are seasonally waterlogged areas, meaning that groundwater levels rise and become close to the natural surface level during wetter months (winter) (Department of Biodiversity, Conservation and Attractions, 2019a). These wetter areas can be diverse in terms of the flora and fauna they support. While it is understood that some site visits were made to ground truth the assessment activities, it is unlikely any visits were made to those on Lot 123 due to the land being in private ownership.

One wetland is currently recognised by the Department of Biodiversity Conservation and Attractions as being present within Lot 123, with portions of two others extending a short distance into the Lot along the western boundary; these are summarised in Table 2 and shown in Figure 8. The landowner has indicated that no standing water has ever been observed on site since he purchased the property more than 60 years ago. The wetland areas present in Lot 123 are not considered locally, regionally, nationally or internationally significant.

Table 2: Wetlands within Lot 123

Unique Feature ID (UFI)	Landform	Wetland Type	Management Category	Area (ha)	Approx. Extent within Lot (ha)
6690	Basin	Dampland	Resource Enhancement	4.22145	0.34638
13969	Basin	Dampland	Resource Enhancement	7.596212	0.53837
6679	Basin	Dampland	Conservation	2.566374	2.566374
15862	Not a wetland	Not a wetland	N/A	0.894903	0.89475
			Totals	**15.278939**	**4.345874**

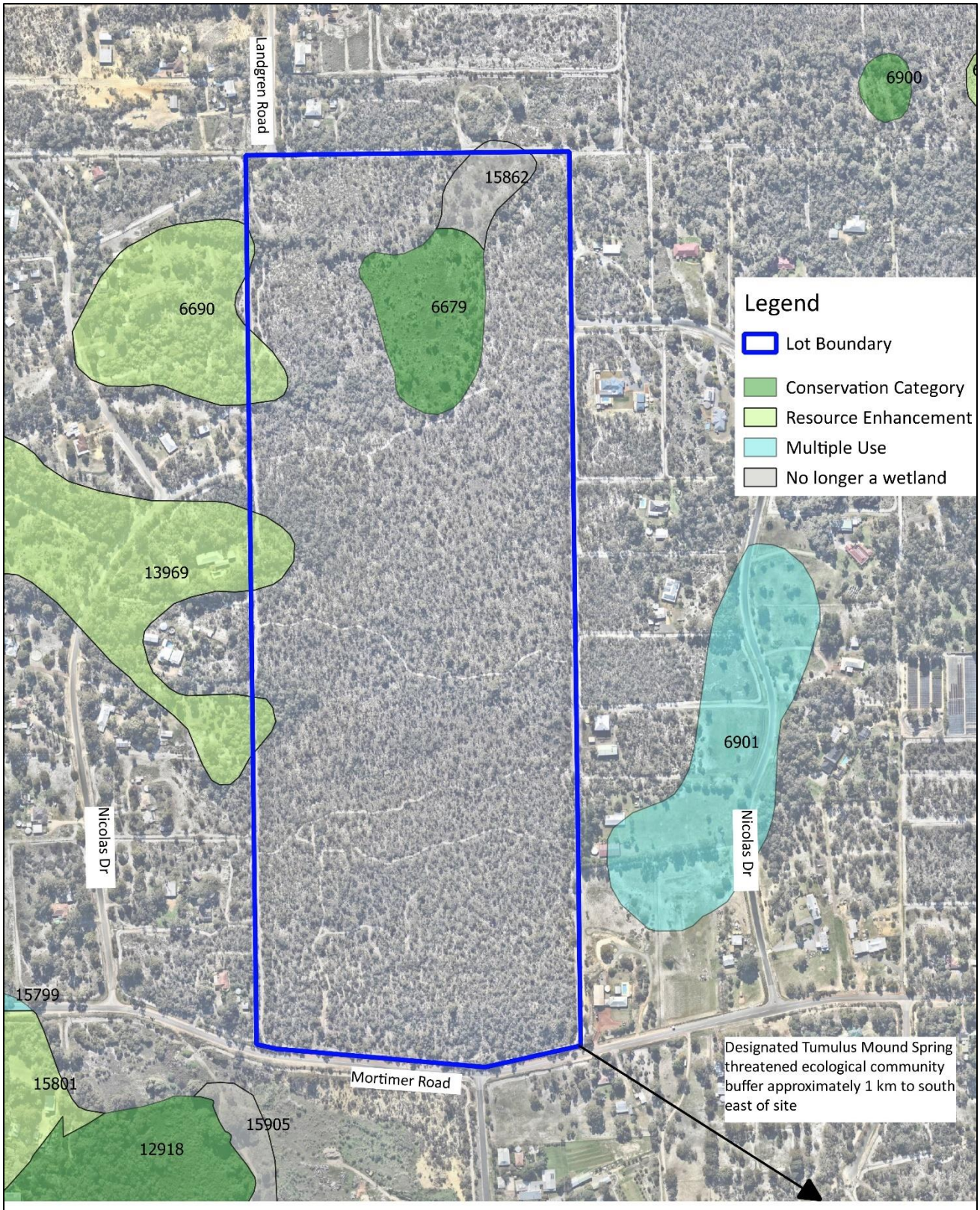

Figure 8:
Designated Wetland Areas as per the Geomorphic Wetlands Dataset
Lot 123 Mortimer Rd, Casuarina

2.3.6 Bush Forever Sites

While Lot 123 is not a designated Bush Forever Site, it is located with 5 km of ten Bush Forever sites (Figure 9):

- Bush Forever Site 67 – Parmelia Ave Bushland, Parmelia, 6.8 ha
- Bush Forever Site 68 – Jackson Road Bushland, 19.3 ha
- Bush Forever Site 70 – Duckpond Bushland, 8.8 ha,
- Bush Forever Site 269 – The Spectacles, 349.7 ha (including lake)
- Bush Forever Site 270 – Sandy Lake and Adjacent Bushland, Anketell, 181.3 ha
- Bush Forever Site 272 – Sicklemore Road Bushland, Parmelia/Casuarina, 84.6 ha
- Bush Forever Site 273 – Casuarina Prison Bushland, Casuarina, 116.9 ha
- Bush Forever Site 348 – Modong Nature Reserve and Adjacent Bushland, Oakford, 242.0 ha
- Bush Forever Site 349 – Leda and adjacent bushland, Leda, 959.8 ha
- Bush Forever Site 353 – Banksia Road Nature Reserve, Wellard, 32.3 ha.

The closest is Site 273, which is approximately 1.5 km to the north-east. All except Site 68 contain some portion of the *Bassendean Complex – Central and South* vegetation complex that is located on Lot 123 (Government of Western Australia, 2000; National Map, 2019).

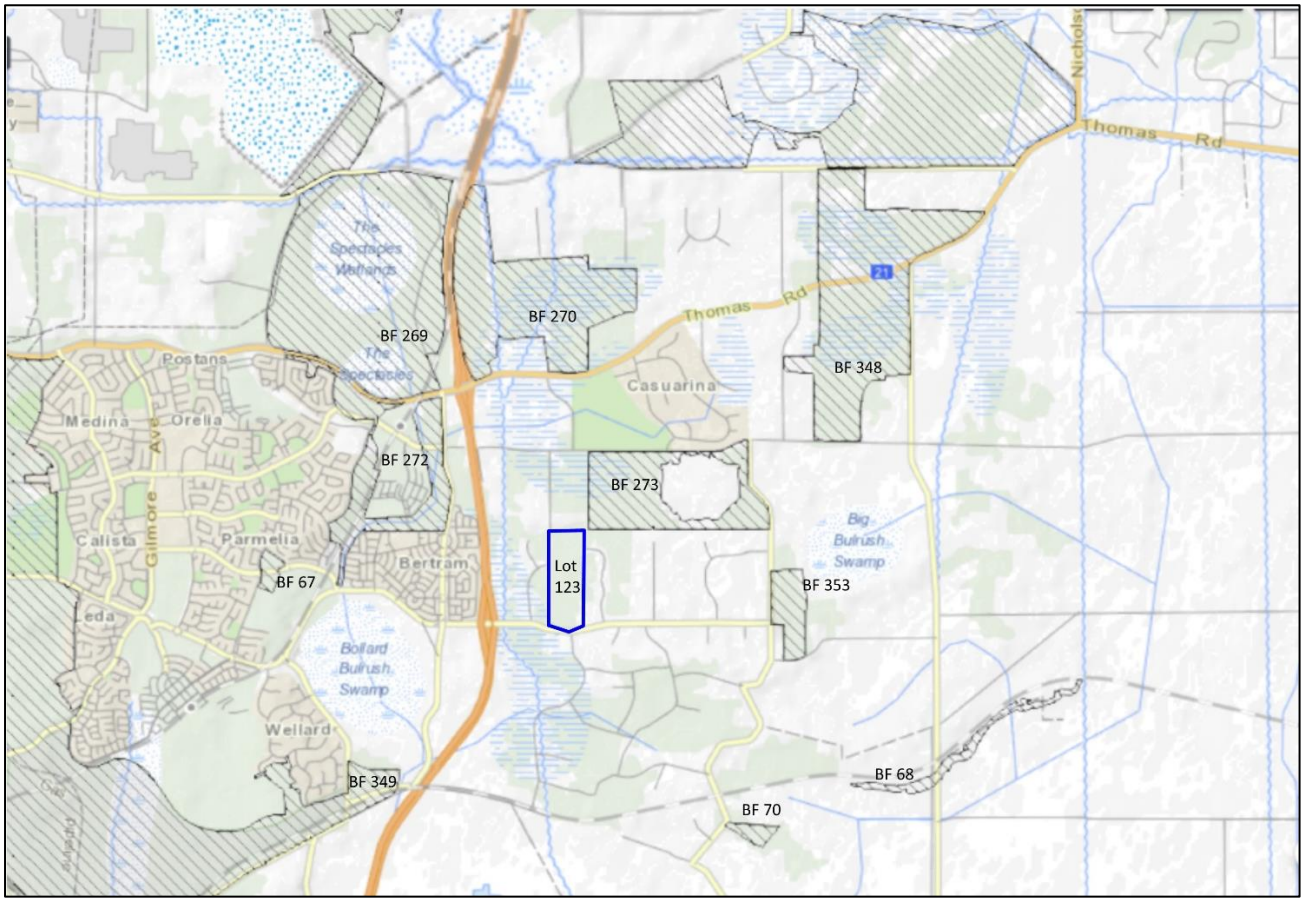

Figure 9: Bush Forever Sites in proximity to Lot 123
(Source: National Map, 2019a)

2.3.7 Vegetation Complex

One vegetation complex, Bassendean Complex – Central and South, is present on site. This complex is typically dominated by Jarrah, Casuarina and *Banksia* species on higher elevations and low woodlands of *Melaleuca* species and sedgelands on lower lying depressions and swamps (Heddle *et al*. 1980) (equivalent to Beard Association 1001). In the Perth area, it includes transitions of *Eucalyptus marginata* (Jarrah) and *Eucalyptus todtiana* (Coastal Blackbutt). Common species on upper slopes include *Banksia attenuata*, *B. menziesii*, and *B. grandis*. Common species in the dampland areas include *Banksia ilicifolia*, *B. littoralis* and *Melaleuca preissiana*. Common shrub species include *Kunzea glabrescens, Hypocalymma angustifolium, Adenanthos obovatus* and *Verticordia* spp. (Heddle *et al*. 1980). All these species except the *B. grandis* and *Verticordia* spp. were found on site during the 2018 flora survey carried out by Natural Area.

2.3.8 Flora and Vegetation

Natural Area undertook an updated flora and vegetation assessment of Lot 123 in during September 2018. That assessment confirmed:

- a total of 219 flora species present from 51 families
- a total of 41 weeds and 178 native flora species
- no priority or threatened flora species were found
- three vegetation types occur within the lot, with Banksia Woodland being the most dominant (Figure 10)
- vegetation across the site ranges from Degraded to Excellent with the majority of the site in Excellent condition (Figure 11)
- the presence of the endangered ecological community 'Banksia Woodlands of the Swan Coastal Plain', covering 37.9 ha (84%) of the site (Figure 10).

When combined with the Bioscience (2006, 2015) survey data, this means a total of 248 species on site, of which 202 are native species and 46 are weeds. A copy of this report is provided in Appendix 1.

2.3.9 Fauna

During the 2018 flora and vegetation assessment, Natural Area also undertook an assessment of habitat utilised by threatened black cockatoos, and recorded sightings of other vertebrate fauna species. The black cockatoo habitat assessment within Lot 123 Mortimer Rd, Casuarina confirmed:

- evidence of foraging by the threatened Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered) and the Forest Red-tailed Black Cockatoos (*Calyptorhynchus banksii naso*) (Vulnerable)
- a total of 28 trees with hollows that are of a suitable size to be utilised for nesting and a further 12 trees that were suitable roosting trees for black cockatoos.

Opportunistic sightings of the Priority 4 Western Brush Wallaby (*Macropus irma*) and diggings of the Priority 4 Southern Brown Bandicoot (*Isoodon fusciventer*) were also recorded during the 2018 spring flora and habitat survey. These will be discussed further in Section 4.3.

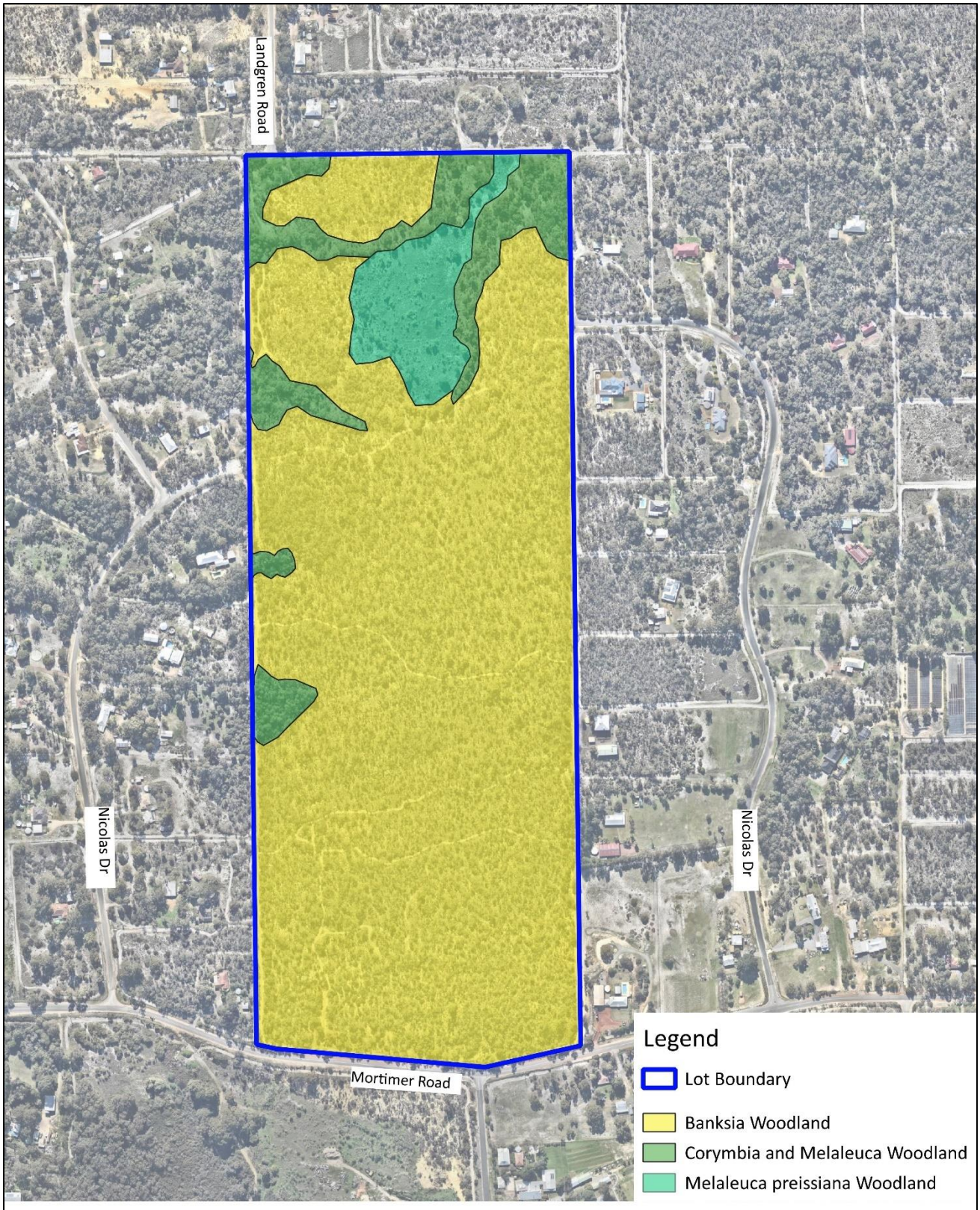

Figure 10:
Vegetation Type
Lot 123 Mortimer Rd, Casuarina

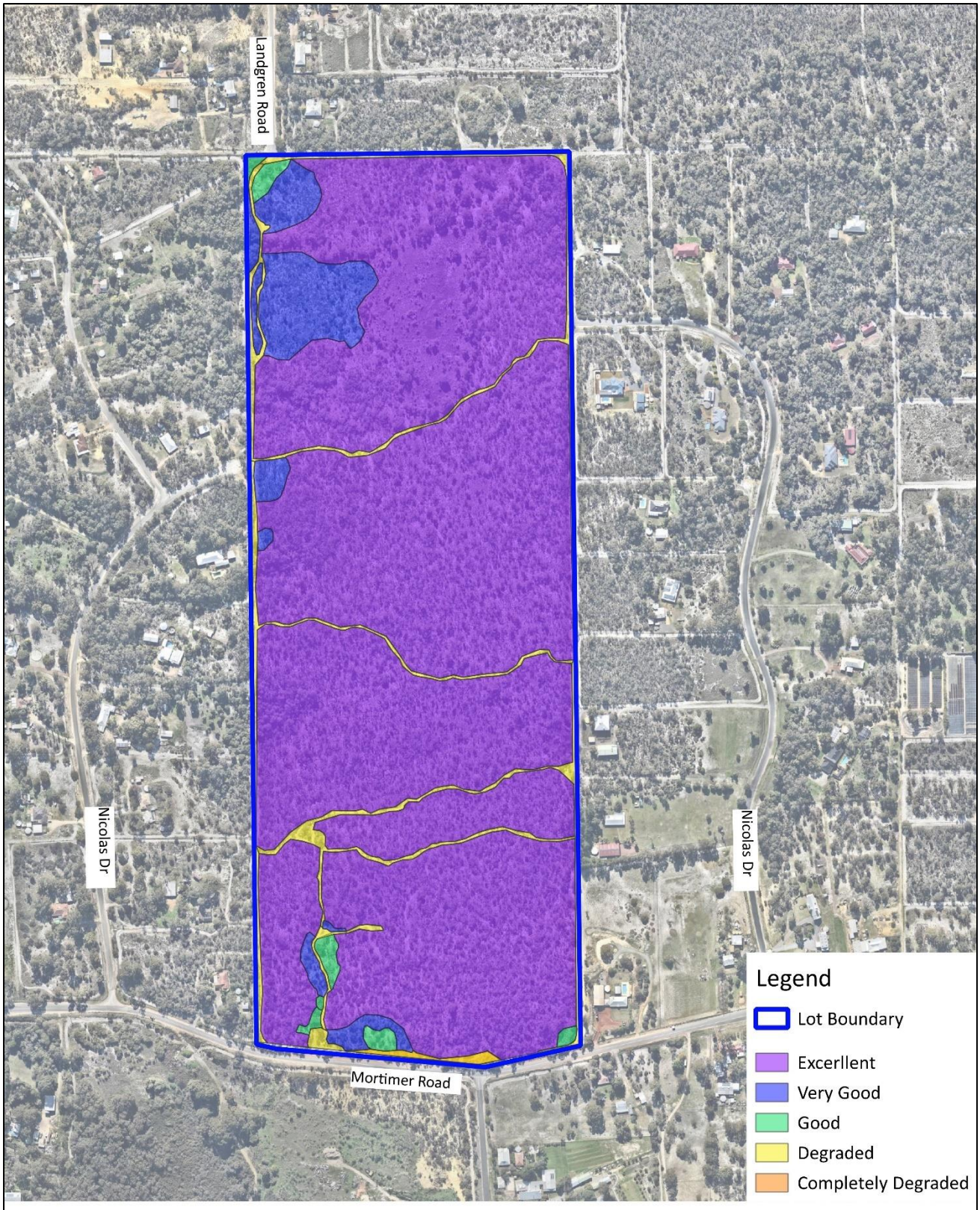

Figure 11:
Vegetation Condition
Lot 123 Mortimer Rd, Casuarina

3.0 Stakeholder Engagement

At present, stakeholder engagement has been limited to discussions with various government agencies and specialist consultants; has been summarised in Table 3. Engagement methodologies have been ad hoc thus far, and have included:

- face-to-face meetings
- direct email
- telephone contact.

Additional stakeholder engagement will come via statutory advertising periods associated with planning and/or environmental approvals processes.

Table 3: Summary of preliminary stakeholder engagement for Lot 123

Stakeholder	Date	Issues/topics Raised	Response/Outcome
Department of the Environment and Energy (DoEE)	21 Dec 2018 02 April 2019	Referral under the EPBC Act 1999 and confirmation that proposed development is a controlled activity	Decision letter – proposal is considered to be a controlled action
Department of Water and Environmental Regulation (DWER) – EPA Services	30 April 2019	Meeting; preliminary discussion relating to most appropriate means of assessing environmental values of the site	Suggested that a planning approach would probably be the most appropriate way forward, and discussions with DPLH recommended
Department of Water and Environmental Regulation (DWER) – EPA Services	16 May 2019	Meeting; advice relating to most appropriate method of quantifying environmental approval requirements for the site	Agreed that a local structure plan that subdivides Lot 123 into two Lots in the first instance would be appropriate. Supporting documents including a review of environmental values and impacts, a local water management strategy and bushfire hazard assessment would be required.
Department of Planning, Lands and Heritage (DPLH)	16 May 2019		
Department of Biodiversity, Conservation and Attractions – Wetlands Branch	15 August 2019	Phone call, advice relating to the presence of wetlands on the site	Acknowledged previous applications made by Bioscience to change boundaries, with limited success. If further advice required, discussion with a DBCA land use planning office may be appropriate

4.0 Environmental Principles and Factors

This section outlines how the principles of environmental protection have been addressed and reviews the environmental factors relevant to the proposed development of Lot 123 for urban development along with outcomes of the assessment methodology applied to each. Based on the EPA advice provided to the Western Australian Planning Commission in response to the MRS Amendment 1117/33 Jandakot Structure Plan Cell 4 – Casuarina Rural to Urban Deferred, Town of Kwinana application, the environmental issues that would need to be addressed at the appropriate time are:

- drainage – management of water quality and quantity
- emissions impacting on adjoining land uses
- **fauna**
- noise and vibration
- **remnant vegetation**
- soil and groundwater contamination
- special catchment requirements – Peel Harvey Catchment
- **wetlands.**

Key factors relevant to Lot 123 (highlighted above) will be discussed in the following sections.

4.1 *Environmental Protection Act* Principles

The Environmental Protection Act 1986 (WA) Principles that need to be considered during the assessment process are provided in Table 4.

Table 4: EP Act principles and how they relate to Lot 123

Principle	Consideration
1. The precautionary principle: *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In application of this precautionary principle, decisions should be guided by:* *a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *b) an assessment of the risk-weighted consequences of various options.*	Lot 123 has been in private ownership for more than 60 years. It is located in an area designated urban development, with the current proposal aiming to progress development in accordance with current zoning and strategic planning. Consideration of the environmental values present on site have been investigated to determine their extent and significance and identify appropriate management strategies that will contribute to minimising and mitigating identified environmental risks. The assessment process has assumed a worst-case scenario approach with the potential clearing of all vegetation on site.
2. The principle of intergenerational equity: *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	Consideration of the broader environmental values in and in proximity to Lot 123 demonstrate that the principle of intergenerational equity has been met through the retention of several wetland and Bush Forever Sites during strategic planning processes that will ensure that the health, diversity and productivity of the environment is maintained and enhanced for

Principle	Consideration
	the benefit of future generations.
3. Principles relating to improved valuation, pricing and incentive mechanisms *(1) Environmental factors should be included in the valuation of assets and services.* *(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing an incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.*	In acknowledging the principles relating to improved valuation, pricing and incentive mechanisms, the strategic planning that has occurred in the Casuarina area in which Lot 123 is located has considered the presence of conservation significant environmental factors in the form of conservation category wetlands, resource enhancement wetlands and Bush Forever sites have been retained. The indicative concept plan for Lot 123 also demonstrates that environmental values will contribute to the future urban planning, with final design subject to discussion with regulators and other stakeholders. In addition, environmental offsets to compensate for the loss of vegetation will result in a net environmental gain.
4. The principle of the conservation of biological diversity and ecological integrity: *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	The principle of conservation of biological diversity and ecological integrity has been considered during the strategic planning process for the Casuarina area with the retention of the various wetland and Bush Forever sites that will enable the conservation of biological diversity in the longer term.
5. The principle of waste minimisation: *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	The principle of waste minimisation is less applicable in the planning stages of this project, however, it is recognised that suitable consideration to this principle will be required during the development phase, such as during civil engineering works and the later construction of buildings.

4.2 Environmental Factor 1 – Flora and Vegetation

4.2.1 EPA Objective

The EPA objective for flora and vegetation is:

> To protect flora and vegetation so that biological diversity and ecological integrity are maintained (EPA, 2018c).

4.2.2 Policy and Guidance

The following policy and guidance documents are relevant to this factor:

- *Environmental Factor Guideline – Flora and Vegetation* (EPA, 2016a)
- *Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA)*, (EPA, 2018a)
- *Instructions on how to prepare an Environmental Review Document* (EPA, 2018b)
- *Perth and Peel @3.5 Million – Environmental Impacts, Risks and Remedies* (EPA, 2015)
- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b)
- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2018c).

1. Instructions on how to Prepare an Environmental Review Document

This guideline provides instructions and a template for the structure of the environmental review document, including its contents, tables and figures. Note that this guideline is relevant to all factors but is discussed in this section only to avoid repetition.

2. Statement of Environmental Principals, Factors and Objectives

This guideline indicates how the EPA will:

- consider the objectives and principles of the *Environmental Protection Act 1986* (WA)
- the use of environmental factors and objectives to assist with the impact assessment process and the determining of significant impacts
- consideration of the significance of identified impacts when determining whether to assess a proposal or scheme, and if it can be implemented
- consideration of the holistic nature of the environment in addition to the significant impacts associated with the project.

Note that this guideline is relevant to all factors but is discussed in this section only to avoid repetition.

3. Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA)

This guideline and its associated documents detail the data requirements and submission process for supporting electronic data collected during the survey/assessment activities (IBSA data packages) that must be supplied to the EPA as part of the assessment process. Note that this guideline is relevant to all factors but is discussed in this section only to avoid repetition.

4. Perth and Peel @ 3.5 Million – Environmental Impacts, Risks and Remedies

This interim advice document recognises the need for balance between maintaining environmental values in the longer term whilst also considering the implications of development in the region. Several recommendations are provided that highlight the need for greater protection of regionally significant areas whilst also working towards a liveable and sustainable city. Note that this advice document is relevant to all factors but is discussed in this section only to avoid repetition.

5. Environmental Factor Guideline – Flora and Vegetation

This guideline outlines how flora and vegetation will be considered by the EPA during the impact assessment process, including:

- application of the mitigation hierarchy
- flora and vegetation that will be affected by the proposal or scheme
- potential impacts from various proposal activities
- required surveys and analyses
- significance of the flora and vegetation
- current state of knowledge relating to the flora and vegetation and the level of confidence underpinning the predicted residual impacts.

6. Technical Guidance – Flora and Vegetation Surveys for EIA

This guidance document indicates the minimum requirements for flora and vegetation surveys to ensure that sufficient and adequate data is provided to the EPA to enable an assessment of impacts. Advice provided includes:

- desktop review and survey preparation activities
- the type of survey
- survey design and sampling techniques
- data analysis and reporting.

The survey undertaken by Natural Area Consulting Management Services (2018) was undertaken in accordance with this guideline.

4.2.3 Surveys and Assessments of Flora and Vegetation

The following survey and assessments of flora and vegetation have been undertaken at Lot 123 Mortimer Road:

- Lot 123 Mortimer Road Flora and Vegetation Survey and Black Cockatoo Habitat Assessment (Natural Area, 2018)
- Vegetation and Black Cockatoo Assessment – Lot 123 Mortimer Road Casuarina (Bioscience, 2015); note that this report also includes information relating to a 2008 flora survey also undertaken by Bioscience.

1. Natural Area 2018 Survey

The Natural Area (2018) survey incorporated the Bioscience (2015) data, thus it represents the outcomes of three separate surveys of Lot 123 and considers the current guidance and information relating to flora and vegetation, including listing information of threatened and priority listed species and ecological communities under the *Biodiversity Conservation Act 2016* (WA) and/or the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). The assessment was carried out during spring by a botanist/zoologist with more than ten years' experience carrying out flora, vegetation and fauna surveys on the Swan Coastal Plain. The site assessment involved the installation of three 10 m x 10 m quadrats in each of the three vegetation types, and confirmed:

- a total of 219 flora species present from 51 families
- a total of 41 weeds and 178 native flora species
- no priority or threatened flora species were found
- three vegetation types occur within the lot, with Banksia Woodland being the most dominant (Figure 10, page 25)
- vegetation across the site ranges from Degraded to Excellent with the majority of the site in Excellent condition (Figure 11, page 26)

- the presence of the ecological community 'Banksia Woodlands of the Swan Coastal Plain', covering 37.9 ha (84%) of the site (Figure 10) that is listed as Endangered under the EPBC Act 1999, and Priority 3 under the *Biodiversity Conservation Act 2016* (WA).

When combined with the Bioscience 2015 survey data, this means a total of 248 species on site, of which 202 are native species and 46 are weeds.

The methodology applied during the survey, results, floristic analysis and implications of the results are discussed in the survey report which is provided at Appendix 1.

2. Bioscience 2015 Survey

Bioscience undertook an assessment of flora and vegetation within Lot 123 in 2008 and again in 2015, with outcomes of both included in their 2015 report. The survey was undertaken in accordance with previous EPA Guidance information with the installation of two quadrats per vegetation type rather than the three as per current guidelines. The methodology, results, and implications of their results are provided at Appendix 2.

4.2.4 Receiving Environment

Lot 123 represents the receiving environment as it relates to flora and vegetation.

4.2.5 Potential Impacts

Depending on the final design for the development, the proposal will result in the following:

- direct clearing of between 35.5 and 45 ha of native vegetation
- direct clearing of up to 38 ha of the endangered ecological community Banksia Woodland of the Swan Coastal Plain listed under the EPBC Act 1999 (Cwlth); this community is listed as Priority 3 under the Biodiversity Conservation Act 2016 (WA)
- no impact to threatened or priority flora listed under the *Biodiversity Conservation Act 2016* (WA)
- no impact to threatened flora listed under the EPBC Act 1999 (Cwlth)
- fragmentation
- cumulative impacts.

4.2.6 Assessment of Impacts

1. Clearing of Native Vegetation

The pre-European extent of the Bassendean Complex – Central and South vegetation complex remaining for the Swan Coastal Plain is 21.38% (11 394.19 ha), and for the City of Kwinana local government area, there is 37.18% (1 745.29 ha) remaining (Government of Western Australia, 2019). In terms of the loss of vegetation from Lot 123, this means between that 0.31% and 0.39% of the remainder on the Swan Coastal Plain, and between 2.0% and 2.6% of that remaining within the City of Kwinana.

In its final form, the urban development of Lot 123 will result in the loss of between 35.5 and 45 ha of Bassendean Complex – Central and South vegetation complex. While this loss is not ideal from a biodiversity protection perspective, that ideal needs to be balanced against the need for urban development to support a growing population within the Perth metropolitan area. A review of strategic planning documents for the Casuarina area in which Lot 123 indicates that the site is zoned urban development, so there is some recognition that there will be a loss of vegetation to enable those needs to be met. Within a 5 km radius of Lot 123, there are ten Bush Forever sites that are also Bassendean Complex – Central and South, and which

will allow for the retention of this vegetation unit well into the future. On this basis, the loss of native vegetation from Lot 123 will not be significant at a regional or local scale.

2. Banksia Woodland of the Swan Coastal Plain Ecological Community

The Banksia Woodland of the Swan Coastal Plain ecological community was listed as endangered under the EPBC Act 1999 in September 2016 and has been a Priority 3 listed in Western Australia for several years. Urban development activities within Lot 123 will result in the loss of up to 38 ha of this ecological community. The rationale for the loss of an area of this ecological community is the same as that provided for the clearing of native vegetation.

3. Conservation Significant Flora

The flora and vegetation surveys carried out by Natural Area (2018), and Bioscience (2015) in 2008 and 2015 recorded no threatened flora species listed at a state and Commonwealth level, nor any priority species listed at a state level. Accordingly, there will be no direct impacts to conservation significant flora species.

4. Fragmentation

Fragmentation of vegetation occurs when pockets remain in amongst cleared areas, become isolated and increasingly prone to degradation through edge effects. The clearing of Lot 123 will result in increased fragmentation within vegetation on site in surrounding areas. This will be an unavoidable impact associated with urban development, the rationale for which is the same as that for the clearing of native vegetation.

5. Cumulative Impacts

Cumulative impacts in relation to Lot 123 is unlikely to be an issue due to consideration of the vegetated nature of the site when undertaking strategic planning processes and zoning the site as urban development. The Lot has been in private ownership for more than 60 years and has been vegetated for all that time. Clearing of some or all this vegetation will be required to support urban development of the site.

4.2.7 Mitigation

Lot 123 is a legacy site due to the single owner for more than 60 years. This situation means that the value of the environmental assets on the Lot have changed during that period of ownership, from land that was considered in the 1960s to have little intrinsic value with respect to the recognition of a threatened ecological community and the designated conservation category wetland in the current environmental and planning approvals climate. It is recognised that these values must be considered when progressing the urban development of the site and that need to clear much if not all of the vegetation to accommodate that development. With that need to clear the vegetation present it is difficult to avoid impacts on site, and it will also be difficult to minimise the level of clearing required. The most likely mitigation measure in this instance is offset site or a conservation covenant and will be discussed further in Section 5.0.

4.2.8 Predicted Outcome

The development of Lot 123 will result in the unavoidable clearing of between 35.5 and 45 ha of native vegetation, much of which is also recognised as being the ecological community Banksia Woodland of the Swan Coastal Plain. The residual impact associated with this clearing is the retention of similar vegetation in ten Bush Forever sites and several other vegetated areas in proximity to the site. An offset site or a conservation covenant is likely to be required as an approval condition.

4.3 Environmental Factor 2 – Terrestrial Fauna

Terrestrial fauna was also identified as an issue that would need to be addressed in the advice the EPA provided to the WA Planning Commission in 2006. Since that initial advice was given, the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) have been listed as threatened species under both the state and Commonwealth legislation.

4.3.1 EPA Objective

The EPA Objective for terrestrial fauna is:

> To protect terrestrial fauna so that biological diversity and ecological integrity are maintained (EPA, 2018c).

4.3.2 Policy and Guidance

The following policies and guidance are relevant to this factor:

- *Environmental Factor Guideline – Terrestrial Fauna* (EPA, 2016c)
- *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna* (EPA, 2016d)
- *Technical Guidance – Terrestrial Fauna Surveys* (EPA, 2016e)
- *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species: Carnaby's Cockatoo, Baudin's Cockatoo and Forest Red-tailed Black Cockatoo* (Department of Sustainability, Environment, Water, Population and Communities, 2012).

1. Environmental Factor Guideline – Terrestrial Fauna

This guideline outlines how terrestrial fauna will be considered by the EPA during the impact assessment process, including:

- application of the mitigation hierarchy
- fauna that will be affected by the proposal or scheme
- potential impacts from various proposal activities
- required surveys and analyses
- significance of the risks to the fauna
- current state of knowledge relating to the fauna and the level of confidence underpinning the predicted residual impacts.

The key fauna species that need to be considered in relation to Lot 123 relates to the presence of habitat suitable for use by the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) which are listed as threatened under the *Biodiversity Conservation Act 2016* (WA) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). Natural Area undertook an assessment of habitat suitable for these species during the flora and vegetation survey carried out in 2018 that updated the assessment carried out by Bioscience in 2015.

2. Technical Guidance – Terrestrial Fauna Surveys

This guidance document indicates the standards and protocols for terrestrial fauna surveys to ensure that sufficient and adequate data is provided to the EPA to enable an assessment of impacts. Advice provided includes:

- survey planning and preparation activities
- determining the type of survey required

- survey design and sampling techniques
- data analysis and reporting.

The assessment of fauna undertaken by Natural Area was undertaken in accordance with this guideline.

3. Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna

This guidance document has the aim of provided information on standards and protocols for terrestrial fauna surveys to ensure that sufficient and adequate date is provided to the EPA to enable an assessment of impacts. Advice provided in the document includes:

- pre-survey protocols
- determining the level of survey required
- identifying the appropriate sampling technique for specific fauna species
- survey design
- data analysis and reporting.

The assessment of fauna undertaken by Natural Area was undertaken in accordance with this guideline.

4. EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species

As one of the key threatening processes contributing to the decline of black cockatoo species is the clearing of large trees with or having the potential to produce hollows of a suitable size for nesting and the loss of foraging habitat, the EPBC Act Referral Guidelines provide advice relating to assessing the suitability of habitat for use by these species. This includes consideration of the size of tree and the potential to produce hollows, the presence of any hollows and their size, the area of vegetation to be affected, and the presence of known flora species preferred as feeding sources. The black cockatoo habitat assessment undertaken out by Natural Area (2018) was carried out in accordance with this guideline.

4.3.3 Studies and Surveys

A review of the NatureMap Species Report using a 2 km search radius obtained ahead of the flora and vegetation survey and black cockatoo habitat assessment indicated the potential presence of:

- 75 birds, including the threatened Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*); while the Priority 4 listed Blue-billed Duck (*Oxyura australis*) was listed as possibly utilising the site, this is considered unlikely as there is no open water on site
- two mammals, namely the Priority 4 listed Southern Brown Bandicoot (*Isoodon fusciventer*) and the Western Brush Wallaby (*Macropus irma*).

Note that the NatureMap Species Report did not include any information relating to the presence of reptiles; a copy of this report is included in Appendix 1 of the *Lot 123 Mortimer Road Flora and Vegetation and Black Cockatoo Habitat Assessment* report prepared by Natural Area (2018) (Appendix 1).

A Protected Matters Search Tool Report using a 2 km search radius was obtained at the same time from the Department of Environment and Energy, with potential species that are listed as matters of national environmental significance (MNES) listed under the EPBC Act 1999 (Cwlth) and their likelihood summarised in Table 5. A copy of the PMST report is provided in Appendix 2 of Natural Area (2018).

Table 5: EPBC Act listed threatened species

Scientific Name	Common Name	Status	Likelihood
Botaurus poiciloptilus	Australasian Bittern	Endangered	Unlikely, habitat unsuitable
Calidris canutus	Red Knot	Endangered	Unlikely, marine species, habitat unsuitable
Calidris ferruginea	Curlew Sandpiper	Critically endangered	Unlikely, marine species, habitat unsuitable
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	Vulnerable	Likely, habitat suitable
Calyptorhynchus baudinii	Baudin's Cockatoo	Endangered	Unlikely, tends to occur further south of the Perth area
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered	Likely, habitat suitable
Westralunio carteri	Carter's Freshwater Mussel	Vulnerable	Unlikely, no open water on site
Dasyurus geoffroii	Chuditch	Vulnerable	Unlikely, probably locally extinct
Leipoa ocellata	Malleefowl	Vulnerable	Unlikely, no records from this area
Numenius madagascariensis	Eastern Curlew	Critically endangered	Unlikely, marine species, habitat unsuitable
Rostratula australis	Australian Painted-snipe	Endangered	Unlikely, marine species, habitat unsuitable
Pseudocheirus occidentalis	Western Ringtail Possum	Critically endangered	Unlikely, habitat not suitable, pre

A threatened fauna database search was requested from the Department of Biodiversity, Conservation and Attractions ahead of the survey activities undertaken by Natural Area in 2018, with only the Carnaby's Cockatoo indicated within Lot 123. All other species provided in that search were a minimum of 600 m from the Lot 123 boundary.

Based on the available information relating to fauna, the Natural Area 2018 survey effort focussed on assessing the suitability of the site as quality habitat for use by Black Cockatoos; this survey updated the one carried out by Bioscience in 2015. The habitat assessment was carried out in accordance with EPBC Act Guidelines (DSEWPaC, 2012), with outcomes included in Natural Area's 2018 report (Appendix 1). Outcomes were consistent with those of Bioscience (2015), whose report is included in Appendix 2. Reptile species are likely to be present at the site, including snakes and several lizard species.

During the 2018 assessment activities, Natural Area biologists also noted the presence of the Priority 4 listed Southern Brown Bandicoot (*Isoodon fusciventer*) and the Western Brush Wallaby (*Macropus irma*). The bandicoot is likely to be part of permanent population on the site, note that there several recordings of this species in nearby areas in the DBCA threatened fauna database search results. The Western Brush Wallaby is likely to be a transient visitor to the site rather than a resident, moving from one bushland area to another in the broader area surrounding Lot 123.

4.3.4 Receiving Environment

The three vegetation types identified by Natural Area (2018) and Bioscience (2015) represent the receiving environment as it relates to fauna.

4.3.5 Potential Impacts

As clearing occurs to support the planned urban development, the fauna species supported by the vegetation will be directly impacted via:

- clearing of between 35.5 and 45 ha of native vegetation that provides a range of habitats for fauna
- fragmentation of habitat
- injury or mortality of species during clearing, presence of an increased number of vehicles, and/or the increased presence of predators.

4.3.6 Assessment of Impacts

1. Clearing of Vegetation

Given the strategic planning activities that have occurred within the Casuarina area where Lot 123, along with its zoning for urban development, it is recognised that some impacts to fauna species as a result of clearing will be necessary, and thus is unavoidable. While the assessment of black cockatoo habitat carried out by Natural Area (2018) confirmed the site was in largely in excellent condition and included several flora species suitable for feeding by the Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, the evidence of foraging by both species was limited to five locations. This suggests that while there are suitable food sources available at the site, it is not an essential food source as there are numerous areas of remnant bushland with similar species within 5 km of Lot 123.

A total of 28 trees had hollows of a size suitable for nesting by black cockatoos, with no evidence of this in the form of scratching or signs of use around the hollow. Again, the presence of similar habitat in proximity to the site suggests there are suitable alternatives within the immediate area, including Bush Forever Site 273 to the north-east which is associated with Casuarina prison, thus is fenced and provides some additional protection from predators. Accordingly, expected impacts to black cockatoos are not likely to be significant.

The bandicoot presence is likely to be a small permanent population, with the level of impact directly related to the amount of clearing that will take place on the site. If the northern area in the vicinity of the designated conservation category wetland is retained, then impacts to this population are likely to be minimal. If the entire site is cleared to accommodate the proposed urban development, then the bandicoot habitat will be lost, and the population displaced as a minimum. Trapping and relocating of the bandicoot and reptiles on site is a possible mitigation activity.

Impacts to the Western Brush Wallaby are likely to be minimal as this species is more likely to be a transient visitor moving between vegetated areas rather than being a permanent inhabitant of the site.

2. Habitat Fragmentation

Depending on the amount of vegetation to be cleared within Lot 123, there is the potential for the retention of small vegetated patches that will be increasingly prone to edge effects such as weed encroachment and greater accessibility to predators such as foxes and cats. The presence of several vegetated remnants in the area surrounding Lot 123 is expected to mitigate against the significance of this impact.

3. Cumulative Impacts

Cumulative impacts in relation to presence of fauna within Lot 123 is unlikely to be an issue due to consideration of the vegetated nature of the site when undertaking strategic planning processes and zoning the site as urban development. The Lot has been in private ownership for more than 60 years and has been vegetated for all that time. Clearing of some or all this vegetation will be required to support urban development of the site. An assessment of the value of the habitat for use by black cockatoos suggest the site is not an important one for feeding or roosting with little evidence of feeding despite the present of suitable foraging species and no evidence of nesting despite the presence of hollows that are of suitable size.

4.3.7 Mitigation

As previously indicated, Lot 123 is a legacy site due to the single owner for more than 60 years. This situation means that the value of the environmental assets on the Lot have changed during that period of ownership, from land that was considered in the 1960s to have little intrinsic value to recognition of a threatened ecological community, some usage by threatened fauna species, and the conservation wetland in the current environmental and planning approvals climate. It is recognised that these values must be considered when progressing the urban development of the site and that need to clear much if not all of the vegetation to accommodate that development. With that need to clear the vegetation present, it is difficult to avoid impacts on site and it will also be difficult to minimise the level of clearing required. The most likely mitigation measure in this instance is offset site or a conservation covenant and will be discussed further in Section 5.0.

4.3.8 Predicted Outcome

Based on the available information the impact to fauna species, including the threatened black cockatoo species, within Lot 123 is likely to be Low.

4.4 Environmental Factor 3 – Inland Water (Wetlands)

The presence of wetlands was identified as an environmental factor that would need to be addressed by the Environmental Protection Authority in 2006 when it provided a response to the WA Planning Commission in relation to the MRS Amendment 1117/33 application.

4.4.1 EPA Objective

The EPA objective for wetland areas is:

> To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (EPA, 2018c).

4.4.2 Policy and Guidance

The following guideline documents are relevant to this factor:

- *Environmental Factor Guideline – Inland Waters* (EPA, 2018f)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ, 2000).

1. Environmental Factor Guideline – Inland Waters

This guideline provides an overview of:

- how the inland waters is considered by the EPA during the EIA process
- the objective of the factor and how it links to other factors
- the environmental values supported by or dependent on inland waters
- identifies activities that can impact on inland waters
- the type of information that may be required by the EPA to support the EIA process.

2. Fresh and Marine Water Quality Guidelines

This guideline outlines the recommended management framework for applying the water quality guidelines to natural, semi-natural and constructed marine and freshwater bodies within Australia and New Zealand. It provides a summary of typical water quality parameters and their nominated normal range for many water bodies that assist with monitoring and ongoing management.

The application of this guideline to wetlands at Lot 123 has been considered by Natural Area (2019) when preparing the Local Water Management Strategy, and by Bioscience when undertaking water quality monitoring activities between 2010 and 2014 (Keating, 2019).

4.4.3 Wetland Assessments

A review of the Geomorphic Wetlands of the Swan Coastal Plain Dataset available via DataWA (2019) and NationalMap (2019) indicates the presence of one designated wetland that occurs within the Lot 123 boundary, two that extend a short distance into the Lot from the west, and one that is no longer considered to be a wetland (Table 6).

Table 6: Wetlands within Lot 123

Unique Feature ID (UFI)	Landform	Wetland Type	Management Category	Area (ha)	Approx. Extent within Lot (ha)
6690	Basin	Dampland	Resource Enhancement	4.22145	0.34638
13969	Basin	Dampland	Resource Enhancement	7.596212	0.53837
6679	Basin	Dampland	Conservation	2.566374	2.566374
15862	Not a wetland	Not a wetland	N/A	0.894903	0.89475
			Totals	**15.278939**	**4.345874**

All are described as damplands, which are seasonally waterlogged areas that are saturated with water without the presence of seasonal surface water. This type of wetland is subject to the natural rise and fall of groundwater between warmer and cooler months, with maximum groundwater levels typically occurring around September – October after winter rainfall has infiltrated into the aquifer, bringing the groundwater table close the natural ground level (Figure 12).

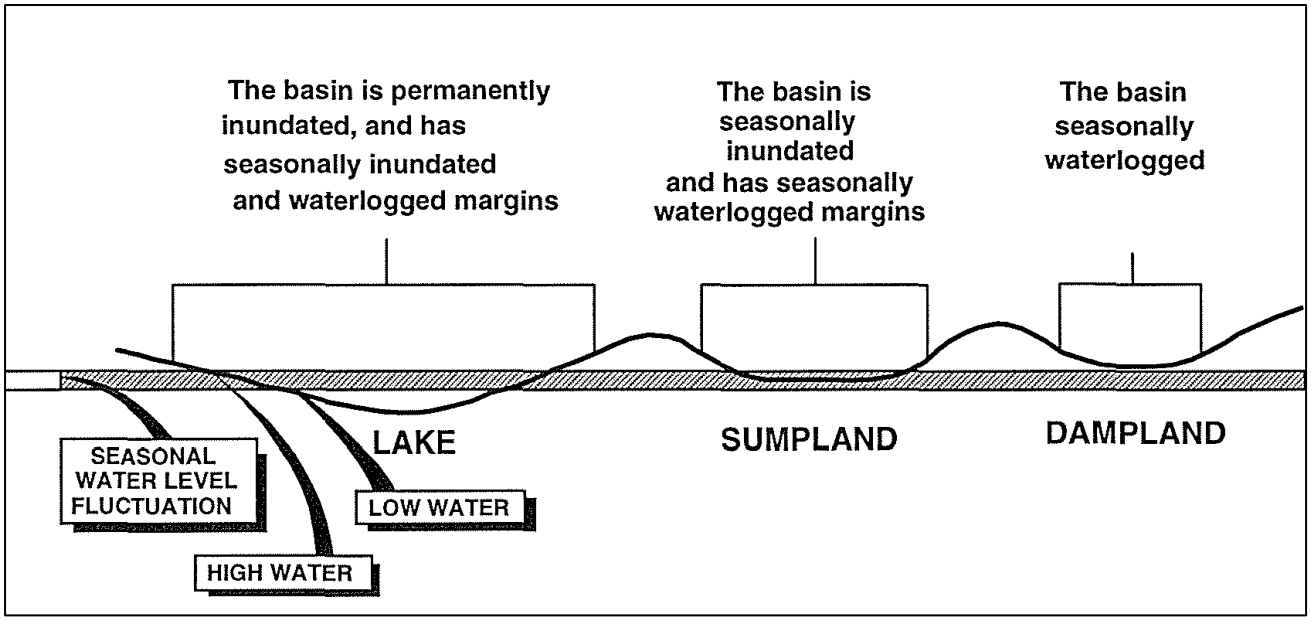

Figure 12: Wetland zones in relation to water level fluctuation
(Source: Hill, Semeniuk, Semeniuk and Del Marco, 1996)

1. Conservation Category Wetland

Requests to modify the extent and classification of the conservation category wetland (UFI 6679) on Lot 123 was undertaken by Bioscience after completing detailed reviews of the vegetation within the designated conservation category wetland, along with a drilling program to investigate the soil profile, depth to groundwater, and other hydrological features (2006 and 2011; copies of reports provided in Appendix 3 and 4). The maximum depth to groundwater was determined to be 1.5 m below the natural surface level, with the Perth Groundwater Map (DWER, 2019) indicating the depth of the water table is 2 m below the surface. Department of Water long term monitoring bores maintained by the then Department of Environment indicated a trend of increasing depth to groundwater over time.

Given the accepted description of a dampland is a wetland that is subject to seasonal waterlogging, it is questionable that this definition can apply on the basis of the known depth to groundwater as determined by Bioscience (2011; Keating 2019), and which is consistent with DWER (2019) data. This depth to groundwater is three times the minimum distance of 500 mm to allow a suitable clearance between the finished floor level the 100 ARI storm event (Department of Water, 2004 – 2007; Natural Area, 2019). The assessment process carried out by Bioscience resulted in a modification to the accepted boundary of the conservation category wetland reducing its extent, with the area no longer considered to be a wetland designated UFI 15862 (Table 6).

2. Resource Enhancement Wetlands

Resource enhancement wetlands are described as those that may have been partially modified but still support substantial ecological attributes and functions (Department of Biodiversity, Conservation and Attractions, 2019b). The Geomorphic Wetlands of the Swan Coastal Plain Dataset indicates that the eastern extremities of two wetlands identified by Hill *et al* (1996) are present along the western boundary of Lot 123. The resource enhancement designation indicates that the wetlands have been modified, but 'substantial' ecological attributes and functions are present. For those portions of UFIs 6690 and 13969 located within Lot

123, there has been significant modification to the areas within the accepted boundaries as indicated on the database due to the requirement to comply with the requirements of the *Bushfires Act 1954* (WA) to have a cleared firebreak of at least 3 m around the perimeter of the Lot; modifications to the wetland values have also occurred on neighbouring properties to the west through clearing to support rural residential development (Figure 13).

Figure 13: Modifications to resource enhancement wetland, Lot 123 and neighbour to the west

Observations during site assessment activities carried out by Natural Area (2018, 2019) suggest that the resource enhancement category assigned to the wetlands considered to extend into Lot 123 along the western boundary are no longer applicable due to the extent of modifications that have occurred through clearing and other development activities. The vegetation within Lot 123 is Marri, which can tolerate moist but not wet conditions with them typically being located adjacent to seasonal damplands, indicating a transition area between wetland and dryland conditions. No formal assessment of the extent of the resource enhancement wetland areas (UFI 6690 and 13969) has been undertaken, thus there has been no formal request to the DBCA to modify their extent and/or classification.

3. Tumulus Mound Springs

Tumulus Mound Springs are a threatened ecological community that is characterised by a continuous discharge of groundwater in locations with areas of raised peat that provide a range of microhabitats that are permanently moist (Department of Environment and Conservation, 2005). A DBCA database search of threatened and priority listed ecological communities for the area surrounding Lot 123 indicated that a Tumulus Mound Spring area is located approximately 3 km to the south-east, with the boundary of the 2 km buffer approximately 1 km to the south east (Figure 8, page 22, off map). As groundwater generally flows to the west combined with the installation of drainage in proximity to Lot 123, impacts to this community are unlikely (Walker, 2019, personal communication).

4. Groundwater

Hydrological investigations carried out by Bioscience (2011) to support the application to reclassify the conservation category wetland in the northern portion of Lot 123 indicated that minimum depth to groundwater is 1.5 m; investigations included a drilling program to determine the lithological profile and the depth to groundwater. Bioscience also undertook a review of depth to groundwater data in nearby monitoring bores maintained by the Department of Water indicated an increasing depth to groundwater below the natural surface level over time.

A series of water quality monitoring bores were installed by Bioscience across the site several years ago, with monitoring data collected for a range of parameters between 2010 and 2014 (Table 7). Results indicate that the water is acidic and in the fresh-brackish range. Phosphate levels are variable but within guideline levels on average. Nitrogen levels, particularly nitrate, is more variable with most of the results being within the acceptable range; the exception is associated with one of the monitoring bores for unknown reasons. Iron readings are higher than guideline levels and are probably associated with the acidic nature of the water. Sulphate and chloride are both within the acceptable range.

Table 7: Summary of water quality sampling results

Parameter	Guideline Values[1,2]	Mean	Median	Std Dev	Max	Min	No. Samples
EC (mS/cm)	0.3 - 1.5	0.86	0.81	0.59	3.50	0.21	50
pH	6.5 - 8.5	4.65	4.40	0.67	5.99	3.83	50
Total P (mg/L)	0.2 mg/L	0.05	0.00	0.11	0.56	0.00	45
PO_4-P	0.03 mg/L	0.02	0.00	0.04	0.18	0.00	40
Total N (mg/L)	2.0 mg/L	0.31	0.02	0.26	1.06	0.01	40
NH_4-N (mg/L)	0.04 mg/L	0.33	0.17	0.35	1.34	0.00	40
NO_3-N (mg/L)	0.1 mg/L	0.48	0.02	1.44	7.00	0.00	40
Fe (mg/L)	0.2 mg/L (3)	8.42	2.23	12.01	47.26	0.01	40
SO_4 (mg/L)	5000 mg/L (5)	195.65	140.62	183.99	870.65	12.46	33
Cl (mg/L)	2500 mg/L (5)	98.73	70.73	93.16	380.84	0.00	33

Source: Keating, 2019 1: ANZECC guidelines, 2: Department of Health domestic non-potable groundwater use guides

When further subdivision of Lot 123 is planned, the location and maintenance status of the monitoring bores will be reviewed, with any repairs carried out and/or the installation of replacement bores. The water quality monitoring program will also be reviewed and discussed with the City of Kwinana and Department of Water and implemented ahead of the development of an updated LWMS or Urban Water Management Plan, as appropriate. The acidic nature of the water mean that it is probably not suitable for use on gardens, lawns and landscaped areas.

5. Drinking Water Source Protection Area

Lot 123 is located on the Jandakot Mound, a major unconfined aquifer located south of the Swan River. Water from this mound contributes to Perth drinking water supplies, with the site being approximately 400 m to the south east of priority 1 and priority 2 (P1 and P2) Drinking Water Source Protection Areas associated with the Jandakot Land Use and Water Management Strategy 1995) (Figure 14). As groundwater flow is towards to the west, development of Lot 123 is unlikely to impact on source protection areas.

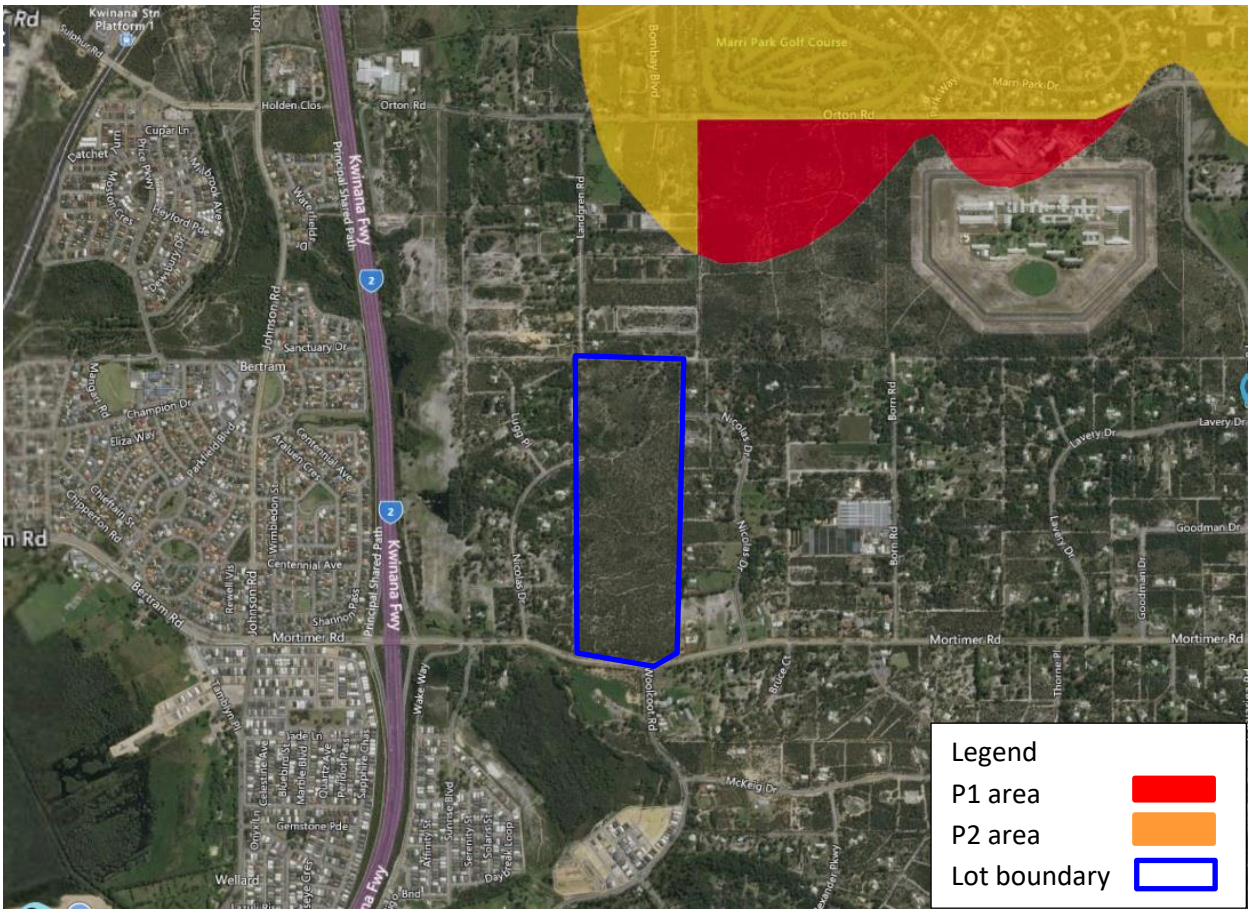

Figure 14: Drinking Water Source Protection Areas
(Source: National Map, 2019b)

6. Acid Sulphate Soils

A review of acid sulfate soil (ASS) mapping held by the Department of Water and Environmental Regulation (DWER) (Data WA, 2019), the majority of the site is shown as having a moderate - low risk of ASS occurring within 3 m of the natural soil surface, with a high – moderate risk of ASS at depths below 3 m. Portions of the site that are in locations designated as wetlands are shown as having a high to moderate risk of ASS within 3 m of the natural soil surface. (Figure 15)

Field testing of pH and pH after oxidation was carried out by Bioscience to support an application to modify the classification of the conservation category wetland in the northern portion of the Lot, with no evidence of ASS noted (Bioscience 2011).

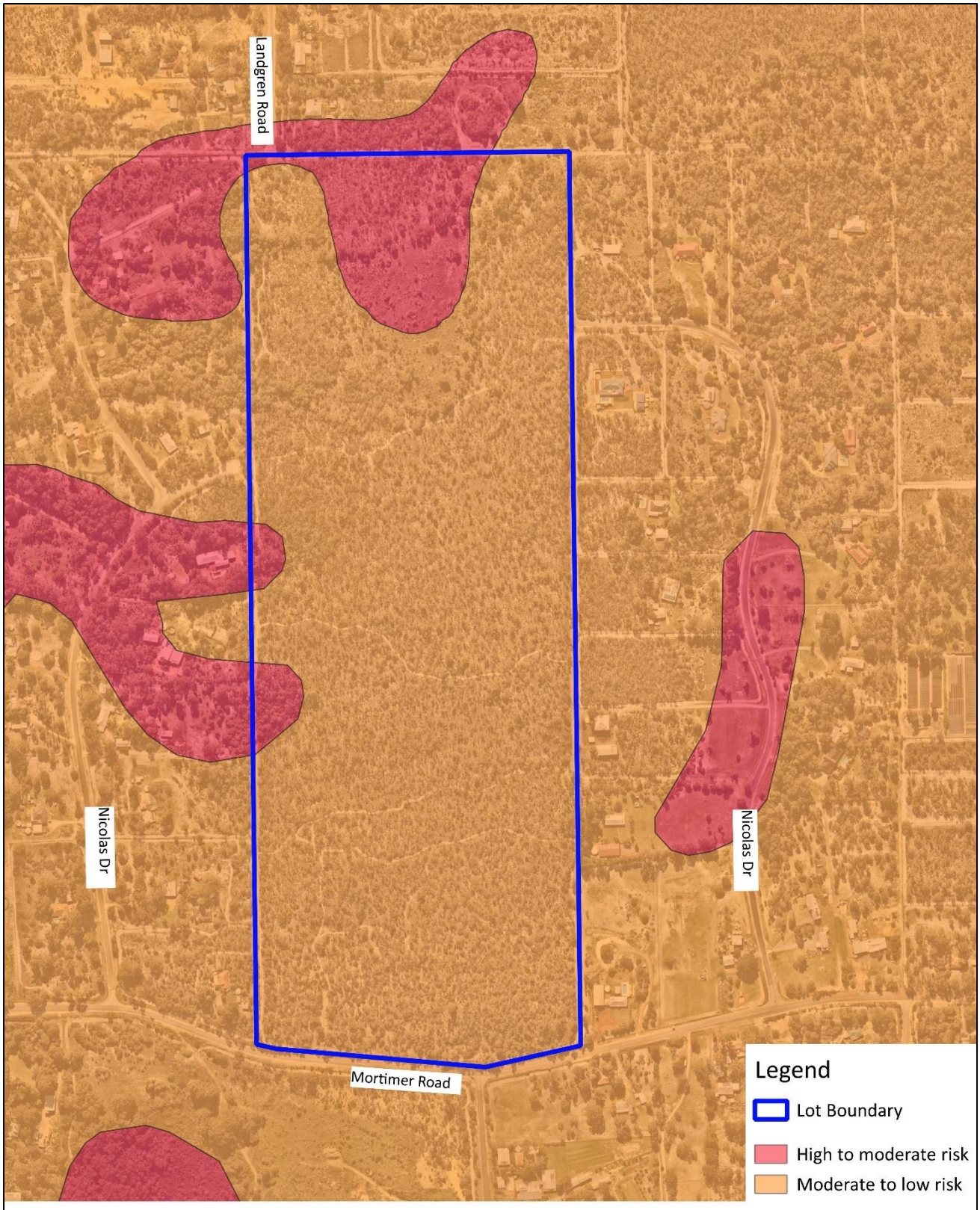

Figure 15:
Acid Sulphate Soil Risk Mapping
Lot 123 Mortimer Rd, Casuarina

4.4.4 Receiving Environment

The designated wetlands within Lot 123 do not contain permanent water, thus the primary receiving environment is the groundwater within the Jandakot Mound. Urban development is an acceptable land use over the Mound. Monitoring carried out by Bioscience (Keating, 2019) indicates that the groundwater is in the fresh – brackish range (0.4 – 2.5 mS/cm).

4.4.5 Potential Impacts

Proposed urban development activities have the potential to impact on hydrological processes and inland waters via:

- loss of designated wetlands due to clearing of native vegetation from the site
- increased runoff during rainfall events associated with the creation of impervious surfaces for roads, footpaths, and buildings that could impact of wetlands and groundwater
- decreased depth to groundwater due to removal of native vegetation
- movement of contaminants within stormwater that could result in water quality declines
- use of phosphorus based fertilisers in turfed areas, landscaped parkland areas and gardens.

4.4.6 Assessment of Impacts

1. Loss of Wetlands

Based on currently available information, the minimum clearing area to support urban development is estimated to be 35.5 ha, with the maximum being clearing of the entire site, or 45 ha; the actual is expected to be somewhere in between and is dependent on how the information presented in relation to the status of the wetland areas is viewed. If the entire site is cleared, all currently designated wetlands as per the Geomorphic Wetlands of the Swan Coastal Plain Dataset will be lost due to clearing and modifications to wetland functions to enable urban development of the entire site to proceed. However, if a reduced area is cleared, it is expected that retention of the conservation category wetland as a minimum is possible, reducing impacts on wetland areas due to clearing.

2. Increased Runoff

Increased runoff results when natural vegetated surfaces are removed and hard, impervious surfaces are installed in the form of tarred roads, concrete footpaths, and buildings constructed of various impermeable materials. Instead of infiltration occurring across the natural surface of site as it does currently, water pools and moves down gradient of where it falls, potentially resulting in pooling, waterlogging and flooding in an area. Increased volumes of water can change the hydrodynamics of wetlands, with more surface water present during cooler, wetter months than at other times of the year.

With appropriate investigations and modelling in accordance with current WA Better Urban Water Management guidelines (WAPC, DEWHA and WALGA, 2008) and the Stormwater Management Manual for WA (Department of Water, 2004 – 2007), appropriate management of stormwater runoff will be possible. The design of the system installed will reflect the design of the site and the level of clearing that occurs. Runoff is discussed further in the preliminary Local Water Management Strategy prepared by Natural Area (2019) and provided in Appendix 5.

3. Decreased Depth to Groundwater

Currently available information indicates that the depth to groundwater below the natural surface levels is a between 1.5 m (Bioscience, 2011) and 2.0 m (Department of Water and Environmental Regulation, 2019). The loss of natural vegetation means a reduction in evapotranspiration through the leaves of plants, and which can lead to increasing groundwater levels over time. A standard requirement for the construction of buildings is the need for the habitable floor levels to be a minimum of 0.5 m above the 100-year ARI flood level. Stormwater modelling will enable the amount of runoff to be quantified, its potential impact on groundwater levels, and a suitable system to be designed to ensure that current groundwater levels and other hydrological factors at the site will be maintained, thus reducing the potential for a decrease in the depth to the groundwater table.

4. Contamination

Urbanisation can result in contaminants such as hydrocarbons from oil and/or fuel leaking from vehicles onto to roads and footpaths, then being washed away into the drainage system, wetlands, and/or the groundwater system with deleterious effects. The effective design of the stormwater management system that allows an appropriate detention time in drainage basins and/or the diversion of potentially contaminated stormwater to the drainage network rather than wetlands or groundwater recharge areas will enable impacts from contamination to be avoided. As the groundwater flow direction is towards the west, impacts to drinking water source protection areas and/or the tumulus mound spring ecological community are not expected.

5. Fertilisers Containing Phosphorus

The nature of the Bassendean soils on which Lot 123 Mortimer Road is located is known to have a low phosphorus retention index. This means that when fertilisers that include phosphorus as an essential nutrient are applied to excess, it can be quickly washed through the soil into the groundwater system where it can contribute to algal blooms in wetlands in the vicinity and downstream of the site. Informing prospective landowners of the issue combined with an effective drainage system within the development will enable impacts associated with increased phosphorus to be minimised.

4.4.7 Mitigation Factors

Mitigation against the loss of wetlands is dependent on the current status of those areas designated wetlands on the Geomorphic Wetlands of the Swan Coastal Plain Dataset, with several scenarios provided for consideration. It is the owner's preference that the entire site is used for development purposes.

1. Designated Wetlands are No Longer considered to Wetlands

It is recognised that if clearing across all of Lot 123 occurs to support urban development, then impacts to designated wetlands will be unavoidable. In mitigating this loss, Bioscience (2011) has argued with some success against the presence of the conservation category wetland (UFI 6679) using the results of a detailed assessment process as the basis of their conclusion. As indicated above, Bioscience (2011) determined a minimum depth to groundwater of 1.5 m, with the Department of Water (2019) indicating the depth to groundwater is 2 m. This distance to the groundwater below surface level strongly suggests that there can be no designated wetland area within Lot 123, in which case the clearing of the wetland cannot be considered significant and mitigation for the loss of the wetland will not be required, with the loss of vegetation being as per that discussed in Section 4.2.6.

The same rationale will apply if those portions of the resource enhancement category wetlands along the western boundary of Lot 123 are no longer considered to be a wetland based on the level of modification that has occurred combined with the recognition that the marri present in those locations is a typical species that indicates a wetland is nearby rather than the presence of the wetland itself.

2. Conservation Category Wetland Retained with Loss of Resource Enhancement Wetlands

If the conservation category is retained, mitigation against impacts will be the inclusion of a suitable buffer and the appropriate design of urban drainage and stormwater management within the development site that considers current guidelines and policies relating to urban water management, noting that the design of the system is dependent on the design of the development that will be finalised at a later planning stage. There is sufficient indication that this can occur successfully, with this strategy applied to urban development sites throughout the metropolitan area and across Western Australia. It is recognised that the development of wetland management plan is a likely approval condition for the project.

Mitigation for the loss of the resource enhancement wetlands will be as per that for the loss of native vegetation as discussed in Section 4.2.6.

3. All Designated Wetland Areas Retained

If all designated wetland areas are retained, the mitigation against impacts will be the design and implementation of a suitable drainage and stormwater management system that complies with current guidelines.

4. Groundwater

Mitigation against impacts to groundwater will include the design and implementation of a suitable drainage and stormwater management system, as previously indicated. In addition, future Lot owners will be informed of the need to avoid the use of and excess application of phosphorus based fertilisers to minimise the potential for nutrients dissolving and entering the groundwater system.

4.4.8 Predicted Outcome

The development of Lot 123 will result in the unavoidable clearing of between 35.5 and 45 ha of native vegetation, some of which may include some or all of the designated wetland areas. The residual impact if the loss of all wetland areas occurs is the continued presence of other designated wetlands within the surrounding area. It is recognised that if wetland areas are lost, this loss may also be the subject of an offset site and/or a conservation covenant. If any or all wetland areas are retained, minimal impacts will occur to their hydrological regime and values.

Minimal impacts from the proposed urban development of the site are expected on the groundwater. No impacts are expected on the tumulus mound springs as the groundwater flow is to the west rather than the south east and none expected on the P1 and P2 priority drinking water source protection areas to the north east for the same reason.

4.5 Environmental Factor 4 – Drainage

Drainage was listed by the EPA as a factor to be considered in its 2006 letter to the WA Planning Commission; however, it is not currently listed as factor in the Statement of Environmental Principles,

Factors and Objectives (EPA, 2018c). Some additional information relating to drainage is provided, recognising that impacts associated with this factor are largely addressed in the discussion of Environmental Factors 1, 2 and 3 in Sections 4.2, 4.3 and 4.5 respectively. Note also that this factor is addressed more fully in the LWMS prepared by Natural Area (2019) and will be investigated further when more detailed planning and subdivision design occurs at some future point.

Assessment activities carried out by Bioscience (2011) indicate that the known depth to groundwater at Lot 123 is around 1.5 m below the natural surface level. Anecdotal information from the owner (Yujnovich, 2019) indicates there has been no free-standing water on the site at any time during his 60+ years of ownership suggest that flooding has not occurred at the site.

A review of drainage infrastructure in and in proximity to Lot 123 indicates that a City of Kwinana drain commences in the northern portion of Lot 123, with water transported to the west (orange line, Figure 16) where it connects with the Water Corporation Peel Sub O Drain. Local stormwater channels are present to the north, east, south and west of Lot 123 (green lines, Figure 17) (City of Kwinana, 2019b). No additional drainage will be required on Lot 123 as result of the current subdivision process but will be required when detailed planning for future subdivision activities occurs. Available information relating to drainage around Lot 23 suggest that suitable design solutions will be achievable, thus minimal impacts to groundwater and any remaining wetlands on site is likely to be minimal.

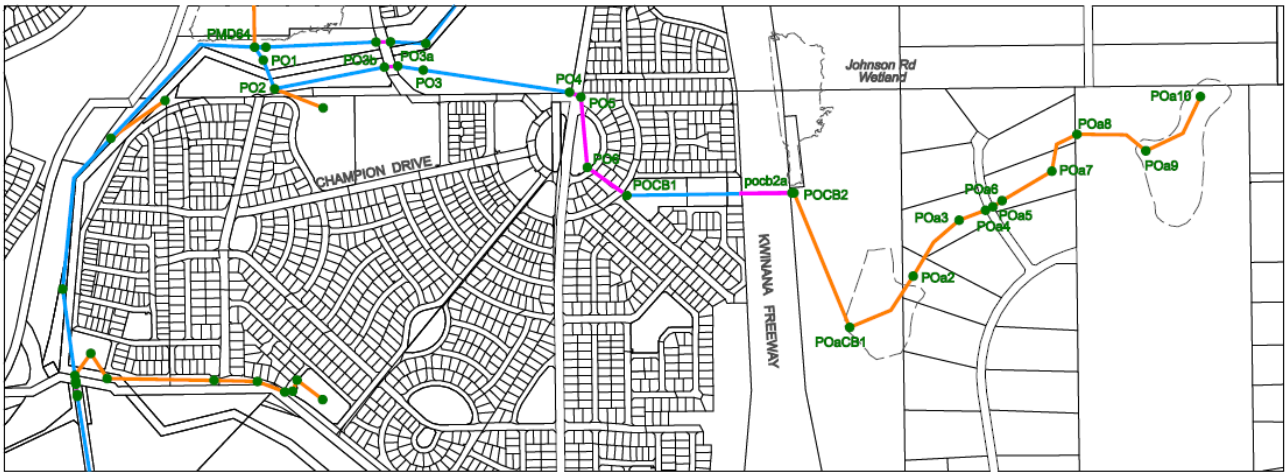

Figure 16: Peel Sub O Drain and Local Authority Drain (Department of Water, 2009)

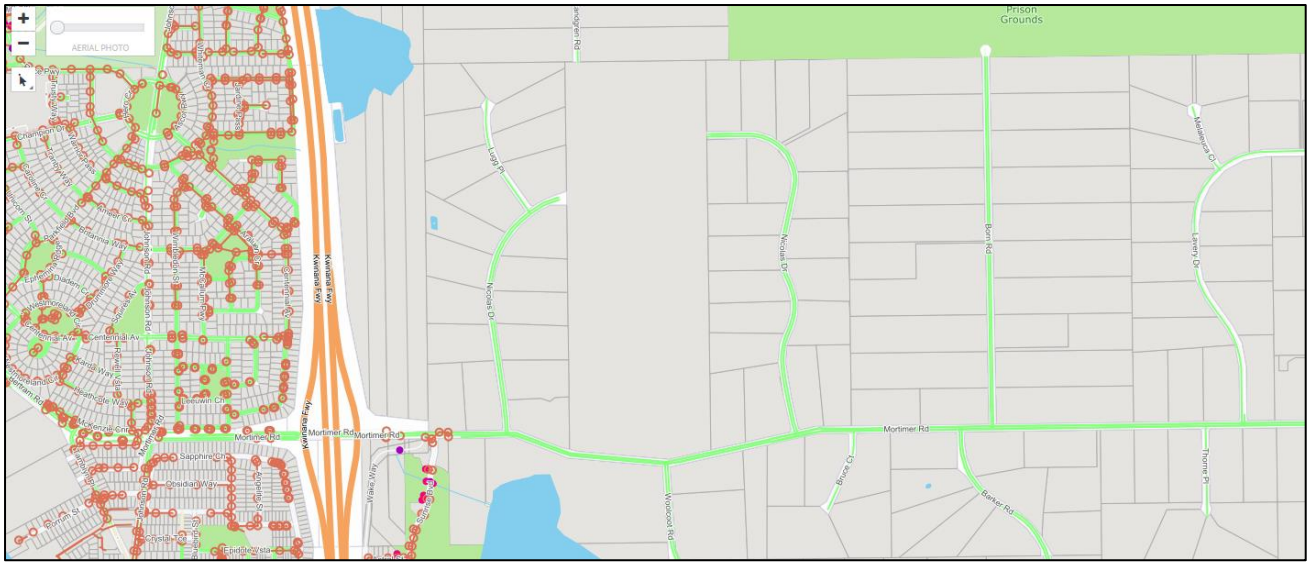

Figure 17: Local stormwater channels (City of Kwinana, 2019)

4.6 Other Environmental Factors

In addition to the environmental factors discussed in Sections 4.2 – 4.5, the EPA also indicated that the following factors would need to be addressed in its 2006 letter to the WAPC:

- emissions impacting on adjoining land uses
- noise and vibration
- soil and groundwater contamination
- special catchment requirements – Peel Harvey Catchment.

Significant impacts associated with these factors are not expected or have been discussed adequately elsewhere; a summary of Natural Area's assessment/reasoning associated with these factors in provided in Table 8.

Table 8: Assessment of other environmental factors relating to Casuarina

Factor	Relevant to Lot 123	Natural Area Assessment
Emissions impacting on adjoining land uses	Unlikely	▪ Zoning over Lot 123 is urban development rather than industrial ▪ Emissions are likely to be limited to those associated with vehicle movement and dust during civil engineering works, thus are unlikely to be significant ▪ Dust suppression via water or other suitable means can be readily implemented during clearing, civil engineering works, or other activities
Noise and vibration	Unlikely	▪ Zoning over Lot 123 is urban development rather than industrial ▪ Noise and vibration is likely to be limited to those associated with vehicle movement, such as trucks during civil engineering works, thus are unlikely to be significant

Factor	Relevant to Lot 123	Natural Area Assessment
Soil and groundwater contamination	Yes	▪ Addressed in Section 4.4 of this document ▪ Considered in the LWMS (Natural Area, 2019)
Special catchment requirements	No	▪ The Peel region includes the City of Mandurah, and the Shires of Boddington, Murray, Serpentine-Jarrahdale, and Waroona ▪ Lot 123 is located in the City of Kwinana, which is to the north of Mandurah and Murray and west of Serpentine-Jarrahdale ▪ There are no water courses on Lot 123 that drain south to the Peel-Harvey system

5.0 Offsets

Environmental offsets area an alternative tool designed to assist with the protection and conservation of environmental values, including biodiversity. They are particularly useful where avoidance and mitigation/minimisation measures are not suitable, such as projects where there will be unavoidable impacts. The proposed urban development of Lot 123 with its final projected clearing footprint of between 35.5 ha and 45 ha is a project where there will be unavoidable impacts in the form of clearing of native vegetation and potentially the loss of designated wetland areas. Offsets in relation to Lot 123 will be relevant to matters of national environmental significance listed under the EPBC Act 1999 (Cwlth) and to environmental matters relevant to State approvals processes under the *Environmental Protection Act 1986* (WA).

5.1 Policy and Guidance

The following policy is relevant to environmental offsets relating to matters of national environmental significance (MNES):

- *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (DSEWPaC, 2012b).

This policy outlines the Department of Environment and Energy's approach to the use of offsets under the EPBC Act 1999, defining an offset as 'measures that compensate the residual adverse impacts of an action on the environment'. The policy indicates that avoidance and mitigation measures should always be the primary means of management significant impacts associated with a proposed activity and that offsets do not reduce the likely impacts but compensate for residual significant impacts.

The following policies and guidance relate to environmental offsets at a State level:

- *WA Environmental Offsets Policy* (Government of Western Australia, 2011)
- *WA Environmental Offsets Guidelines* (Government of Western Australia, 2014).

The WA policy indicates that offsets may only be considered when all other reasonable attempts to avoid or mitigate impacts of a proposal and will be used to compensate those residual impacts that are otherwise unavoidable (Figure 18). The WA Environmental Offsets Guidelines (Government of Western Australia, 2014) provides information on the policy will be applied, and includes information relating to the hierarchy of impact mitigation.

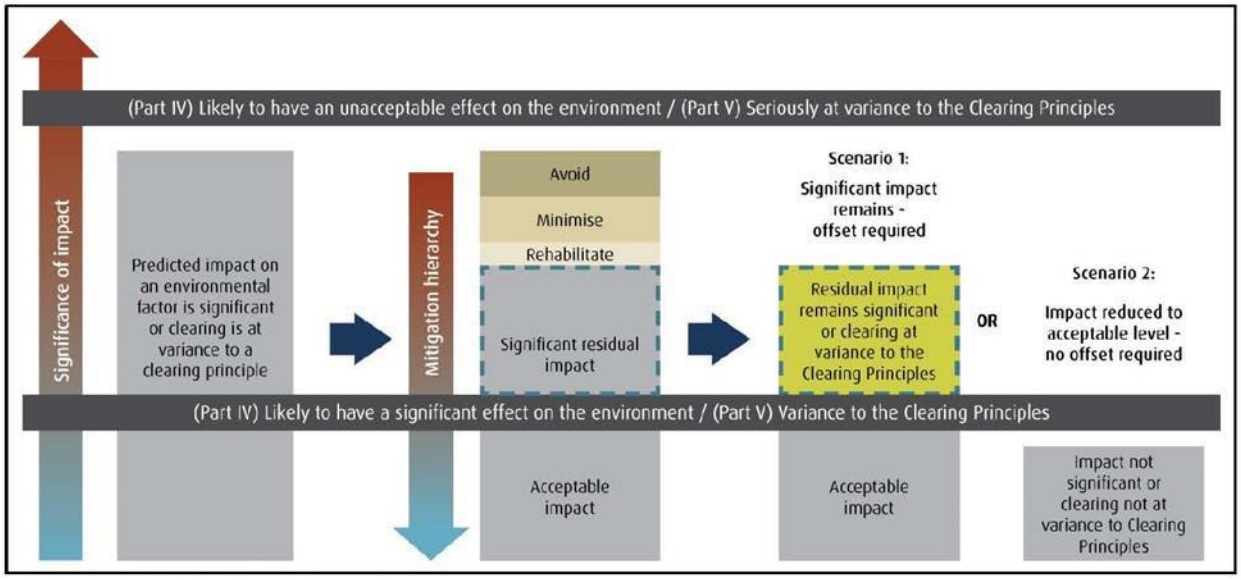

Figure 18: Impact mitigation hierarchy
(Source: Government of Western Australia, 2014)

5.2 Residual Impacts for Lot 123

The proposed urban development of Lot 123 will result in several unavoidable impacts that mean the need for an offset under the EPBC Act 1999 (Cwlth) and the *Environmental Protection Act 1986* (WA) is very likely. In relation to the EPBC Act 1999 (Cwlth), the need to clear between 35.5 ha and 45 ha of native vegetation, much of which is considered to be the threatened ecological community *Banksia Woodlands of the Swan Coastal Plain* that is also habitat suitable for use by the endangered black cockatoos, mean a significant residual impact will remain.

The WA offset policy and guidelines are also directly relevant to Lot 123 as the need to clear native vegetation along with the potential loss of all designated wetlands within the Lot boundaries mean that there are several unavoidable impacts associated with urban development activities that will need to be compensated for. As the Lot has been in private ownership by a single owner for more than 6o years and with potential purchasers wary of the implications of the environmental values on future development, the need to quantify potential impacts and determine likely offset requirements in addition to other environmental and planning approval conditions that will need to be complied with if the proposed future urban development of Lot 123 is a key step for the Lot owner. An assessment of the proposed urban development of Lot 123 against the principles described in the WA Offsets policy (Government of Western Australia, 2011), and its associated guidelines (Government of Western Australia, 2014) is provided in Table 9.

Table 9: Assessment of the development of Lot 123 against the WA Environmental Offsets principles

No.	Principle	Consideration
1	Environmental offsets will only be considered after avoidance and mitigation options have been pursued	▪ Lot 123 has been in private ownership for more than 60 years and is zoned urban development, thus is a legacy site in relation to the environmental values present. ▪ In order to avoid impacts associated with clearing, the planned urban development consistent with the zoning of the Lot would need to be abandoned. ▪ This would result in an ongoing financial burden to the owner in the form of rates, insurance and other outgoings on a Lot with little or no possibility of financial return. ▪ Mitigation in the form of mitigation is not possible for similar reasons
2.	Environmental offsets are not appropriate for all projects	▪ For the majority of projects, many environmental impacts can be avoided or mitigated through careful design ▪ That approach is more difficult for urban development projects on a Lot where the major land use is remnant vegetation
3.	Environmental offsets will be cost-effective as well as relevant and proportionate to significance of the environmental value being impacted	▪ This will be negotiated through the approvals process, with the expectation that offset requirements will be suited to both the Department of the Environment and Energy as they relate to MNES, as well as those impacts associated with the *Environmental Protection Act 1986* (WA)
4.	Environmental offsets will be based on sound environmental information and knowledge	▪ The assessment activities carried out by Natural Area and Bioscience on the owner's behalf represent a level of sound environmental information as it relates to Lot 123 and is considered suitable for application of these requirements
5.	Environmental offsets will be applied within a framework of adaptive management	▪ This document outlines the expected minimum and maximum projected clearing area to accommodate future urban development of the site ▪ it is expected that the residual impact as it applies to the clearing of native vegetation and the associated potential loss of designated wetlands will be somewhere in between the two extremes and negotiated during the approvals processes ▪ Depending on the area to be cleared, monitoring of some description is likely to be required, with management strategies implemented as required to ensure ongoing compliance with planning and environmental approval conditions

No.	Principle	Consideration
6.	Environmental offsets will be focussed on longer term strategic outcomes	▪ Natural Area has identified three possible forms an offset might take, will all have a focus on longer term strategic outcomes

Given the strategic planning processes that have occurred in relation to the Casuarina area in which Lot 123 is located, it can be assumed that there is recognition that loss of native vegetation and potentially designated wetland areas is possible, if not probable, by State regulators, and to a lesser degree by the Commonwealth during the Perth-Peel planning and assessment activities that occurred several years ago and which have since been shelved. Under these circumstances, an offset of some description that satisfies both State and Commonwealth approvals processes is very probable. The form and 'size' of the offset will need to be negotiated and agreed, and could take the form of one or more of the following:

- financial offset
- identification and implementation of a suitable offset site, say, in the Gingin area of Western Australia where an offset that includes a like-for-like vegetation type, namely Banksia Woodland of the Swan Coastal Plain
- identification of an area where a conservation covenant could be applied, again in a like-for-like vegetation type.

As a minimum, it is recognised that offsets are applied at a minimum ratio of 'like-for-like or better', or at a minimum ratio of 1:1, or at a higher ratio as applied by regulators depending on the values and condition present at the site. The ratio for any offset relating to Lot 123 will need to be discussed and agreed, as will other aspects associated with the nominated offset, such as the need for revegetation, management, and monitoring.

6.0 Matters of National Environmental Significance

Lot 123 is known to contain the threatened ecological community *Banksia Woodlands of the Swan Coastal Plain*, with evidence of feeding by the Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*), all of which are listed as matters of national environmental significance (MNES) under the EPBC Act 1999 (Cwlth).

The remnant bushland on Lot 123 was assessed by Natural Area as part of the flora and vegetation survey carried out during 2018, with statistical analysis and assessment against the listing advice confirming that it is consistent with the key characteristics of the threatened ecological community. The banksia species associated with this vegetation type are known preferred foraging sources for the Carnaby's Cockatoo, with the marri that is present in portions of the site known to be a preferred food course for the Forest Red-tailed Black Cockatoo. Some evidence of feeding by both species was recorded during site assessment activities carried out by Natural Area during 2018 and included in the report documenting outcomes of the assessment process.

As a result of the presence of this ecological community and the two black cockatoo species, the decision was made to refer the proposal to the Department of the Environment and Energy, with that occurring on 21 December 2018 (reference 2018/8379). The approach taken was the same as that applied in this document, with the indication that the proposed clearing area would be a minimum of 35.5 ha and a maximum of 45 ha (all of Lot 123). Advice was received in a letter and decision document (Appendix 6) that the proposed urban development of Lot 123 would be a controlled action, and that an assessment approach under the bilateral agreement would enable a consistent and streamlined approach across the state and federal approvals.

Note that the advice letter from the Department of the Environment and Energy also listed several flora species and another ecological community that could potentially occur within Lot 123. Table 10 provides an overview of why their presence within Lot 123 is unlikely, and thus why impacts are also unlikely.

Table 10: Other MNES and their likelihood within Lot 123

Scientific Name/Name	Common Name	Description	Natural Area Comments
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain Ecological Community (endangered)	Tumulus Mound Spring	Characterised by a continuous discharge of groundwater in locations with areas of raised peat that provide a range of microhabitats that are permanently moist	Not likely. ▪ One location of this ecological community has been recorded approximately 3 km to the south-east of Lot 123, with the 2 km buffer approx. 1 km to the south-east ▪ Soil types on Lot 123 are inconsistent with those associated with this ecological community ▪ There are no locations where there is a continuous discharge of water that result in permanently moist conditions
Caladenia huegelii (endangered)	King Spider Orchid	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green & cream & red, Sep to Oct	Not likely. ▪ Occurs on Grey or brown sand, clay loam ▪ No brown sand or clay load present in Lot 123 ▪ Flora surveys carried out by both Natural Area (2018) and Bioscience (2008 and 2015) did not record this species
Calyptorhynchus baudinii (endangered)	Baudin's Black Cockatoo	Bird, same family as other endangered black cockatoos listed as MNES, very similar the Carnaby's Cockatoo	Not likely. ▪ This species tends to occur further south of Perth; if it utilised Lot 123, any management strategies implemented for the Carnaby's and Forest Red-tailed Black Cockatoos will also be suitable for this species
Drakaea elastica (endangered)	Glossy-leafed Hammer Orchid	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red & green & yellow, Oct to Nov	Not likely. ▪ Occurs on white or grey sand, in low-lying situations adjoining winter wet swamps ▪ No winter wet swamps occur in Lot 123. ▪ Flora surveys carried out by both Natural Area (2018) and Bioscience (2008 and 2015) did not record this species

Scientific Name/Name	Common Name	Description	Natural Area Comments
Diuris micrantha (Vulnerable)	Dwarf Bee Orchid	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. yellow & brown, Sep to Oct	Not likely. ▪ Occurs on loamy clay, winter wet swamps in shallow water ▪ Soil type at Lot 123 is unsuitable for this species ▪ No winter wet swamps occur in Lot 123 ▪ Flora surveys carried out by both Natural Area (2018) and Bioscience (2008 and 2015) did not record this species

7.0 Holistic Impact Assessments

The holistic impact assessment considers the whole of the environment, along with the connections and interactions between the various environmental factors. Also considered are the predicted outcomes in relation to the environmental principles and the EPA's environmental objectives (Table 11). While the initial plan is to subdivide Lot 123 into two Lots, this process is designed to serves as a vehicle to enable consideration of environmental values associated with the broader urban development of the site. Preliminary site design activities indicate that the minimum clearing that will occur is 35.5 ha, with a maximum of 45 ha (the entire site); it is expected that the actual area to be cleared will be somewhere between the two.

Table 11: Holistic Impact Assessment – Lot 123

Theme	Impact	Management and Mitigation	EP Act Principles
Land	▪ Clearing of between 35.5 and 45 ha of native vegetation, the majority of which was assessed as being in Excellent condition, representing between 0.31% and 0.39% of that remaining on the Swan Coastal Plain ▪ Clearing of up to 38 ha of bushland that has been confirmed as being the Priority 3 listed Banksia Woodlands of the Swan Coastal Plain under the *Biodiversity Conservation Act 2016* (WA) and as endangered under the EPBC Act 1999 (Cwlth) ▪ Habitat fragmentation ▪ Bushland that showed some signs of feeding by the Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo, both threatened species at state and Commonwealth level ▪ Injury or death of fauna species during clearing	▪ The nature of the proposed development means that avoidance and mitigation strategies are limited ▪ An environmental offset or conservation covenant of some description is a probable approval condition ▪ Feeding evidence by the threatened black cockatoos was limited, and there was no evidence of the use of hollows suitable for nesting, suggesting use of the site by these species are limited due the availability of several other suitable sites close by ▪ Trapping and relocation of bandicoots and reptiles as a minimum ahead of clearing	**Precautionary Principle** ▪ Assessment of impacts assumes worst case scenario ▪ Strategic planning processes associated with the urban development of the broader Casuarina area provide a tacit acknowledgement that the loss of various environmental values will be required to progress planned urban development **Intergenerational Equity** ▪ While it is acknowledged that there will be a permanent loss of vegetation from Lot 123, this loss is compensated for through the retention of other bushland reserves within 5 km of the site, including ten Bush Forever sites ▪ Intergenerational equity also extends to the need to provide sustainable urban areas to house a growing population **Improved Valuation and Pricing Mechanism** ▪ An environmental offset of some description is seen as likely approval condition, and which will provide a net

Theme	Impact	Management and Mitigation	EP Act Principles
			environmental gain to compensate for the loss the vegetation **Conservation of Biological Diversity and Ecological Integrity** ▪ The presence of ten Bush Forever sites and other bushland remnants within 5 km of Lot 123 mean that biological diversity and ecological integrity will be maintained in the area ▪ An environmental offset will ensure an additional area is maintained in the longer term that will also act to conserve biological diversity and ecological integrity
Water	▪ The potential loss of some or all areas designated as wetlands on Lot 123 ▪ Contamination of groundwater ▪ Use and excess application of fertilisers containing phosphorus as a key nutrient	▪ Bioscience 2011 provides a strong argument suggesting the conservation category wetland in the northern portion of Lot 123 is no longer a wetland as the depth to groundwater is a minimum of 1.5 m below the natural surface level, meaning the significance of any loss of wetland areas is minimised ▪ The areas designated as being resource enhancement wetlands are highly modified with the vegetation present typical of transition areas between	**Precautionary Principle** ▪ Assessment of impacts assumes worst case scenario ▪ Strategic planning processes associated with the urban development of the broader Casuarina area provide a tacit acknowledgement that the loss of various environmental values will be required to progress planned urban development **Intergenerational Equity** ▪ While it is acknowledged that there will be a permanent loss of vegetation from

Theme	Impact	Management and Mitigation	EP Act Principles
		wetland and dryland areas, rather than being directly associated with wetlands ▪ Groundwater flow direction is to the west, meaning impacts to the drinking water source protection area to the north-west and the tumulus mound spring to the south-east is very unlikely ▪ In the event of the loss any wetland areas, an offset site or conservation covenant will provide a means of compensating for the loss ▪ Appropriate urban and stormwater drainage will mitigate against any local hydrological changes associated with the development, as well as minimising the potential for contamination ▪ Informing purchasers of the Lots of the implications of using fertilisers containing phosphorus as a key nutrient	Lot 123 that may include areas designated as wetlands, this loss is compensated for through the retention of several other wetland areas within 5 km of the site, a conservation category wetland to the south of the site ▪ Intergenerational equity also extends to the need to provide sustainable urban areas to house a growing population **Improved Valuation and Pricing Mechanism** ▪ An environmental offset of some description is seen as likely approval condition, and which will provide a net environmental gain to compensate for the loss the any designated wetland areas **Conservation of Biological Diversity and Ecological Integrity** ▪ The presence of several wetland areas in proximity to Lot 123, including a conservation category wetland to the south and the tumulus mound springs to the south east mean that biological diversity and ecological integrity will be maintained in the area

Theme	Impact	Management and Mitigation	EP Act Principles
			An environmental offset will ensure an additional area is maintained in the longer term that will also act to conserve biological diversity and ecological integrity

7.1 EPA Objectives

An assessment of the EPA factors and objectives is provided in this section.

1. Flora and Vegetation

Objective: To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

Assessment activities ahead of the eventual urban development of Lot 123 recognise that there will be a permanent, unavoidable loss of flora and vegetation from the site. However, higher level strategic planning processes associated with the broader Casuarina area recognise that some losses will be necessary to enable urban development to support a growing population within the area. The application of an environmental offset or conservation covenant will enable the proposal to meet the EPA objective for this factor.

2. Terrestrial Fauna

Objective: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained

Assessment activities associated with the presence of threatened black cockatoo species, in particular, demonstrated that usage of the site was minimal, probably due to the presence of many other vegetated areas with the same type of vegetation within 5 km of Lot 123. Despite this, the habitat is good quality habitat, thus the application of an environmental offset or conservation covenant will enable the proposal to meet the EPA objective for this factor.

3. Inland Waters

Objective: To maintain hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

Extensive assessment activities carried out by Bioscience (2011) suggest that the designated conservation category wetland is not present on the site as the minimum depth to groundwater is 1.5 m below the natural surface level. The Lot owner also indicates that there has been no surface water on the Lot since he purchased it in the late 1950s. Accordingly, changes to hydrology are expected to be minimal.

Urban development will result in changes to the rainwater infiltration through increased impervious areas in the form of roads, along with an increased potential for contamination such as through from hydrocarbons from vehicles and the use of fertilisers with phosphorus as key nutrient. The appropriately design urban drainage and stormwater management system will ensure impacts will be minimal, ensuring the proposal will meet the EPA objective for this factor.

8.0 References

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), (2000), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1*, accessed September 2019 via: https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf.

Biodiversity Conservation Act 2016 (WA)

Bioscience, (2006), *Report on Field Investigations – Ground Truthing the Presence and Management Classification of Wetlands, Lot 123 Mortimer Road, Casuarina, City of Kwinana*, unpublished report prepared for Mr I. Yujnovich.

Bioscience, (2011), *Geomorphic Wetlands Swan Coastal Plain Dataset Request for Modification*, unpublished report prepared for Mr I. Yujnovich.

Bioscience, (2015), *Vegetation and Black Cockatoo Assessment – Lot 123 Mortimer Road Casuarina*, unpublished report prepared for Mr I. Yujnovich.

Bureau of Meteorology (BOM), (2019), *Climate Data Online – Perth Airport Station ID 009021*, accessed September 2019 via: http://www.bom.gov.au/climate/data/.

City of Kwinana, (2018), *Local Planning Policy No. 6 – Guidelines for Structure Planning in the Casuarina Cell*, accessed September 2019 via https://www.kwinana.wa.gov.au/our-services/planning-services/town-planning-scheme-policies/Documents/Policy%20-%20Local%20Planning%20Policy%2006%20No.%206%20-%20Guidelines%20for%20Structure%20Planning%20in%20the%20Casuarina%20Cell.pdf.

City of Kwinana, (2019a), *Local Planning Scheme No. 2*, accessed September 2019 via https://www.dplh.wa.gov.au/getmedia/8cf5c948-fea4-4a12-ba69-3746cacaa790/Kwinana-scheme-2-text.

City of Kwinana, (2019b), *IntraMaps – Local Stormwater Channels*, accessed September 2019 via: https://maps.kwinana.wa.gov.au/IntraMaps90/.

Department of Biodiversity, Conservation and Attractions, (2019a), *What are Wetlands?*, accessed September 2019 via: https://www.dpaw.wa.gov.au/management/wetlands.

Department of Biodiversity, Conservation and Attractions, (2019b), *Wetlands – Swan Coastal Plain – What do the Wetland Management Categories Mean?*, accessed September 2019 via: https://www.dpaw.wa.gov.au/management/wetlands/mapping-and-monitoring?showall=1.

Department of Environment and Conservation, (2005), *Interim Recovery Plan No. 198 Assemblages of Organic Mound (Tumulus) Springs of the Swan Coastal Plain Recovery Plan*, accessed September 2019 via: http://www.environment.gov.au/system/files/resources/779ce1c7-5a7b-49c7-987f-4a6bbc2fe2ca/files/tumulus-moundsprings.pdf.

Department of Planning, Lands and Heritage, (2019a), Personal communication.

Department of Planning, Lands and Heritage, (2019b), *Metropolitan Region Scheme*, accessed September 2019 via: https://www.dplh.wa.gov.au/information-and-services/district-and-regional-planning/region-planning-schemes/metropolitan-region-scheme/scheme-text-and-maps.

Department of Planning, Lands and Heritage and the Western Australian Planning Commission, (2018), *South Metropolitan Peel Sub-regional Planning Framework*, accessed September 2019 via https://www.dplh.wa.gov.au/getmedia/becc75c4-cd43-4f28-9372-1044387ab62a/FUT-PP-South_Metro_Peel_Sub_Region_March2018_v2.

Department of Primary Industries and Regional Development, (2019), *NRInfo for Western Australia: map application*, accessed September 2019 via https://www.agric.wa.gov.au/resource-assessment/nrinfo-western-australia.

Department of Sustainability, Environment, Water, Population and Communities, (2012b), *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*, accessed September 2019 via: https://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf

Department of Sustainability, Environment, Water, Population and Communities, (2012a), *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species – Carnaby's Cockatoo, Baudin's Cockatoo, Forest Red-tailed Black Cockatoo*, accessed September 2019 via http://www.environment.gov.au/system/files/resources/895d4094-af63-4dd3-8dff-ad2b9b943312/files/referral-guidelines-wa-black-cockatoo.pdf.

Department of Water, Department of the Environment, Water, Heritage and the Arts, and the West Australian Local Government Association (WALGA), (2008), *Better Urban Water Management*, accessed via https://www.dplh.wa.gov.au/getmedia/c093b181-a309-4b36-8e42-c27a77c2b413/GD_Better_Urban_Water_Management.

Department of Water, (2004 - 2007), *Stormwater Management Manual*, accessed September 2019 via https://www.water.wa.gov.au/__data/assets/pdf_file/0020/4772/44217.pdf.

Department of Water, (2008), *Interim: Developing a Local Water Management Strategy*, accessed September 2019 via https://www.water.wa.gov.au/__data/assets/pdf_file/0015/4218/83705.pdf.

Department of Water, (2009), *Jandakot Drainage and Water Management Plan – Peel Main Drain Catchment, Drainage and Water Management Plan No. 3*, accessed September 2019 via https://www.water.wa.gov.au/__data/assets/pdf_file/0018/1746/91068.pdf.

Department of Water and Environmental Regulation, 2019), *Perth Groundwater Map*, accessed September 2019 via: https://maps.water.wa.gov.au/#/webmap/gwm.

Environmental Protection Act 1986 (WA)

Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)

Environmental Protection Authority, (2015), *Perth and Peel @ 3.5 Million – Environmental Impacts, Risks and Remedies*, accessed September 2019 via https://www.epa.wa.gov.au/interim-strategic-advice-perth-and-peel-35-million-environmental-impacts-risks-and-remedies.

Environmental Protection Authority, (2016a), *Environmental Factor Guideline – Flora and Vegetation*, accessed September 2019 via http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Flora-Vegetation-131216_4.pdf.

Environmental Protection Authority, (2016b), *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, accessed September 2019 via: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/EPA%20Technical%20Guidance%20-%20Flora%20and%20Vegetation%20survey_Dec13.pdf.

Environmental Protection Authority, (2016c*), Environmental Factor Guideline – Terrestrial Fauna*, accessed September 2019 via http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Terrestrial-Fauna-131216_3.pdf.

Environmental Protection Authority, (2016d), *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna*, accessed September 2019 via http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Sampling-TV-fauna-Dec2016.pdf.

Environmental Protection Authority, (2016e), *Technical Guidance – Terrestrial Fauna Surveys*, accessed September 2019 via http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Tech%20guidance-%20Terrestrial%20Fauna%20Surveys-Dec-2016.pdf.

Environmental Protection Authority, (2016f), Environmental Factor Guideline – Inland Waters, accessed September 2019 via: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Inland-Waters-29062018.pdf.

Environmental Protection Authority, (2018a), *Instructions for the Preparation of Data Packages for the Index of Biodiversity Surveys for Assessments (IBSA)*, accessed September 2019 via: https://www.epa.wa.gov.au/sites/default/files/Forms_and_Templates/Instructions%20-%20IBSA%20Data%20Packages%20-%20181214_0.pdf.

Environmental Protection Authority, (2018b), *Instructions on How to Prepare and Environmental Review Document*, accessed September 2019 via: https://www.epa.wa.gov.au/sites/default/files/Forms_and_Templates/Instructions%20and%20template%20-%20ERD%20260418.pdf.

Environmental Protection Authority, (2018c), *Statement of Environmental Principles, Factors and Objectives*, accessed September 2019 via http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Statement%20of%20Environmental%20Principles%2C%20factors%20and%20objectives.pdf.

Government of Western Australian, (2000), *Bush Forever, Volume 2*, Government of Western Australia, Perth, Western Australia.

Government of Western Australia, (2011), *WA Environmental Offsets Policy*, accessed September 2019 via: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/WAEnvOffsetsPolicy-270911.pdf.

Government of Western Australia, (2014), *WA Environmental Offsets Guidelines*, accessed September 2019 via: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/WA%20Environmental%20Offsets%20Guideline%20August%202014.pdf.

Government of Western Australia, (2019), *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report), Current as of March 2019*, WA Department of Biodiversity, Conservation and Attractions, accessed September 2019 via: https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics.

Heddle, E., Loneragan, O., and Havel, J, (1980), Vegetation Complexes of the Darling System Western Australia. In *Atlas of Natural Resources - Darling System, Western Australia* (pp. 37 - 72), Department of Conservation and Environment, Western Australia.

Hill, A., Semeniuk, C., Semeniuk, V., and Del Marco, A., (1996), *Wetlands of the Swan Coastal Plain, Volume 2A – Wetland Mapping, Classification and Evaluation – Main Report*, Water and Rivers Commission and Department of Environmental Protection, Perth, Western Australia.

Keating, P, (2019), Personal Communication, Director, Bioscience

Landgate, (2019), *Map Viewer Plus – Aerial Imagery*, accessed September 2019 via https://maps.landgate.wa.gov.au/maps-landgate/registered/.

Mitchell, Williams and Desmond, (2002), *Swan Coastal Plain 2* (*SWA2 – Swan Coastal Plain Subregion*), accessed September 2019 via: https://www.dpaw.wa.gov.au/images/documents/about/science/projects/waaudit/swan_coastal_plain02_p606-623.pdf.

National Map, (2019a), *Department of Planning, Lands and Heritage – Bush Forever Sites*, accessed September 2019 via: https://nationalmap.gov.au/.

National Map, (2019b), *Department of Water and Environmental Regulation – Public Drinking Water Source Protection Areas*, accessed September 2019 via: https://nationalmap.gov.au/.

Natural Area Consulting Management Services, (2018), *Lot 123 Mortimer Road Flora and Vegetation Survey and Black Cockatoo Habitat Assessment*, unpublished report prepared for Mr I. Yujnovich.

Natural Area Consulting Management Services, (2019),

Planning and Development Act 2005 (WA)

Walker, C, (2019), personal communication, Consultant Hydrogeologist – Geo and Hydro Environmental Management.

Appendix 1: Natural Area Flora Survey Report, 2018

Appendix 2: Bioscience Flora Survey Report, 2015

Appendix 3: Bioscience Field Investigations Report 2006

Appendix 4: Bioscience Wetland Reclassification Application 2011

Appendix 5: Natural Area Local Water Management Strategy 2019

Appendix 6: DoEE Decision Letter and Notice