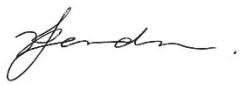
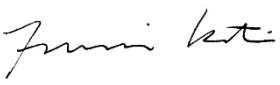
BIRD VIEWING STRUCTURES

Feasibility Study - Yellagonga Regional Park

City of Wanneroo

ecoscape

Revision	Author	QA Reviewer	Approved	Date
03	Andrew Fry Francis Kotai			30/07/2020
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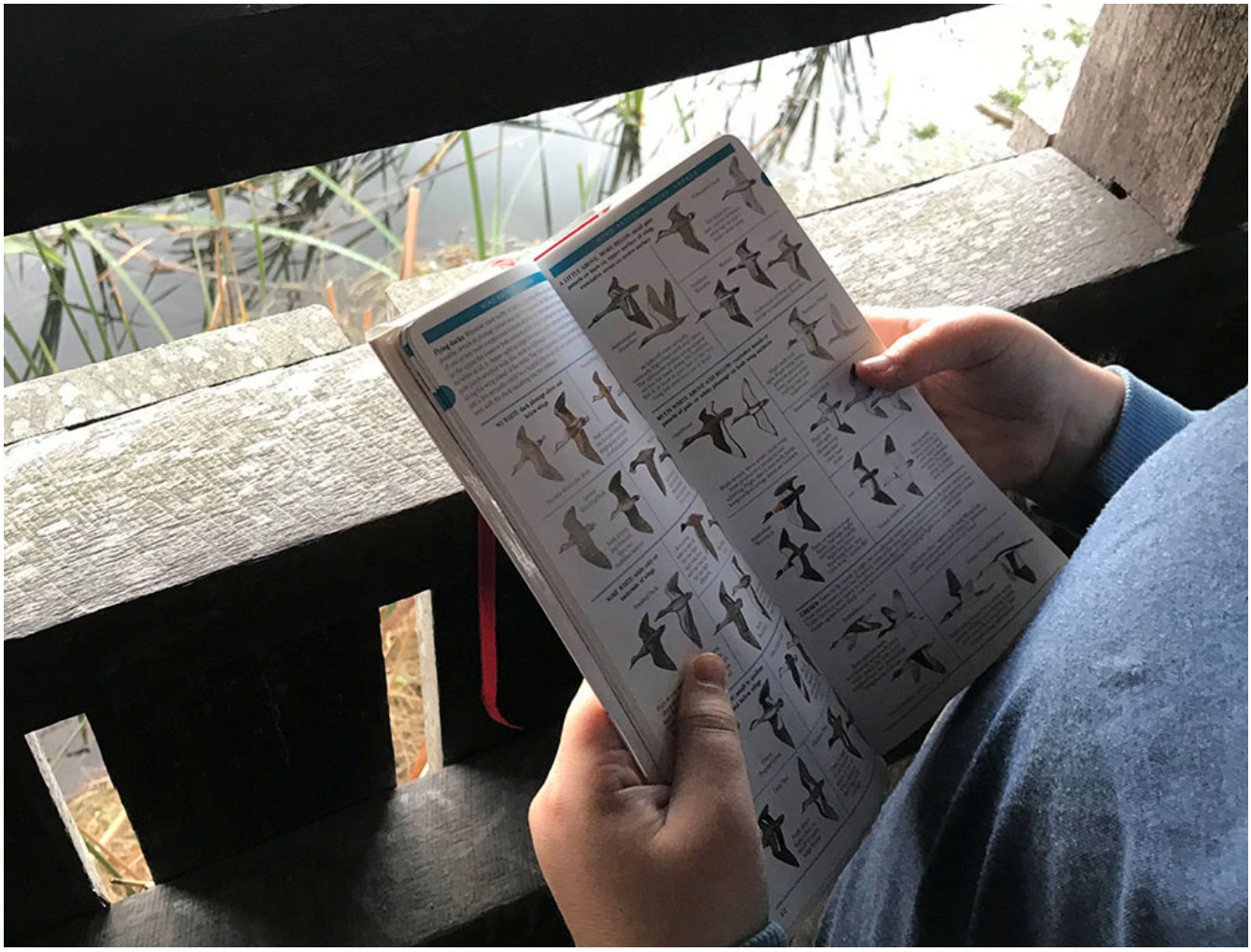

EXECUTIVE SUMMARY

The City of Wanneroo (the City) engaged Ecoscape (the Consultant) to undertake a feasibility study for the construction of bird viewing structures at Lake Joondalup in the Yellagonga Regional Park (YRP). The purpose of this study is to ascertain the need for bird viewing structures at YRP and the feasibility of such installations at five sites selected by the City in conjunction with DBCA and Birdlife Australia.

The study included an environmental assessment, a landscape assessment, consultation with key stakeholders identified by the City and research of existing benchmark structures in the metropolitan area. The findings of the study have revealed a clear need for bird viewing structures at YRP to cater to enthusiasts and the general public and sustainably manage access to Lake Joondalup.

Five potential sites on the eastern side of Lake Joondalup were provided by the City and assessed using a 100m study area radius at each location. The following locations were investigated:

- Site 1 Ariti Avenue
- Site 2 Lake Joondalup Park
- Site 3 South West Pine Seed Orchard
- Site 4 Ashley Road
- Site 5 Rotary Park.

A Multi Criteria Analysis (MCA) was undertaken using the information gathered and input from key stakeholders. Site 2, Lake Joondalup Park, was identified as the most feasible site for development of a bird viewing structure due to ease of accessibility, lower environmental impacts, desirable views and popularity with enthusiasts.

Discussion with key stakeholders has revealed that a floating pontoon-type structure is preferred. This would have external viewing areas for use by the public and a hide designed to accommodate enthusiasts. Additionally, there is community and stakeholder support for a lookout tower-type structure that can provide panoramic views of Lake Joondalup to be incorporated with the hide and boardwalk which will be explored further in the concept design phase of the project.

A concept design has been developed for the Lake Joondalup Park location as part of the feasibility study. The concept includes designs for separate bird hide and lookout structures situated so that they could be undertaken individually, staged or in tandem depending on the City's strategic priorities. Refer to **Appendix Two, Concept Design** for more information.

The preferred location at Lake Joondalup Park sits in proximity to the Wanneroo Recreation Precinct Master Plan study area and ongoing coordination between the two projects will be undertaken for key elements such as path locations landscape upgrades and interpretive signage. It is expected that the bird viewing structure will be a key destination at the northern extent of the recreation precinct.

1 INTRODUCTION

Yellagonga Regional Park is a 1400-hectare Conservation Category Wetland chain (Lake Joondalup, Beenyup Swamp, Walluburnup Swamp and Lake Goollelal). The reserve is important as a summer refuge and provides breeding habitat for many resident and trans-equatorial migratory water bird species. For this reason, Yellagonga Regional Park (herein known as the 'YRP') is a renowned area for local, national and international birdwatchers and photographers. The City of Wanneroo (the City) has received requests from the community over a number of years to provide bird viewing facilities within the reserve, in particular on the eastern (City of Wanneroo) side of Lake Joondalup.

The installation of bird viewing structure/s within YRP would provide the local and wider community with safe facilities to view bird species while protecting local vegetation from un-authorised access and reducing disturbance to the birds being viewed / photographed. The structures may also provide environmental education, eco-tourism and community awareness opportunities.

This vision is supported by the Yellagonga Regional Park Management Plan 2003-2013 and the Yellagonga Integrated Catchment Management Plan 2014-2019.

The scope of this project was to undertake a feasibility study of selected locations within the City managed portion of YRP to determine if bird viewing structures are required, and if so, the most appropriate locations for the installation of bird viewing structures. Initial concept designs of suitable locations would then be prepared.

Site information to support the feasibility assessment was collected through a desktop assessment, biological surveys and a landscape assessment. Consultation was undertaken with stakeholders including representatives from Birdlife Australia, the Department of Biodiversity Conservation and Attractions (DBCA), Friends of Yellagonga Regional Park and local birders. Information provided by stakeholders has been included in this report and the local knowledge has been a valuable resource.

The results of the desktop and site assessments were considered and a Multi Criteria Analysis (MCA) undertaken to determine the most suitable locations. MCAs are a form of decision making tool used to evaluate problems with different alternatives, opportunities, threats and stakeholder views, in order to find the most 'suitable' solutions. MCAs constitute a framework for structuring decision problems as well as a set of methods to generate preferences among alternatives in a transparent and accountable way.

Sites considered were:

- Site 1- Ariti Avenue
- Site 2- Lake Joondalup Park
- Site 3- South West of the Pine Seed Orchard
- Site 4- Ashley Road, North of the Pine Seed Orchard
- Site 5- Rotary Park

Refer to **Maps 1 to 6** for site locations.

2 METHODOLOGY

Biological surveys were undertaken considering methods described in the Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority 2016) and EPA Technical Guidance – Terrestrial fauna survey (2016). Surveys were undertaken at a low intensity and outside of recommended survey timing for botanical surveys.

2.1 DESKTOP

The following were reviewed to identify significant environmental features within and near the sites prior to commencing field survey:

- Threatened Flora, Fauna and Ecological Communities listed under the Commonwealth *EPBC Act 1999*
- Threatened Flora and Fauna listed under the Western Australian *BC Act 2016*
- Priority Flora, Fauna and Threatened and Priority Ecological Communities listed by Department of Biodiversity, Conservation and Attractions (DBCA)
- Protected Matter Search Tool (PMST)
- Environmentally Sensitive Areas (ESAs) and Conservation class wetland mapping

2.2 FIELD SURVEY TIMING

The field survey was conducted on the 15th and 18th May 2020. This survey window is outside of the recommended timing of the primary season of survey for the South-West Botanical Province (September to November), as described in the Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). Due to the degraded nature of the survey areas this is not considered to represent a significant constraint to the adequacy of the surveys.

2.3 FLORISTIC RELEVÉS

The flora survey assessed vegetation at the sites using relevés (unbounded flora sample sites).

The following parameters were recorded at each relevé:

- photograph of the quadrat taken from the north-west corner, diagonally across the quadrat
- a vegetation description based on the height and estimated cover of dominant species, using the National Vegetation Information System (NVIS) Level V
- an inventory of common or dominant species (native and introduced) including common species that were well known to the survey botanist were identified in the field. Voucher specimens of all other species were collected.

2.4 TARGETED SEARCHES

Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted for searches in areas of potential habitat. Targeted searches consisted of low intensity traverses of the survey area.

2.5 WEEDS

Introduced species (weeds) were recorded if listed as a priority species by the City or listed as WONS and Declared Pest plants. A description of their locations and numbers/extents were recorded during the field

survey, if present. Due to the season of survey (autumn) observed abundance is expected to be lower than the period following rainfall.

2.6 VEGETATION DESCRIPTION AND CLASSIFICATION

Vegetation was described using the height and estimated cover of dominant and characteristic species of each stratum based on the NVIS, recorded at Level V (NVIS Technical Working Group 2017). Up to three species per stratum (upper, mid and ground) were used to formulate vegetation descriptions for each vegetation type. Common and dominant flora were described only.

2.7 VEGETATION CONDITION

Vegetation condition was assessed at each site using the Vegetation Condition Scale for the Southwest and Interzone Botanical Provinces (EPA 2016).

2.8 FAUNA

An assessment of potential habitat for conservation significant fauna was undertaken by the survey ecologist. Searches for secondary evidence such as scats, diggings, tracks or chewed nuts was also undertaken. Any evidence of fauna was recorded and confirmed by an experienced zoologist (Bruce Turner) following field survey.

The Commonwealth Protected Matters Search Tool (PMST) and DBCA database were searched for each survey area to identify potential significant fauna and/or fauna habitat that may occur within the area. A 5km buffer was set at each survey area and the information produced was used to create a combined list of potential conservation significant species. Species with no potential of occurring at the survey areas e.g. marine species were removed from this list.

The potential for threatened and priority fauna to occur was assessed based on species distribution, habitat requirements and local species knowledge.

2.9 BIRD LIFE AT SITE

The eBird database was interrogated to determine species previously recorded on site. Consultation was undertaken with local birders, Bird Life Australia and the Friends of Yellagonga to confirm species diversity. Stakeholders also provided information on preferred bird viewing locations and opportunities.

2.10 LANDSCAPE ASSESSMENT

The landscape assessment was undertaken by Ecoscape in tandem with the environmental assessment. The landscape assessment identifies functional and cultural factors that apply to the sites in addition to outlining the criteria for the installation of bird hide structures at each of the sites. The assessment included the following tasks:

- Background literature review
- Site visit
- Summary of landscape elements at each site
- Review of existing bird viewing structure precedents.

2.10.1 BACKGROUND LITERATURE REVIEW

A background literature review was undertaken. The key text for this is the *Yellagonga Regional Park Management Plan 2003-2013.* The draft *Wanneroo Recreation Precinct Master Plan* was also reviewed in relation to the study area overlap with sites two and five.

2.10.2 SITE VISIT

The site visit was undertaken on the 15th of May at the same time as the environmental survey. Ecoscape staff visited the five sites, initially with City officers to get an overview and then followed up with recording and photo documentation of on-site conditions. The assessment included the following key elements:

- Site Approach
- Topography
- Vegetation
- Parking
- Water Access
- Views
- Appeal
- Constraints and Considerations

An appreciation of each site and the overall context of the reserve was gained through the site visit. This has been used as the basis for the landscape assessment.

Refer **Map 6** for landscape assessment of each site.

2.10.3 PRECEDENT STUDY

There are several bird viewing structures located in reserves throughout the metropolitan area that have provided guidance on what the new structures may be in terms of functional and material aspects. These include:

- Narma Kullarck bird walk at Bibra Lake, a larger boardwalk type structure
- Baumea bird hide at Herdsman Lake, a smaller pier type structure

A thorough description of the Narma Kullark bird walk has been provided by Denise Crosbie at the Cockburn Wetland Centre that has been used to help define the bird viewing structure requirements. Mention as well should be given to the Studmaster Park lookout located to the south of the site that is popular for providing an elevated view of the lake and has been mentioned by several stakeholders.

2.10.4 STAKEHOLDER ENGAGEMENT

Contact with key stakeholders was made by Ecoscape on 14th May. Stakeholders were notified by email of the project and asked to contact Ecoscape with any information they felt was important to share. Ecoscape made followup calls to some stakeholders that had been identified as having a preference for specific locations so that their preferences could be better understood and included in the assessment. Stakeholder engagement was undertaken by phone and email due to COVID-19 restrictions in place during the study.

The stakeholders contacted are all very knowledgeable about the site and type of facility being proposed and provided valuable information on local conditions and the types of features a bird viewing structure should include. A previous site visit undertaken by the City and stakeholders through which the five sites had been decided and preferences noted formed the basis for conversations and allowed an efficient transfer of information.

Information provided by BirdLife Australia has been particularly useful for defining the requirements of the facility's users. Local birders have also been generous with information about the qualities of the locations and why they are worth considering and concerns they may have with the sites.

Table 1: Key Stakeholders

Name	Organisation	Position
Tim Fisher	DBCA	Manager Regional Parks Unit
Lori-Ann Shibish	DBCA	Community Liaison Officer –Regional Parks Unit
Plaxy Barrett	BirdLife WA	Shorebirds Coordinator
Tegan Douglas	BirdLife WA	Citizen Science Project Coordinator
Vicky Stokes	BirdLife WA	Program Manager
Barry Poole	Friends of Yellagonga Regional Park	Volunteer, long-term
Heather Chester	Friends of Yellagonga	Secretary
Gary Tate	Local renowned wildlife photographer	
Phil Snow	Local bird photographer, videographer	

3 DESKTOP AND ENVIRONMENTAL SITE ASSESSMENT RESULTS

3.1 LAND TENURE

Tenure of lots intersecting potential project areas were assessed to identify potential complexities. The results are shown in **Map 5** and summarised in **Table 2**.

Table 2: Tenure investigation

Site	Tenure Intersecting	Tenure Complexity
Site 1	Reserve-City of Wanneroo Freehold-Water Corporation Freehold-Ministry for Planning Public Road corridor	High
Site 2	Crown Land- City of Wanneroo managed as reserve	Low
Site 3	Crown Land- City of Wanneroo managed as reserve Unallocated Crown Land- DBCA managed as reserve	Moderate
Site 4	Crown Land- City of Wanneroo managed as reserve Unallocated Crown Land- DBCA managed as reserve	Moderate
Site 5	Crown Land- City of Wanneroo managed as reserve	Low

3.2 ABORIGNAL AND EUROPEAN HERITAGE

The reserve is recognised as falling within the Whadjuk People Indigenous Land Use Agreement area. It is recognised that the entirety of the wetland systems of the Perth region would have been extensively used by Aboriginal people and continue to be significant to Aboriginal people.

All potential sites are shown by the Aboriginal Heritage Inquiry System as intersecting with registered aboriginal site 3740-Lake Joondalup (Department of Planning Lands and Heritage 2019) accessed 12/05/2020. The location is recognised as a mythological, camping and hunting location. No specific restrictions are applied to this site. If significant disturbance to the site is identified as likely as a result of these works an application for consent under Section 18 of the Aboriginal Heritage Act should be sought.

The European land usage history for the area is largely market gardening and agriculture. Sections of revegetation works have been undertaken since the area was transferred to reserve. No significant European heritage sites were identified during surveys or in discussion with City and stakeholders.

3.3 ENVIRONMENTAL CONSIDERATIONS

3.3.1 ASSETS

VEGETATION

A desktop assessment of pre European vegetation present at the sites was undertaken. Heddle *et al.* 1980 divided the Swan Coastal Plain into medium to large areas based on soil and landform units, with the vegetation within these areas defined in terms of floristic composition, growth-form dominance, species composition and stratal structure.

According to Heddle et al. (1980), there is two vegetation complexes intersecting the sites.

Herdsman Complex-Sedgelands and fringing woodland of *E. rudis* - *Melaleuca* spp.

Karrakatta Complex, Central and South-Predominantly low open forest of *E. gomphocephala* - *E. marginata* - *E. calophylla* and woodland of *E. marginata* - *Banksia* spp.

The results of the Ecoscape 2020 surveys are described below. The results of an Eco Logical 2016 survey covering sites three and four were considered when preparing the vegetation descriptions. Seven floristic releves were undertaken, describing six vegetation types. These vegetation types are described in **Table 3** and shown in **Map 3.** Full releve data is provided in **Appendix One, Quadrat Data Sheets**. The extent of the vegetation types at each site is summarised in **Table 4**.

Table 3 Vegetation Types

Vegetation Type	Quadrats	Vegetation Images	
Eucalyptus rudis and *Corymbia calophylla* forest-Degraded condition *Eucalyptus rudis* subsp. *rudis*, *Corymbia calophylla* mid open forest over *Allocasuarina fraseriana* tall isolated shrubs, understory very open and dominated by weedy grass species mainly **Avena* and **Bromus*	01		
Melaleuca rhaphiophylla tall shrubland over *Typha orientalis* sedgeland-Degraded condition *Melaleuca rhaphiophylla* tall shrubland over *Typha orientalis, Cenchrus clandestinus, Cynodon dactylon* tall closed sedgeland/grassland. *Baumea articulata* also common in sections.	02 07		

Vegetation Type	Quadrats	Vegetation Images	
Baumea articulata, Typha orientalis rushland-Degraded condition *Baumea articulata, Typha orientalis* Tall rushland/ sedgeland, grass weed species *Cenchrus clandestinus*, *Cynodon dactylon* common in drier areas.	03		
Melaleuca preissiana, Banksia littoralis forest-Degraded condition *Melaleuca preissiana, Banksia littoralis* subsp. *littoralis* low open forest over *Jacksonia furcellata* tall isolated shrubs over *Lepidosperma leptostachyum* mid sedgeland. Grass weeds *Avena* sp. and *Cynodon dactylon* common.	04		No image

Vegetation Type	Quadrats	Vegetation Images	
Eucalyptus rudis and *Banksia* woodland- Good condition with degraded patches *Eucalyptus rudis* subsp. *rudis*, *Banksia attenuata*, *Banksia ilicifolia* mid woodland over *Lepidosperma squamatum*, *Avena barbata* sedgeland/ grassland. Mid story is mostly absent. Weed species *Avena barbata* and *Carpobrotus edulis* common.	05		
Eucalyptus rudis woodland over *Melaleuca rhaphiophylla*- Degraded condition *Eucalyptus rudis* subsp. r*udis* mid woodland over *Melaleuca rhaphiophylla* tall shrubland over **Cenchrus clandestinus, Baumea articulata, Typha orientalis* mid closed grassland/sedgeland	06		

Table 4: Vegetation Types Extent

Site	Regional Vegetation Complex (Heddle *et al* 1980)	Vegetation Types (Ecoscape 2020)	Condition and extent
Site 1	Herdsman Complex	*Eucalyptus rudis* and *Corymbia calophylla* forest	Degraded - 1.76 ha
		Melaleuca rhaphiophylla tall shrubland over *Typha orientalis* sedgeland	Degraded - 0.39 ha
Site 2	Herdsman Complex	*Baumea articulata, Typha orientalis* rushland	Degraded - 0.73 ha
Site 3	Karrakatta Complex-Central and South and Herdsman Complex	*Eucalyptus rudis* and *Banksia* woodland	Good - 0.94 ha
		Melaleuca preissiana, Banksia littoralis forest	Degraded - 0.38 ha
		Melaleuca rhaphiophylla tall shrubland over *Typha orientalis* sedgeland	Degraded - 0.41 ha
Site 4	Karrakatta Complex-Central and South and Herdsman Complex	*Eucalyptus rudis* and *Banksia* woodland	Degraded - 1.13 ha
		Melaleuca rhaphiophylla tall shrubland over *Typha orientalis* sedgeland	Degraded - 0.76 ha
Site 5	Herdsman Complex	*Baumea articulata, Typha orientalis* rushland	Degraded - 0.58 ha
		Eucalyptus rudis woodland over *Melaleuca rhaphiophylla*	Degraded - 0.86 ha

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The City's Environmental Planning Conditions Report and The Protected Matters Search Tool (Australian Government & Department of Agriculture Water and the Environment 2020) were interrogated using a 5 km buffer around a point approximating the centre of the sites, identified two EPBC-listed TECs:

- Banksia Woodlands of the Swan Coastal Plain (Endangered) – 'likely to occur' within the search area buffer
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain (Critically Endangered) – 'likely to occur' within the search area buffer.

The DBCA database search (search reference 02062020) was undertaken using a 5 km buffer surrounding the survey area. The search identified one Commonwealth EPBC Act-listed TEC, one Western Australian BC Act-listed TEC and four PECs listed by DBCA

The results of the desktop assessment are shown in **Map 1.**

The results of the desktop and site assessment are summarised below in **Table 5**.

Table 5: Threatened and Priority Ecological Communities Assessment

Site	Desktop	Site Assessment of TEC or PEC
Site 1	Commonwealth and State listed threatened ecological community identified- Banksia Woodlands of the Swan Coastal Plain	Not present
Site 2	Commonwealth and State listed threatened ecological community identified- Banksia Woodlands of the Swan Coastal Plain	Not present
Site 3	Commonwealth and State listed threatened ecological community identified- Banksia Woodlands of the Swan Coastal Plain	Vegetation type *Eucalyptus rudis* and *Banksia* woodland highly likely to qualify as TEC, as part of a larger block. Vegetation is representative of Banksia dominated woodlands of the Swan Coastal Plain IBRA region PEC (Priority 3).
Site 4	Commonwealth and State listed threatened ecological community identified- Banksia Woodlands of the Swan Coastal Plain	Vegetation type *Eucalyptus rudis* and *Banksia* woodland highly likely to qualify as TEC, as part of a larger block. Vegetation is representative of Banksia dominated woodlands of the Swan Coastal Plain IBRA region PEC (Priority 3).
Site 5	Commonwealth and State listed threatened ecological community identified- Banksia Woodlands of the Swan Coastal Plain	Not present

The areas of remnant vegetation type *Eucalyptus rudis* and *Banksia* woodland dominated by *Banksia* species are consistent with the description of the TEC *Banksia dominated woodlands of the Swan Coastal Plain IBRA region* (Threatened Species Scientific Committee 2016). This community is commonly known as the Banksia Woodlands TEC.

The structural features of the community are:

- upper stratum dominated or co-dominated by one or more *Banksia* tree species, most commonly *B. attenuata* and *B. menziesii* and occasionally *B. prionotes* or *B. ilicifolia* but not, as a dominant species, *B. littoralis*
- species rich understorey of sclerophyllous shrubs and ground stratum of cord rushes, sedges and ephemeral herbs including grasses.
- restored (revegetated or replanted) sites are not excluded for inclusion in the TEC as long as they meet the description, key diagnostic characteristics and condition thresholds and there is evidence of post-regeneration recruitment.

The criteria for inclusion in the TEC includes the soils and landform, structure and composition, and condition thresholds (minimum patch size for each condition level as below).

Table 6: Keighery (1994) Vegetation Condition

Keighery (1994) Vegetation Condition	Minimum Patch Size for Inclusion
Pristine	No minimum
Excellent	0.5 ha
Very Good	1 ha
Good	2 ha

The areas identified at sites three and four form part of a larger area of *Banksia* vegetation of approximately 20ha size. This block when considered as a whole, as required under guidelines is highly likely to qualify under the listing criteria. The vegetation is also representative of a Western Australian-listed Priority Ecological

Community (PEC) that does not have size and condition thresholds (Banksia dominated woodlands of the Swan Coastal Plain IBRA region PEC (Priority 3).

THREATENED AND PRIORITY FLORA

A search of DBCA's databases was conducted (search reference 27-0520FL) using a 5 km buffer around the survey area (TPFL List, taken from Threatened and Priority Flora Report Forms and DBCA surveys, and WA Herb, taken from vouchered specimens held in the Western Australian Herbarium). DBCA database search results are shown on **Map 1**.

No threatened or priority flora were identified by the desktop as intersecting the survey areas. Low intensity targeted survey traverses did not identify any threatened or priority species during the site investigations. Due to the degraded nature of the areas surveyed and the low observed flora diversity it is considered unlikely that the areas support priority flora populations.

THREATENED AND PRIORITY FAUNA

A search of DBCA's databases was conducted (search reference 2020/000669 #6339) using a 5 km buffer around the survey area. The results are shown in **Map 2** and summarised in **Table 7**. Within close proximity of the sites (less than two kilometres) the vast majority of records relate to bird species. The species of greatest significance in the area is the endangered Carnaby's Cockatoo. Quenda (P4) was the only terrestrial animal identified in close proximity to the sites by the database search, however the Yellagonga Regional Park Management Plan identifies Western Brush Wallaby (P4), Rakali (P4) and Carpet Python (other specially protected) as potentially occurring.

Broad habitat types were identified during the site investigation. In addition areas of significant sized trees were identified. These are shown in **Map 4.**

Broad habitat types identified were:

Sedges and Rushes- Dense sedge and rushland with significant volume of Kikuyu and Couch grass. Area is generally inundated. Scattered Melaleucas and Flooded Gums. This habitat type supports wading and reed bird species, frogs, Tiger Snake and potentially Rakali.

Woodland- Woodland of Flooded Gums, Marri and scattered Melaleucas with sections of Banksia woodland. Mid stratum with scattered native shrub species. This habitat type supports a range of bushbirds and potentially reptiles including Carpet Python, Western Tiger Snake, Bobtail and other terrestrial fauna such as Quenda, Echidna and Western Brush Wallaby (Department of Conservation and Land Management, 2003)

Parkland- Mature trees including Marri, Jarrah, Tuart, Melaleucas and European species over maintained grass. Provided some habitat for parkland birds and nesting/ roosting opportunities in mature trees for other species.

Open Water- Open sections of the lakebed. Area periodically dries out over summer months creating system of mudflats. This habitat type supports a high diversity of wading and migratory bird species.

Table 7: Threatened and Priority Fauna Assessment

Site	Desktop	Site Assessment
Site 1	Quenda (P4) records in close proximity to sites	Areas of Woodland and drier Sedges and Rushes habitat type provide some habitat for Quenda and other terrestrial animals. Very open and degraded understory significantly limits habitat quality. Groves of large Marri and Flooded Gums provide roosting and some feeding opportunities for Black Cockatoo species. Lack of mid story or proteaceous species limits feeding opportunities for Black Cockatoo species. Area of Sedges and Rushes habitat may provide some opportunity for Rakali. Open Water area provides habitat for wading and migratory bird species
Site 2	Quenda (P4) records in close proximity to sites	Narrow section of Sedges and Rushes habitat between Open Water and Parkland does not provide high habitat value for priority species identified. Area of Sedges and Rushes habitat may provide some opportunity for Rakali. Open Water area provides habitat for wading and migratory bird species.
Site 3	High number of records for Carnaby's Cockatoo (Endangered) in close proximity to the site. The site is within a "Confirmed" roosting area buffer	Areas of Woodland and drier Sedges and Rushes habitat type provide some habitat for Quenda and other terrestrial animals. Presence of some understory improves habitat values. Areas of Banksia woodland with native shrub species present provide feeding habitat for Black Cockatoo species. Area of Sedges and Rushes habitat may provide some opportunity for Rakali. Open Water area provides habitat for wading and migratory bird species
Site 4	High number of records for Carnaby's Cockatoo (Endangered) in close proximity to the site. The site is within a "Confirmed" roosting area buffer	Areas of Woodland and drier Sedges and Rushes habitat type provide some habitat for Quenda and other terrestrial animals. Presence of some understory improves habitat values. Areas of Banksia woodland with native shrub species present provide feeding habitat for Black Cockatoo species. Groves of large Marri, Tuart and Flooded Gums provide roosting and some feeding opportunities for Black Cockatoo species. Area of Sedges and Rushes habitat may provide some opportunity for Rakali. Open Water area provides habitat for wading and migratory bird species
Site 5	Quenda (P4) records in close proximity to sites	Area of Sedges and Rushes habitat may provide some opportunity for Rakali. Open Water area provides habitat for wading and migratory bird species

BIRD LIFE

Lake Joondalup and Yellagonga Regional Park are recognised as a significant hotspot for birdwatching in the Perth region. The wetlands in YRP serve as an important breeding ground and summer refuge for a diverse bird population, some of which are trans-equatorial migratory wading birds. A number of migratory birds listed under the Japan Australia Migratory Birds Agreement (JAMBA) and the China-Australia Migratory Birds Agreement (CAMBA) have been sighted at YRP (Department of Conservation and Land Management, 2003). As the lake dries in late summer and autumn waterbird populations peak as mudflats become exposed.

A search of eBird data for Lake Joondalup identified 154 species as having previously been recorded. Communications with local birdwatching groups suggest there may be up to 170 species that utilise the area. Results of eBird database search are presented in **Table 8.** Feedback from stakeholders regarding site preference for bird watching opportunities is discussed in **Section 4**.

Table 8: Bird Records

Shorebirds	Waterfowl	Rails, Gallinules, and Allies
Pied Stilt	Domestic goose sp. (Domestic type)	Buff-banded Rail
Banded Stilt	Freckled Duck	Black-tailed Native hen
Red-necked Avocet	Black Swan	Australian Crake
Pacific Golden-Plover	Australian Shelduck	Dusky Moorhen
Banded Lapwing	Muscovy Duck (Domestic type)	Eurasian Coot
Red-capped Plover	Maned Duck	Australasian Swamphen
Red-kneed Dotterel	Australian Shoveler	Baillon's Crake
Hooded Plover	Pacific Black Duck	Spotless Crake
Black-fronted Dotterel	Mallard (Domestic type)	
Black-tailed Godwit	Gray Teal	
Hudsonian Godwit	Chestnut Teal	
Sharp-tailed Sandpiper	Pink-eared Duck	
Long-toed Stint	Hardhead	
Red-necked Stint	Blue-billed Duck	
Pectoral Sandpiper	Musk Duck	
Common Greenshank		
Marsh Sandpiper		
Wood Sandpiper		
Gulls, Terns, and Skimmers	**Cormorants and Anhingas**	**Herons, Ibis, and Allies**
Silver Gull	Australasian Darter	Black-backed Bittern
Gull-billed Tern	Little Pied Cormorant	Pacific Heron
Caspian Tern	Great Cormorant	Great Egret
White-winged Tern	Little Black Cormorant	Intermediate Egret
Whiskered Tern	Pied Cormorant	White-faced Heron
Chlidonias sp.		
Pelicans	**Kingfishers**	**Grebes**
Australian Pelican	Laughing Kookaburra	Australasian Grebe
	Sacred Kingfisher	Hoary-headed Grebe
		Great Crested Grebe
Grouse, Quail, and Allies	**Frogmouths**	**Swifts**
Brown Quail	Tawny Frogmouth	Pacific Swift
Cuckoos	**Falcons and Caracaras**	**Pigeons and Doves**
Horsfield's Bronze-Cuckoo	Australian Kestrel	Rock Pigeon
Shining Bronze-Cuckoo	Australian Hobby	Spotted Dove
Pallid Cuckoo	Brown Falcon	Laughing Dove
Fan-tailed Cuckoo	Peregrine Falcon	Common Bronzewing
		Crested Pigeon

Vultures, Hawks, and Allies Osprey Black-shouldered Kite Oriental Honey-buzzard Square-tailed Kite Little Eagle Wedge-tailed Eagle Swamp Harrier Spotted Harrier Brown Goshawk Collared Sparrowhawk Brown Goshawk Collared Sparrowhawk Whistling Kite White-bellied Sea-Eagle	**Cockatoos** Red-tailed Black-Cockatoo Carnaby's Black-Cockatoo black-cockatoo sp. Galah Long-billed Corella Western Corella Little Corella Sulphur-crested Cockatoo	**Parrots, Parakeets, and Allies** Regent Parrot Australian Ringneck Western Rosella Red-capped Parrot Purple-crowned Lorikeet Rainbow Lorikeet
Owls Southern Boobook	**Bee-eaters, Rollers, and Allies** Rainbow Bee-eater	**Monarch Flycatchers** Magpie-lark
Fairywrens Purple-backed Fairywren Splendid Fairywren	**Bellmagpies and Allies** Gray Butcherbird Australian Magpie	**Fantails** Willie-wagtail Gray Fantail
Thornbills and Allies White-browed Scrubwren Western Thornbill Inland Thornbill Yellow-rumped Thornbill Weebill Western Gerygone	**Whistlers and Allies** Gray Shrikethrush Western Whistler Rufous Whistler	**Honeyeaters** Western Spinebill Western Wattlebird Red Wattlebird Singing Honeyeater White-fronted Chat Black Honeyeater Brown Honeyeater New Holland Honeyeater White-cheeked Honeyeater
Pardalotes Spotted Pardalote Striated Pardalote	**Jays, Magpies, Crows, and Ravens** Australian Raven	**Australasian Robins** Red-capped Robin
Reed Warblers and Allies Australian Reed Warbler	**Grassbirds and Allies** Little Grassbird Brown Songlark	**Cuckooshrikes** Black-faced Cuckooshrike White-winged Triller
Martins and Swallows Welcome Swallow Tree Martin White-backed Swallow	**Sittellas** Varied Sittella	**White-eyes, Yuhinas, and Allies** Silvereye
Woodswallows Dusky Woodswallow	**Flowerpeckers** Mistletoebird	**Estrildids** Zebra Finch
Wagtails and Pipits White Wagtail		

BUSH FOREVER

Regionally significant bushland was identified under the Bush Forever Scheme following its introduction in 2000 (Government of Western Australia 2000).

All sites fall within Bush Forever Site 299- Yellagonga Regional Park, Wanneroo/Woodvale/Kingsley.

ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas around Western Australia identified as being of environmental significance, within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the Environmental Protection (Environmentally Sensitive Areas) Notice (Government of Western Australia 2005).

All sites fall within ESA mapping. The ESA extent in these areas is associated with Conservation class wetland mapping and the Yellagonga Regional Park.

3.3.2 THREATS

ACID SULPHATE SOILS

Assessment of the DWER Acid Sulphate Soils (ASS) Risk Map (Department of Water and Environmental Regulation 2019) accessed 12/05/2020 (Department of Water and Environmental Regulation 2019) shows all sites are categorised as High-Moderate Risk for ASS. The listing of the area as high to moderate risk requires that potential soil disturbance is considered for all proposed works in the mapped area. Disturbance of or exposure to oxygen of the ASS has potential to cause significant environmental impacts.

If any soil disturbing works or excavations are planned for the area, a specific ASS investigation and management plan would likely be required to mitigate risks

CONTAMINATED SITES

No proposed sites are mapped as contaminated sites (Government of Western Australia & Department of Water and Environmental Regulation 2020) accessed 12/05/2020.

WEEDS

Significant weed invasion was present at all sites. No declared pest plants or Weeds of National Significance were recorded during the surveys, however during spring surveys in 2016 Eco Logical identified Bridal Creeper (*Asparagus asparagoides*), Arum Lily (*Zantedeschia aethiopica*) and One Leaf Cape Tulip (*Morea flaccida*) as occurring in the area.

Common widespread weed species in dryland areas are:

- Annual and Perennial Veldt Grass (*Ehrharta longiflora* and *Ehrharta calycina*)
- Wild Oats (*Avena barbarta*)
- Couch Grass (*Cyndon dactylon*)
- Geraldton Carnation Weed (*Euphorbia terracina*)
- Pelargonium (*Pelargonium capitatum*)
- Sandplain Lupin (*Lupinus cosentinii*)

Wetland areas are heavily dominated by invasive or overabundant native weedy species. The main species observed were:

- Bulrush (*Typha orientalis*)
- Kikuyu (*Cenchrus clandestinus*)

- Couch Grass (*Cyndon dactylon*)
- Water Couch (*Paspalum* sp.)
- Giant Reed (*Arundo donax*)

DIEBACK

Dieback has been identified as a key threat to vegetation in the regional park. A number of species and vegetation types occurring in YRP have been identified as being highly susceptible to dieback including *Banksia* species, Grasstrees (*Xanthorrhoea* sp.) and Jarrah (City of Joondalup, 2015). General hygiene practices should be enacted during construction of any trails or bird viewing infrastructure. The susceptibility of vegetation at each site is summarised below in Table 9.

Table 9: Dieback Susceptibility

Site	Vegetation Types (Ecoscape 2020)	Susceptibility to Dieback
Site 1	*Eucalyptus rudis* and *Corymbia calophylla* forest	Moderate
	Melaleuca rhaphiophylla tall shrubland over *Typha orientalis* sedgeland	Very Low
Site 2	*Baumea articulata, Typha orientalis* rushland	Very Low
Site 3	*Eucalyptus rudis* and *Banksia* woodland	High
	Melaleuca preissiana, *Banksia littoralis* forest	High
	Melaleuca rhaphiophylla tall shrubland over *Typha orientalis* sedgeland	Very Low
Site 4	*Eucalyptus rudis* and *Banksia* woodland	High
	Melaleuca rhaphiophylla tall shrubland over *Typha orientalis* sedgeland	Very Low
Site 5	*Baumea articulata, Typha orientalis* rushland	Very Low
	Eucalyptus rudis woodland over *Melaleuca rhaphiophylla*	Low

4 LANDSCAPE ASSESSMENT

4.1 CURRENT USE AND NEED

Amongst birders and other recreational users of the YRP there is a high demand for locations that cater to bird watching, nature appreciation and connection to the water. In addition to bird watching, the reserve is a popular destination for walkers, joggers and cyclists that use the shared path and trails encircling the lake. There are however few locations where the public can get close to the water due to the dense fringing vegetation and lack of accessible points. The western side of the Lake has the jetty at Neil Hawkins Park which has some provision, however this doesn't cater to the needs of bird watchers or have the educational qualities commonly associated with wetland structures.

Existing bird watching activities generally take advantage of natural features and geographic locations at the edge of the lake. These include spurs or old tracks that occur perpendicular to the shoreline or in broader areas such as the Joondalup Lake Park that has become a popular destination following sightings of the Oriental Honey Buzzard. Informal bird watching destinations are situated in both recreational and bushland areas and are generally aimed at viewing water birds when the lake is full and waders as the lake seasonally dries in summer.

The Yellagonga Regional Park Management Plan defines the recreational value of the Reserve and states that, "the wide variety of natural features such as the lakes wetlands and bushland areas provide visitors with a multitude of experiences and recreational opportunities". Bird watching is identified as one of these opportunities along with bushwalking, general nature observation and other recreational pursuits such as cycling. Some of the selected sites for consideration are also in close proximity to sports fields, playgrounds and other active uses.

Bird viewing structures have the potential to create destinations with the reserve complementing existing uses and supplementing the larger recreational nodes such as the Wanneroo Recreation Centre and Rotary Park and helping promote the value of natural areas. These destinations become integral to the lake experience and encourage active use by visitors who will seek them out or consider further exploration of the reserve. The structures also have the potential to provide access to the water and educational opportunities for organised school group and tertiary students, in addition to interpretive information for the general public.

Given the passive nature of the structures, broad appeal and community value there is potential for the development of a structure, or structures, in the reserve. The sites and structures proposed are for viewing aquatic and wading bird species at the lake. Other bird species, such as the bushland birds may be visible from the locations however don't form part of this study.

4.2 ACCESSIBILITY

The City's Access and Inclusion Plan aims to provide accessibility to all of the City's facilities as an integral part of strategic and community development. The bird viewing structures will be developed in accordance with the plan and provide for the whole community and improve accessibility opportunities for people with a disability to use Public Open Space facilities. Accessibility will be considered in the approach to sites, the design of structures and the availability of information on informational signage.

In recreational and natural areas, this access is defined through the provision of pedestrian and wheelchair accessible approaches in accordance with the Australian Standards to achieve compliance with the Disability and Discrimination Act (DDA). The main standards that define this access include:

- AS 1428.1 Design for Access and Mobility- General Requirements for Access
- AS 2156.2 Walking Track Infrastructure
- AS 2690.1 Design for Off-Street Parking
- Building Code of Australia (BCA).

A key objective for the design of the structures is provision of DDA compliant access to the structure. For this assessment access is categorised as:

- *Site Approach*, access from the reserve boundary to the shore
- *Water Access,* from the shore to the bird viewing location.

Each has separate criteria for consideration. The approach is largely dependent on existing conditions that will not be modified in the planning and design of the structures but have a bearing on planning and siting. The water access will involve consideration of the bird viewing structures and their design requirements. Both are interrelated and to be considered in the decision making process.

4.2.1 SITE APPROACH

Accessibility of the approach is generally dictated by existing conditions such as proximity to recreational facilities or the impact of topographic features on path grades. The assessment has considered the approach in terms of how DDA compliant the current approach is and what would be required to provide the access to the location. Key elements are considered to be topography, which determines the gradient of paths accessing the site and nearby parking locations. Connections to YRP's shared path are considered for pedestrian and cycle connectivity of the locations. Provision of bicycle access and secure parking should also be included in the design of structures to encourage more sustainable means of visiting the lake.

The location and provision of new access to the structures should consider the lake environs and use existing tracks for proposed pathways to minimise impacts on remnant or planted trees and shrubs.

4.2.2 WATER ACCESS

Access to the water is dictated by site features such as level changes, existing vegetation and preferred viewing locations, all of which are considered in the planning and design process. The type of structure is also of importance when affirming site suitability and each site should be considered in terms of its potential to accommodate either a pontoon boardwalk or pier type structure

4.2.3 USER EXPERIENCE

Consideration of access from the shore to the lake takes into account the type of experience that is desired. The key objectives of watching include getting a good vantage and approaching the site without disturbing the bird life. Through conversations with stakeholders, additional considerations came to light including, for some, the importance of getting close to the water to get better angles for viewing and photographing and for others getting an elevated experience that provides long views and vistas to the open water of the lake. The lower connection to the water is a desirable quality for birders and the elevated experience would likely be more popular with the general public. Also highly desirable is the opportunity to look back towards the Lake's eastern shoreline for sunset photography to increase the potential viewing times.

4.2.4 FURTHER CONSTRAINTS AND CONSIDERATIONS

Each site has specific constraints and considerations described in the assessment. Some of the sites are located near known bird-nesting areas. Care must be taken to avoid disturbing these areas, which may be achieved through the design or by avoiding the site entirely.

4.2.5 CLIMATE CHANGE

The ongoing trend due to climate change is for longer, hot periods, increased evapotranspiration and reduced water volumes at Lake Joondalup and higher bushfire risk in bushland areas. The result of this may be changes to:

- Water levels both seasonally and annually
- Water quality
- The frequency of some bird types, for example waders when water levels are low
- Migratory bird movements and natural range of all species
- The Lake's fringing vegetation, bushland and bird habitat
- Accessibility for ramps and structures at the water's edge
- Distance to deep water and viewing areas from the shoreline
- Storm and heat damage to structures
- Bushfire attack hazards
- Desirability of natural areas due to Urban Heat Island effects.

The bird viewing structures are an opportunity to highlight the importance of natural habitat and increase value in the community through signage and education.

4.3 STRUCTURE TYPES

There are several types of bird viewing structures that have been successfully implemented in reserves that can be used as benchmarks for the project. Broadly, they fall into two categories including:

- Pontoon and shelter
- Pier and shelter.

Selection of a structure type for a given site involves several factors, notably the expected usage demand in a given location and appropriateness of the structure to its setting.

4.3.1 PONTOON AND SHELTER

The pontoon and shelter type comprises of a boardwalk spanning from the shoreline to a floating pontoon structure that is situated on the water. The boardwalk requires a gangway articulated ramp link at the shore to allow for water level fluctuations. The span of the boardwalk can range from 20m to 80m depending on site conditions and may require additional gangways to achieve the levels required. The pontoon structure is of a larger scale, more suited to popular destinations where more users are expected. It has accessible deck to all sides that can be supplemented with steps to the water's edge and has the advantage of providing views to all sides including back towards the shore for late-afternoon photography. An example of this boardwalk structure is the Narma Kullarck Bird Walk at Bibra Lake.

Image 1: Narma Kullarck Bird Hide

Image 2: Narma Kullarck Bird Hide gangway access with hand rails

Image 3: Narma Kullarck boardwalk sections with raised edges through bushland

Image 4: Narma Kullarck boardwalk through sensitive wetland vegetation

4.3.2 PIER AND SHELTER

The pier and shelter type is a rigid structure that stays at a constant level. It comprises of an abutment set at the level of the shore and a boardwalk structure on piers extending towards the water body with the hide located at the end. This is a simplified structure that remains at the same level whilst lake water levels fluctuate and it is less suited to use in long boardwalk situations and is more suitable for hides located on the shoreline. An example of this is the Baumea bird hide at Herdsman Lake.

Image 5: Baumea Bird Hide entry

Image 6: Baumea Bird Hide view from lake

Image 7: Baumea Bird Hide view

Image 8: Baumea Bird Hide approach

4.3.3 TOWER

There is potential for an additional level to be incorporated into the structure so that panoramic views of the lake can be gained and this has been put forward by several stakeholders contributing to the study. This is possible however it is likely that access to the upper level will not be DDA compliant due to the ramp length required and access would need to be by a flight of stairs. It is feasible to locate a tower structure on the shore, close to the water's edge, however a floating structure would require considerable engineering inputs that impact on feasibility. Other considerations include:

- Visual impact and architectural style of the tower
- Engineering requirements and increased environmental impacts
- Additional cost involved with a larger structure.

The popularity of a tower structure may outweigh these considerations and should be seen in the context of the overall recreational strategy for the lake that could benefit from such an attraction.

Image 9: Lookout tower, Lake Richmond, Rockingham

4.4 VIEWING STRUCTURE GENERAL REQUIREMENTS

In addition to the general arrangement of the bird viewing structure that is determined by the site location and type of structure to be used, the following points are general considerations for the design of these facilities.

4.4.1 USER REQUIREMENTS

The following general user requirements have been developed based on research of existing bird hides and discussion with key stakeholders:

- Wide window sills for binoculars and books
- Internal seating for adults and kids to stand or kneel on
- External seating benches
- Kickrails to boardwalk or pier if no handrail is present
- Informational signage including bird ID board located inside the hide.
- A clear sight line from the access into the hide
- Slot windows at a variety of heights to cater for all users including wheelchair users
- Steps to the water's edge on the sides of the structure.

Additional user requirements for boardwalk type installations

- Perimeter access to outside of the hide with a roof overhead
- Step-down access to the water from the bird hide platform
- Possible inclusion of a second tier lake viewing platform with stair access
- Gangway structure with handrail connecting the boardwalk to the shore.

4.4.2 MATERIAL SELECTION

Material selection for the structures will aim for low impact and be durable to minimise ongoing maintenance costs. Materials will be selected that blend in with the environment as is appropriate for the location and use. The lake environment can also be corrosive and the City has a preference for Fibre Reinforced Decking and similar durable material selections. The following points are considerations for the selection of materials:

- Durability
- Simple construction
- High UV resistance
- Termite resistance
- Susceptibility to rot
- Low visibility
- Material compatibility
- Ease of maintenance
- Sustainability
- Fire resistance.

4.4.3 DESIGN SYSTEMS

The design system for boardwalks, piers and viewing structures will be modular to minimise wastage and allow for ease of assembly on site. The design system defines will be developed to:

- Minimise impact to the lake environment from piles and footings.
- Avoid disturbance of acid sulphate soils in the lake bed
- Consider use of floating Styrofoam-filled, pontoons to minimise disturbance of the lake bed
- Consider non-concrete or pile-less anchoring systems
- Design to avoid impact to fauna that may inhabit or seek refuge in the structure
- Design abutments and surrounding landscape to control public access and minimise damage to vegetation
- Minimise level changes to reduce the need for handrails and balustrades
- Design to avoid bushfire ember attack and other fire related damage
- Design to anticipate movement, loads and irregular settlement of the structure on fixings and connections.

Image 10: Abutment edge connecting to the approach path

Image 11: Kickrail used on all boardwalks for wheelchair safety

Image 12: Provide handrails along bird hide entry to contain access and for safety

Image 13: Provide a generous windowsill for books, binoculars and other equipment

Image 14: Gangway entry used to provide access onto a pontoon style boardwalk

Image 15: Pontoon style boardwalk anchoring pile

Image 16: External deck seating and steps down to water's edge for dab-netting

Image 17: Access to the hide with a clear sightline to the interior

Image 18: External furniture that allows views from the interior increasing the functionality of the hide and structure

Image 19: Interior of the hide with window at varying heights to allow for a range of users

Image 20: Informational signage showing plant species and Noongar naming in line with the City's Reconciliation Action Plan

Image 21: Informal step-downs into bushland for access

4.4.4 SITE IMPROVEMENTS

The installation of a bird viewing structure should be accompanied by site improvements. For a site that is environmentally degraded, site improvements such as revegetation and upgrade of paths can assist with containment of movement and ongoing management of the facility. For the sites near to Rotary Park this should be coordinated with the upgrades to the Recreational Precinct there. The following recommendations for site improvements are made.

- Provide path access to the proposed structure using materials that are appropriate to the location
- Include revegetation of the site area using locally sourced seed in either tubestock or direct seeded installation
- Rehabilitate disturbed areas and design surfaces to assist in site management such as weed control.

4.4.5 CONSTRUCTION

There are a range of considerations when installing structures in natural areas and aquatic environments. The following points are provided. This list is not exhaustive and it is expected that a Construction and Environment Management Plan (CEMP) would be prepared for a site prior to construction.

- Prefabricate wherever possible to avoid cutting materials on site i.e. plastic shavings
- Minimise disturbance to existing vegetation and trees
- Manage turbidity and sediment movement in the water body caused by site operations
- Manage and minimise waste on site.

The CEMP will also need to include:

- An Acid Sulphate Soil management plan
- Section 18 – indigenous approval
- Environmentally Sensitive Area approval from DWER as part of Clearing Regulations.

4.4.6 MONITORING AND MAINTENANCE

The viewing structure will be an asset managed by the City and needs to function in its purpose without becoming a maintenance burden. The structure will then need to be included in the City's asset maintenance plan with consideration of the following items:

- Design life
- Vandalism
- Corrosive environment
- Pest infestation
- Potential site for ongoing water quality monitoring.

4.5 LANDSCAPE ASSESSMENT FINDINGS

Refer to **Map 6** for accompanying landscape assessment maps.

4.5.1 ASSESSMENT SITE 1: ARITI AVENUE

Image 22: Site 1 view facing north

Site Approach

The approach to the site is via the unsealed management track that is an extension of Ariti Avenue. The track is well connected to the local neighbourhood street and the Lake Joondalup Shared Path. A single track trail also approaches the site from the south. The track is in good condition and appears well used. It is possible to access the water from the path relatively easily. Due to the extensive tree canopy provided by *Eucalyptus rudis* stands the access is well shaded and sheltered. The natural trail experience that has evolved here and is valued by lake visitors should be considered in the siting of a structure that is likely to require new surfaces and materials.

Topography

The topography is mild and relatively flat throughout which provides ease of access to the water's edge. Internal to the site a small pond forming part of the Water Corporation's storm water system provides additional habitat.

Vegetation

The site has significant stands of *Eucalyptus rudis* Flooded Gum that provide enclosure to the access track and existing informal viewing area. The gums are an important component of the site character providing shade and protection from the westerly wind in combination with an understorey of local native species shrubs that are used by bushland bird species. Sedges and rushes define the viewing space occurring on small islands to the west and in denser banks toward the shoreline.

Parking

There is no formalised parking in the location and access to the broad hardstand area between Scenic Drive and the track is restricted. There is potential for parking to be included in the broad western verge of Scenic Drive in proximity to the site. The area immediately south of Ariti Avenue is a favoured location for the nesting of the Rainbow Bee Eaters so any proposal to install parking should be north of the intersection.

Water Access

The elevation change from the track to the water level is minimal which can be advantageous for DDA compliant access. The logical take-off point is northward towards the small lagoon that accesses the main viewing area and is sheltered from prevailing winds on the open water. Due to the extension of the landform past the main bank of vegetation a structure of around 10m length to the viewing area would be required.

Views

The main viewshed is towards the small lagoon north of the site. The view is enclosed by vegetation and focused on the lagoon. Filtered views of the open water occur towards the west through the Flooded Gum stands.

Appeal

The site has a natural enclosure and landform that shelters the lagoon and a reach of water that is popular for sighting water bird species. The substantial tree canopy provides shade and shelter from the wind and for sightings of bushland bird species.

Constraints and Considerations

It has been noted by BirdLife Australia that access to the location has been restricted occasionally due to Water Corporation operations on the adjacent site and by a local birder that the area has nesting habitat that may be disturbed by the inclusion of a new structure and increased use.

4.5.2 ASSESSMENT SITE 2: LAKE JOONDALUP PARK

Image 23: Site 2 view facing north

Site Approach

Current access to the site is from the car park on Scenic Drive, at Clarkside Park, or from the Opportunity Park and recreational centre. The Joondalup Lake Shared Path is aligned to Scenic Drive and there is not a path to access the location. The approach to the site is across the open lawn and does not pass through any natural areas before arriving at the lake. The Recreation Precinct Master Plan has recommendations for significant changes to access in the location that should be taken into consideration, including relocation of the shared path alongside the site.

Topography

The location is relatively flat and the top of the embankment at the shoreline is well elevated above the water. It would be possible to utilise this height difference to achieve universal access to an elevated structure.

Vegetation

The area's vegetation includes few canopy trees, the sedges and rushes of the lake and a substantial Melaleuca thicket. Due to the oval lawn there is no significant understorey however the Melaleuca thicket is known to be frequented by bushland bird species such as wrens. Any design for the location should consider extensive planting of local native species on the shore embankment to enhance the site's environmental values. On the water, the sedges and rushes form a significant physical barrier that a boardwalk structure would need to traverse to achieve a good vantage for the structure.

Parking

Parking occurs near the site on Scenic Drive and north and south of Rotary Park. These are a short distance away, 130m and 320m respectively, however the access from the parking to the site is not defined by track or

path. It is noted that a shared path through this area is shown on the Wanneroo Recreation Precinct Master Plan that would provide this. The Scenic Drive parking is the closest and includes 14 bays of angled parking.

Water Access

Access at the shoreline is down a moderate slope grassed embankment. *Typha sp.* in the location extends approximately 40m from the shoreline. A boardwalk to a viewing structure of approximately 60m length would be required to span the vegetation and the level change at the shoreline.

Views

The site has 180-degree views of the Lake's central area from the shore, with the northerly aspect being emphasised due to the location of Lake Island to the south. With a boardwalk structure it would be possible to achieve views back towards the shoreline which would be advantageous for photography at sunset.

Appeal

The location is open and accessible with views across the lake and potential views back to the reedy mudbank edges of the shoreline. It has potential for connection to the amenities at Rotary Park and could be a larger boardwalk and structure type installation.

Constraints and Considerations

The area is included in the City's Recreation Precinct Master Plan that proposes more formalised active use including lighting of the area. Development of a structure at this location should consider the compatibility of uses.

4.5.3 ASSESSMENT SITE 3: SOUTH WEST PINE SEED ORCHARD

Image 24: Site 3 view from approach

Site Approach

The site approach is via the Lake Joondalup Shared Path from the northern Pine orchard car park or from the southern parklands including Banyandah Park and Donnelly Park. The site is the most inaccessible of the locations due to distance from public open space and parking. From the shared path, access to the water is on existing access track that has been surfaced in limestone and is now in disrepair. The existing track provides good access to the site that would minimise impact on remnant or planted trees and shrubs.

Topography

Access on the shared path is generally undulating however access from the north includes a steeper hill section that is greater than universal access standards allow. This would generally not impact an ambulant person but compromises the site's accessibility especially due to the distance to southern parking locations.

Vegetation

The site approach passes through Banksia Jarrah woodland and features several mature specimens that are exemplars of the species and are important contributors to the landscape character. The shoreline is defined by mature Melaleucas and further inland Banksia and Jacksonia forming a natural enclosure to the site entry. Historical clearing and vehicle use of the area has degraded the understorey, which presents an opportunity for revegetation planting to be incorporated into the design. Sedge and rushes in the location extend from the shore to 5-10m into the water.

Parking

Parking occurs both north and south of the site however these are at a considerable distance. The northern car park, on the stub of Ashley Road 600m from the site, is the primary parking location however this is not an official car park. The southern parking is at Donnelly Park 650m away however this is very limited on-street

parking due to the residential use of the area. The limited parking at Donnelly Park could potentially cause issues for residents if users chose to park there.

Water Access

Closer to the water's edge a pronounced level change provides a good vantage for a boardwalk abutment and access to viewing areas. This occurs through a natural break in the fringing vegetation. A boardwalk from the shoreline to viewing platform would need to span approximately 20m and consider the level change from the embankment to the water level. An alternative would see a pier type structure that could maintain a higher level above the water.

Views

The site has 180-degree views of the Lake's northern portion with a vista that takes in 'Raptor Ridge' on the western side of the lake and the natural bushland areas of the northern perimeter.

Appeal

The location is open and accessible. Being in the northern section of the lake it provides a good location for seeing waders as the lake dries in summer. Sightings at Raptor Ridge are also possible in addition to the water birds on the lake. The site has an existing track to the shoreline so access can be achieved without impacts on remnant or planted trees and shrubs in the Banksia Woodland TEC.

Constraints and Considerations

The main constraint of the location is the aforementioned points covering access and car parking. A further consideration is the location is situated in a Banksia Woodland TEC area that is under rehabilitation and may be sensitive to development for recreational uses. The location is also more remote and a structure at the location may be more prone to vandalism due to reduced passive surveillance.

4.5.4 ASSESSMENT SITE 4: ASHLEY ROAD

Image 25: Site 4 view on approach to spur from Melaleuca stand and clearing

Site Approach

The site approach is via unsealed tracks from the Ashely Road car park. The tracks are undergoing rehabilitation with recent revegetation works closing off the access and helping to stabilise the ground. Two tracks extend directly from the car park to the site that have potential to be developed for access to the site.

Topography

The site is located at the base of a gentle rise. It would be accessible for ambulant people but may be steeper than DDA compliant design could achieve using the existing direct paths. This can be mitigated by installation of a path that runs across the slope to reduce steepness.

Vegetation

The vegetation of the site includes Banksia woodland with a degraded understorey of low shrubs. Closer to the lake the vegetation composition transitions to Melaleuca stands with an understorey of sedges and rushes that extend approximately 15m from the shoreline into the lake. This creates a continuous physical barrier broken only by the spur that forms the current viewing location. The Melaleucas create an open enclosure and threshold for the access. On the upper areas of the site, extensive revegetation has resulted in a young understorey occuring on rehabilitated tracks. Several large Banksia and Eucalypt trees occur here and define the approach to the site from the car park.

Parking

Parking is located at Ashley Road and is approximately 120m from the site This parking location is unofficial. No bicycle parking is currently available.

Water Access

Access to the water is provided by a spur that juts past fringing vegetation into the lake. The spur is close to the water level. A connection to a structure could be achieved with minimal level change however the spur would need significant modification to accommodate the required path widths. A boardwalk structure would require approximately 20m length to a viewing area on the water body. Alternatively, a pier type structure could achieve views westward with 10m length of boardwalk.

Views

The site has 180-degree views of the lake's northern portion with a vista that takes in 'Raptor Ridge' on the western side of the lake and the natural bushland areas of the northern perimeter.

Appeal

The location is open and accessible and being in the northern section of the lake is a good location for seeing waders as the lake dries in summer. Sightings at Raptor Ridge are also possible in addition to the water birds on the lake. The location is well connected to existing parking.

Constraints and Considerations

Similar to site 3, the location is situated in a Banksia Woodland TEC area that is under rehabilitation and may be sensitive to development for recreational uses. The location is also more remote and a structure at the location may be more prone to vandalism due to reduced passive surveillance.

4.5.5 ASSESSMENT SITE 5: ROTARY PARK

Image 26: Site 5 view to west, concealed by dense vegetation

Site Approach

The approach is via the grassed area in front of the Wanneroo Recreation Centre. The area is densely vegetated and access is restricted by conservation fencing, however a break in the fence line to the south allows pedestrian entry. Due to the marshland nature of a majority of the site accessibility is limited. The Recreation Precinct Master Plan has recommendations for significant changes to access in the location that should be taken into consideration including relocation of the shared path alongside the site. A logical connection would be between the site and the playground which should be developed if this site is progressed.

Topography

The site is generally low-lying and flat. A low earth bund is situated on the northern perimeter that is an extension of the living stream landform and has potential to be used as an access point. To the south, the embankment of the soccer oval restricts pedestrian access and further connections.

Vegetation

The location is the most heavily vegetated of the sites including (from east to west) a row planting of Tuarts with an understorey of sedges, rushes and smaller Melaleucas extending into the marshy shore zone and, further out, stands of mature Melaleuca trees that define the edge of the channel between Lake Island and the shore. Across the site the vegetation creates enclosures that reduce visibility of the shore to the east and open water to the west. This inaccessibility and shelter would provide greater habitat value throughout the site

Parking

Parking is well catered for at Rotary Park and the Recreation Centre which are both in close proximity.

Water access

Access to the water from this location is limited due to the densely vegetated nature of the site including established trees and understory. Views to open water would require an extensive boardwalk and/ or an elevated platform to get beyond the large Melaleuca stands located on the extent of the muddy shoreline. A boardwalk to a structure would need to span at least 80m to achieve this.

Views

Views of open water from the site are in a south-westerly direction framed by the shoreline and Lake Island. The presence of the island and vegetative enclosure provided by trees limits the visibility of water bird areas from lower vantage points.

Appeal

The location's appeal is primarily due to its proximity with the Wanneroo Recreation Centre and Rotary Park that would ensure popularity and use by the general public with potential for an educational component connected to the existing playground. As such, it is a location that would be suited to a boardwalk and elevated platform to gain views of the lake however this may not meet the specific requirements of birders.

Constraints and Considerations

The site's heavy vegetation, while not pristine, is an important habitat in the area. There have also been sightings of raptors at the island and there is the risk that they would be disturbed by the addition of a structure and human presence. The site is also under consideration in the Wanneroo Recreation Precinct Master Plan that includes boardwalk and viewing structures and any proposal would need to coordinate with this plan.

5 MULTI CRITERIA ANALYSIS

5.1 MCA OVERVIEW

The Multi Criteria Analysis (MCA) provides a transparent and accountable decision making tool. The analysis considers a number of factors to identify:

- Potential impacts or constraints posed by values of site
- Potential opportunities and benefits
- The relative importance or weighting of the above factors.

This MCA has been structured into two parts including environmental and landscape with the parts then aggregated in a summary ranking presenting a score for each site. Environmental and landscape are scored separately because the environmental assessment is defined by constraints whereas the landscape assessment includes value-based criteria in addition to constraints. The MCA has been prepared to assist the decision making process and includes both objective and subjective assessment by the consultants, a summary of the outcomes is provided identifying which site is most suitable.

5.1.1 ENVIRONMENTAL FACTORS

Environmental factors considered in the MCA include:

- Land tenure and potential tenure complexity
- Aboriginal and European heritage
- Presence of threatened and priority ecological communities
- Presence of threatened and priority flora/fauna and fauna habitat
- Environmentally sensitive area mapping and Bush Forever
- Acid sulphate soils risk
- Dieback risk
- Contaminated sites
- Weeds (Declared pest plans and WONS species)

5.1.2 LANDSCAPE FACTORS

Landscape factors are considered in terms of their value to the viability and feasibility of a bird viewing structure and therefore do not always align to the physical value of the element being assessed. For instance, at site 2, lack of natural vegetation is seen as a positive attribute due to the ability to install a structure with minimal impact to remnant and planted vegetation.

Landscape factors considered in the MCA include:

- Site Approach
- Topography
- Vegetation
- Parking
- Water access
- Views
- Appeal
- Constraints and Considerations

5.1.3 MCA SCORING SYSTEM

The scoring system ranges from +3 to -3. The scoring system considerations are described below.

Table 10: MCA Scoring System

Score	Description of Scoring Considerations
+3	Very high value and recommendation
+2	High value, generally recommended
+1	Medium value, neutral effect
0	Neutral effect
-1	Slight constraint, neutral or slightly negative impact
-2	Some constraints, generally not supported
-3	Heavily constrained

5.2 ENVIRONMENTAL MULTI CRITERIA ANALYSIS

Table 11: Environmental MCA

Factor Considered	Site 1	Site 2	Site 3	Site 4	Site 5	Notes-explaining the score
Potential Impacts or Constraints						
Land tenure	-2	+1	0	0	+1	Sites 2 and 5 are entirely on City managed lands. Site 1 intersects several land parcels and may require liaison and permission from several land holders
Aboriginal and European Heritage	-1	-1	-1	-1	-1	All sites fall within registered aboriginal site 3740-Lake Joondalup. An application for consent under Section 18 of the Aboriginal Heritage Act should be sought for any significant development.
Presence of threatened and priority ecological communities	0	0	-2	-2	0	Sites 3 and 4 are highly likely part of a TEC and are a Priority 3 PEC
Presence of threatened and priority flora	0	0	0	0	0	None recorded or considered likely
Presence of threatened and priority fauna or fauna habitat	-1	0	-2	-2	0	Banksia vegetation at sites 3 and 4 provides foraging habitat for Black Cockatoo species. Sites 2 and 5 due to narrow and degraded strip of vegetation have lower habitat values
Environmentally sensitive area mapping	-1	-1	-1	-1	-1	All sites fall within ESA mapping associated with Conservation class wetland mapping and the Yellagonga Regional Park
Bush Forever	0	0	0	0	0	All sites fall within a Bush Forever site
Acid sulphate soils risk	-1	-1	-1	-1	-1	All sites are categorised as High-Moderate Risk for ASS. The listing of the area as high to moderate risk requires that potential soil disturbance is considered for all proposed works in the mapped area
Dieback risk	-1	0	-2	-2	0	Banksia vegetation at sites 3 and 4 are highly susceptible to dieback introduction. Vegetation at site 1 has some susceptibility to dieback.
Contaminated sites	0	0	0	0	0	No contaminates sites identified
Extent of remnant or planted trees and shrubs to be removed	1	2	-1	-2	-2	Site 1 has access to the water via track. Site 2 is predominantly grassed recreational space. Sites 3 &4 are in Banksia TEC, Site 5 is densely vegetated
Weeds	0	0	0	0	0	No significant populations of declared pest plants or WONS species identified
Total Score	**-6**	**0**	**-10**	**-11**	**-4**	

5.3 LANDSCAPE MULTI CRITERIA ANALYSIS

Table 12: Landscape MCA

Factor Considered	Site 1	Site 2	Site 3	Site 4	Site 5	Notes-explaining the score
Site Approach	-2	1	2	1	3	Sites 1, 2 and 5 are located close to recreational amenity and are more accessible. Sites 3 and 4 are in bushland areas and less accessible.
Topography	2	2	-1	-1	2	Approaches to sites 1, 2 and 5 are relatively flat which improves access. Sites 3 and 4 have steeper topography that may act as a constraint to universal access
Parking	0	2	-3	2	3	Sites 2 and 5 have parking facilities within easy walking distance. Site 1 has potential for parking to be developed on Scenic Drive. Sites 3 and 4 have good parking within reasonable walking distance however for site 3 parking is a significant distance from the site over steeper topography, furthermore, there is limited parking at open space to the south
Vegetation	2	3	2	2	-1	All sites aside from site 5 and 4 could be developed with relatively minimal impact on existing native vegetation. Site 2 has the least vegetation. Site 5 has dense vegetation and stands of Melaleuca that act as physical barriers to access and views
Water Access	2	2	0	1	1	Sites 1, 3 and 4 have easy access to the water without significant level change. Site 5 is heavily vegetated and connection to the water will require a longer boardwalk. Site 2 has minimal native vegetation and is less constrained for access.
Views	1	3	2	2	0	Site 1 views are confined to the smaller northward lagoon. Sites 3 and 4 have good views to the north and west. Site 5 has reasonable views to the south however Lake island and dense vegetation is a constraint. Site 2 has panoramic views from the shoreline that can be complemented by the bird viewing experience.
Appeal	2	3	1	1	2	Site 1 has appeal as a natural space, Site 2 has a very good viewing area and appeals to birders. Sites 3 and 4 have appeal as bushland areas that are more secluded with connection to the Lake's northern environs. Site 5 has appeal due to connection with the recreation precinct however this may not be optimal for birders.
Constraints	1	3	1	0	-1	Site 1 has constraints due to tenure and potential habitat disturbance, Site 2 is relatively unencumbered. Site 3 is unencumbered due to the ease of access however, it is in the TEC area as is Site 4. Site 5 is relatively unencumbered however there are potential impacts on habitat
Total Score	8	19	4	8	9	

5.3.1 MCA OUTCOMES

The results of the MCA for the Yellagonga Bird Viewing Structures reveals Site 2 Lake Joondalup Park as the most appropriate site based on the ranking scores. This is due to a number of factors including accessibility, user appeal and minimal disturbance to sensitive habitat that would be required. It is a site that would be suitable for a larger scale pontoon structure. The site would require extensive rehabilitation planting and new access from the adjacent Wanneroo Recreation Precinct and Scenic Drive however these are opportunities that the project could embrace and make a contribution to the lake environment.

Site 5, Rotary Park, came second due to similar attributes including accessibility and user appeal. It ranked slightly lower due to constraints including more limited access to views and potential impact on sensitive bird habitat. The site has merit as a location for wetland educational experiences such as boardwalks and lake views (that may incorporate bird watching) but is not the optimal location for this specific use.

Sites 3 and 4 scored well however their location in a TEC did not work in their favour environmentally. Site 3 has additional access constraints due to the location of parking and other access. The locations would be suitable for bird viewing structures however due to the secluded nature and bushland setting smaller hides would be more appropriate.

Site 1 also has natural attributes that are admirable and make it a great location for bird watching. It is a naturally beautiful location with a high canopy of trees to provide shelter and evidence that the area is well frequented by walkers, trail runners and other users and these types of experiences and environments should be preserved. In addition, the Water Corporation assets nearby present potential risk of delay in the project approvals process and potential access restrictions on an ongoing basis. For these reasons site 1 is not recommended.

Based on the outcomes of the MCA the City would like to progress Site 2 to concept designs with two different concepts developed for this site.

5.4 MULTI CRITERIA ANALYSIS SUMMARY

Table 13: MCA Analysis Summary

Factors		Site 1	Site 2	Site 3	Site 4	Site 5
Environmental		-6	0	-10	-11	-4
Landscape		8	19	4	8	9
Total		**2**	**19**	**-6**	**-3**	**5**

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BVS20Q01

Staff JLT **Date** 15/05/2020 **Season** Average

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386170 **mE** 6485397 **mN** **Lat.** -31.7613 **Long.** 115.7980

Habitat Lake fringe

Aspect N/A **Slope** N/A

Soil Type Quindalup sand with loose limestone

Rock Type Limestone

Loose Rock <2 % cover; 2-6 mm in size **Litter** 2 % cover ; <1 cm in depth

Bare ground 20 % cover **Weeds** 70 % cover

Vegetation U+ ^*Eucalyptus rudis* subsp. *rudis*,^*Corymbia calophylla*\^tree\7\c;M ^*Allocasuarina fraseriana*\^shrub\4\bi;

Veg. Condition Degraded

Disturbance

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia saligna		.4	<1	
Allocasuarina fraseriana		2.5	1.5	
**Avena fatua*			10	
**Bromus diandrus*		.25	<1	
Corymbia calophylla		22	5	
Daucus glochidiatus		.1	<1	

Eucalyptus rudis subsp. *rudis*	28	20
**Euphorbia terracina*	.35	<1
Hardenbergia comptoniana	.2	<1
**Hypochaeris glabra*	.2	<1
**Lactuca serriola*	.35	<1
**Lysimachia arvensis*	.1	<1
**Sonchus oleraceus*	.3	<1

BVS20Q02

Staff JLT **Date** 15/05/2020 **Season** Average

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386155 **mE** 6485280 **mN** **Lat.** -31.7623 **Long.** 115.7979

Habitat Lake fringe

Aspect N/A **Slope** N/A

Soil Type Brown clay

Rock Type

Loose Rock 0 % cover **Litter** 100 % cover ; 0.15 cm in depth

Bare ground 1 % cover **Weeds** 80 % cover

Vegetation M ^*Acacia rostellifera*\^shrub\4\bi;G+ ^*Cenchrus clandestinus*,^*Cynodon dactylon*\^tussock grass\2\c

Veg. Condition Degraded

Disturbance

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		2.8	1	
**Arundo donax*		3	1	
Baumea articulata		.4	<1	
**Cenchrus clandestinus*		.6	40	
**Cynodon dactylon*		.4	1.5	
**Paspalum distichum*		.6	<1	

**Pelargonium capitatum*	.4	<1
Typha orientalis	2	<1

BVS20Q03

Staff JLT **Date** 15/05/2020 **Season** Average

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 385682 **mE** 6486799 **mN** **Lat.** **Long.**

Habitat Lake fringe

Aspect N/A **Slope** N/A

Soil Type Brown clay

Rock Type

Loose Rock 0 % cover **Litter** 5 % cover ; 1-2 cm cm in depth

Bare ground 2 % cover **Weeds** 2 % cover

Vegetation 4dG+ ^*Baumea articulata*,^*Typha orientalis*\^rush,sedge\4\d

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Bacopa monnieri*		0.1	<1	
Baumea articulata		2.5	55	
**Cenchrus clandestinus*		.4	<1	
**Conyza bonariensis*		.4	<1	
**Cynodon dactylon*		.35	<1	
**Lolium perenne*		.2	<1	
**Oxalis pes-caprae*		.15	<1	

**Sonchus oleraceus*	.2	<1
Typha orientalis	2.3	<1

BVS20Q04

Staff JLT **Date** 15/05/2020 **Season** Average

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 384825 **mE** 6488810 **mN** **Lat.** -31.7304 **Long.** 115.7842

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 2 % cover ; <1 cm in depth

Bare ground 40 % cover **Weeds** 2 % cover

Vegetation U+ ^*Melaleuca preissiana*,^*Banksia littoralis* subsp. *littoralis*\^tree\6\c;M ^*Jacksonia furcellata*\^shrub\4\bi;G ^*Lepidosperma leptostachyum*\^sedge\\

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Avena barbata*		.3	<1	
Banksia littoralis		18	7	
**Cynodon dactylon*		.3	<1	
Dianella revoluta var. *divaricata*		.6	<1	
**Ehrharta calycina*		.3	<1	
Jacksonia furcellata		2	1.5	

Lepidosperma leptostachyum	.45	5
Macrozamia riedlei	.5	<1
Melaleuca preissiana	.4	40
**Pelargonium capitatum*	.4	<1
Spyridium globulosum	2.5	<1

BVS20Q05

Staff JLT **Date** 15/05/2020 **Season** Average

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 384825 **mE** 6488864 **mN** **Lat.** -31.7299 **Long.** 115.7842

Habitat

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type

Loose Rock 0 % cover; 2-6 mm in size **Litter** 5 % cover ; <1 cm in depth

Bare ground 20 % cover **Weeds** 5 % cover

Vegetation U+ ^^*Eucalyptus rudis* subsp. *rudis*,*Banksia attenuata*,*Banksia ilicifolia*\^tree\7\i;G ^*Lepidosperma squamatum*,^*Avena barbata*\^sedge,tussock grass\\

Veg. Condition Good

Disturbance

Fire Age 5-10 years

Notes Missing shrub layer and species present in adjacent Good Condition vegetation.

Species	WA Cons.	Height (m)	Cover (%)	Count
**Avena barbata*		.4	3	
**Avena barbata*			0.5	
Banksia attenuata		15	12	
Banksia ilicifolia		3	1.5	
**Briza maxima*		.4	<1	
**Carpobrotus edulis*		.5	1	

Corymbia calophylla	.5	<1
Dianella revoluta var. *divaricata*	.4	<1
**Ehrharta calycina*	.2	<1
Eucalyptus rudis subsp. *rudis*	21	8
Hardenbergia comptoniana	.2	<1
**Hypochaeris glabra*	.05	<1
Jacksonia furcellata	3	<1
Lepidosperma squamatum	.4	1
Macrozamia riedlei	1.5	<1
**Pelargonium capitatum*	.2	<1
**Phytolacca octandra*	0.4	<1
Thysanotus sp. indet.	.3	<1

BVS20Q06

Staff JLT **Date** 18/05/2020 **Season** Average

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 385828 **mE** 6486128 **mN** **Lat.** -31.7546 **Long.** 115.7945

Habitat Lake fringe

Aspect N/A **Slope** N/A

Soil Type Brown clay

Rock Type

Loose Rock 0 % cover **Litter** 10 % cover ; 2 cm in depth

Bare ground <1 % cover **Weeds** 80 % cover

Vegetation U+ ^*Eucalyptus rudis* subsp. *rudis*\^tree mallee\7\i;M ^*Melaleuca preissiana*\^shrub\5\r;G ^^*Cenchrus clandestinus*,*Baumea articulata*,*Typha orientalis*\^tussock grass,rush,sedge\2\d

Veg. Condition Degraded

Disturbance

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia rostellifera		.6	<1	
**Avena barbata*		.25	<1	
Baumea articulata		1.8	25	
**Cenchrus clandestinus*		1	55	
Corymbia calophylla		2	1	
**Cynodon dactylon*		.5	2	

**Ehrharta calycina*	.25	<1
Eucalyptus rudis subsp. *rudis*	15	22
Melaleuca preissiana	2.8	8
**Oxalis pes-caprae*	.35	<1
**Pelargonium capitatum*	.3	<1
**Schinus terebinthifolia*	2	1
Typha orientalis	1.6	8

BVS20Q07

Staff JLT **Date** 18/05/2020 **Season** Average

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 385893 **mE** 6486096 **mN** **Lat.** **Long.**

Habitat Lake fringe

Aspect N/A **Slope** N/A

Soil Type

Rock Type

Loose Rock 0 % cover **Litter** 8 % cover ; 0.05 cm in depth

Bare ground 1 % cover **Weeds** 20 % cover

Vegetation M+ ^*Melaleuca preissiana*\^shrub\\;G ^*Typha orientalis*,^*Cenchrus clandestinus* \^sedge,tussock grass\2\d

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia saligna		2	1	
**Cenchrus clandestinus*		.5	8	
**Cenchrus clandestinus*		0.25	1	
**Cynodon dactylon*		.4	3	
**Lupinus cosentinii*		.2	<1	
Melaleuca preissiana		2	3	

**Sonchus oleraceus*	.1	<1
Typha orientalis	1.8	66

YELLAGONGA BIRD VIEWING STRUCTURES

CONCEPT DESIGN

The Yellagonga Bird Viewing Structures concept has been developed for the site at Lake Joondalup Park. The concept has been developed following a Multi Criteria Analysis (MCA) of five potential sites on the eastern side of Yellagonga Regional Park managed by the City of Wanneroo. Through the MCA process, including conversations with key stakeholders, the location was identified as the preferred site primarily due to the level of access and lower potential impact on the wetland's environment.

The concept includes two options for the Lake Joondalup Park site . These include:

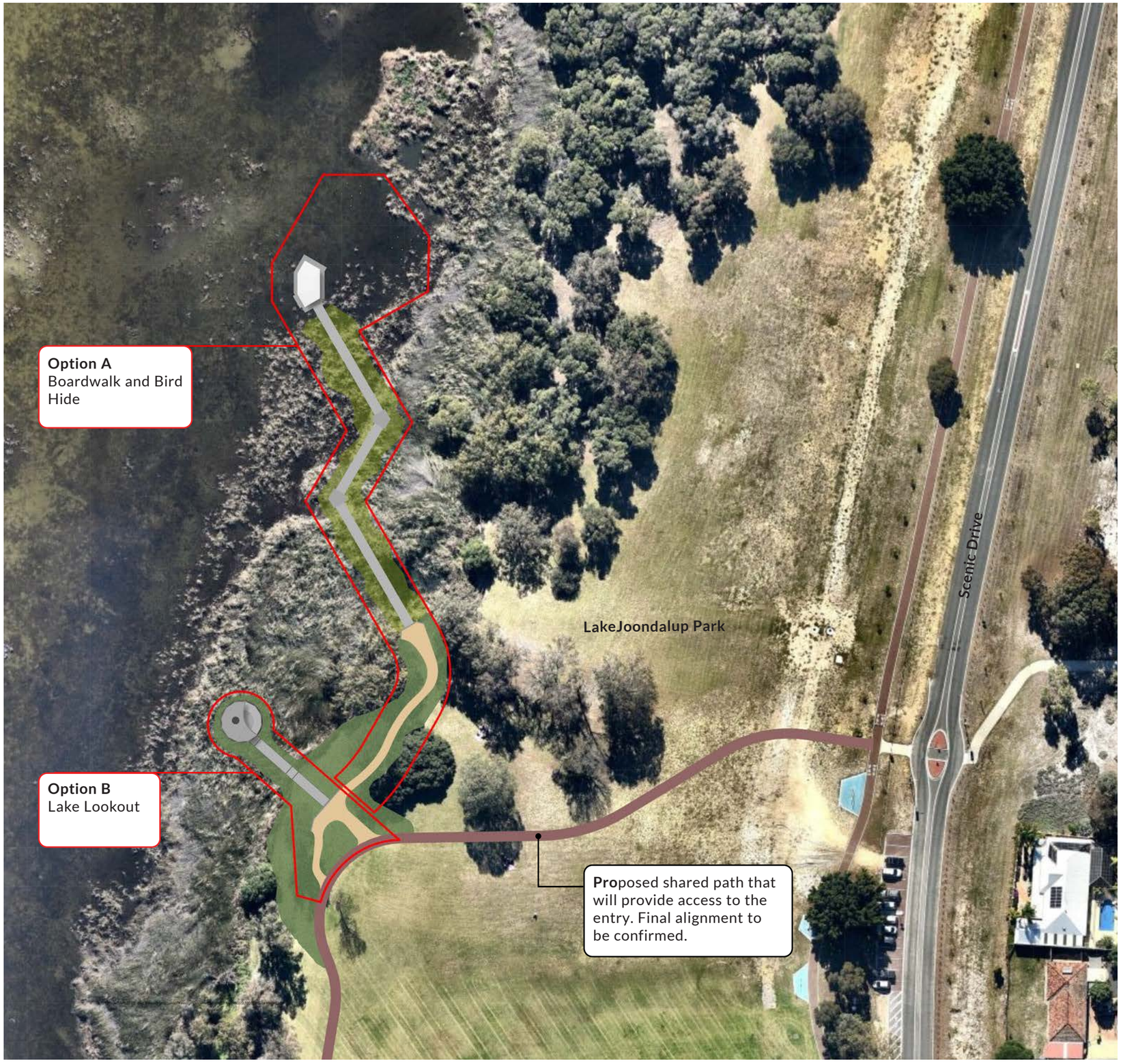
(A) Boardwalk and Bird Hide

(B) Lake Lookout

These options identify ways in which bird viewing structures could be integrated with the site to provide the public with positive wetland experiences. Both options allow viewing of wetland bird species in their natural habitat and reinforce the environmental values of the area in accordance with the Yellagonga Regional Park Management Plan.

Through consultation with key stakeholders it has been identified that birders want to get close to habitat and the water for viewing and photography. There is also a desire from the general public to have an elevated lookout with views across the lake that could also be use for bird sightings. The two options address these requirements and have been designed so that they could be staged or constructed independently of each other depending on the City of Wanneroo's determination.

The decision to site each option has been made in consultation with key stakeholders and City of Wanneroo staff. The hide is located to capitalise on the northern area which has access to open water, natural habitat and views eastward towards the shore. The lookout is located on the prominent corner of the existing oval with good access and views toward the west and Lake Island. It is expected that a shared path will ultimately provide access to the entry point and there is potential for built form associated with the Wanneroo Recreation Precinct to be developed a short distance from the proposed lookout that will increase the site's future visitation.



ecoscape
9 STIRLING HIGHWAY, NORTH FREMANTLE WA 6159
(08) 9430 8955 WWW.ECOSCAPE.COM.AU

AUTHOR: FK/LD
REVISION: B
PROJECT NO: 4530-20
DATE: JULY 2020
SCALE 1:1000 @A3

0 5 10 15 20 25 50m

YELLAGONGA BIRD VIEWING STRUCTURES
CITY OF WANNEROO

SITE CONTEXT

SK01

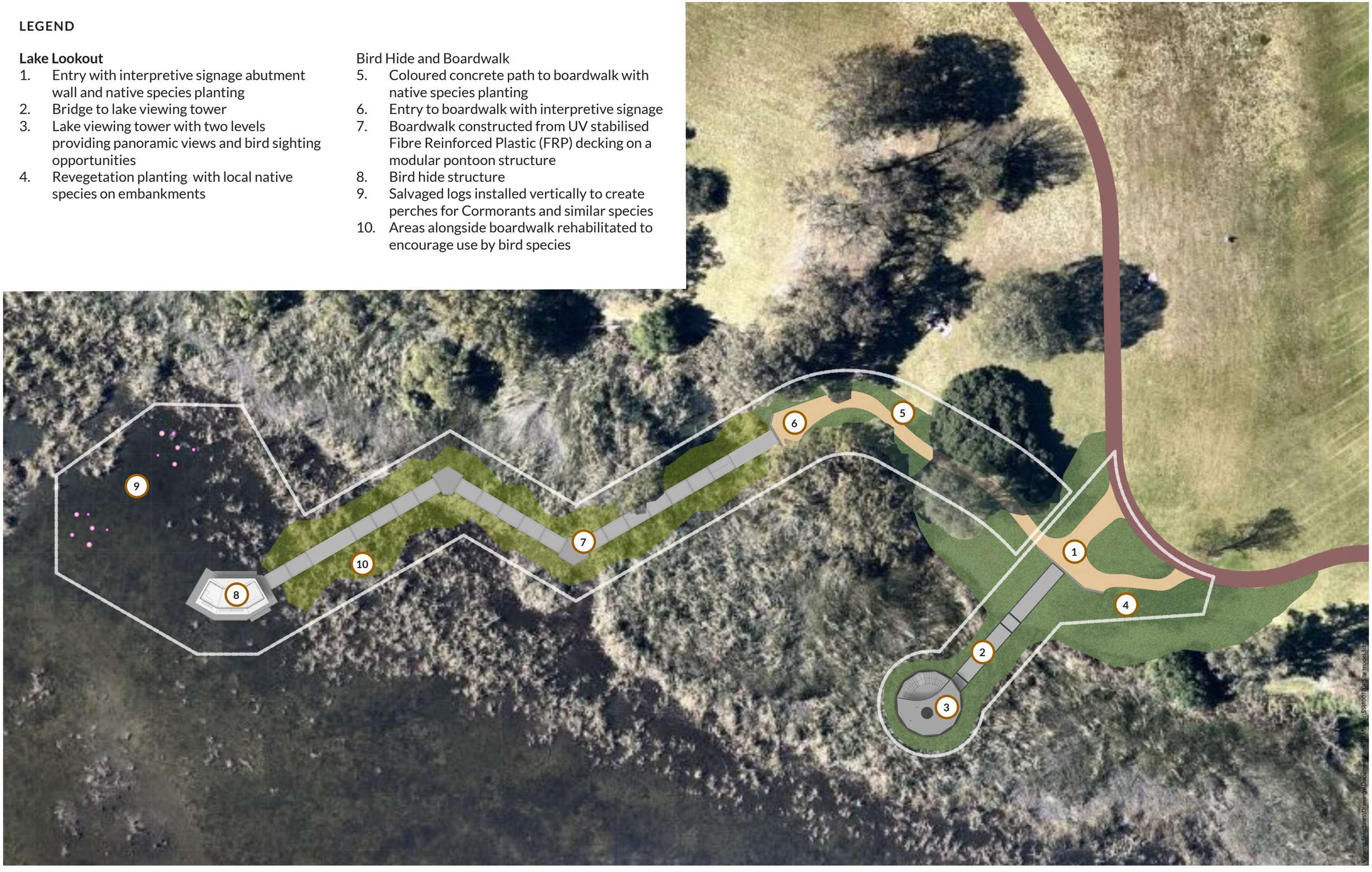
LEGEND

Lake Lookout

1. Entry with interpretive signage abutment wall and native species planting
2. Bridge to lake viewing tower
3. Lake viewing tower with two levels providing panoramic views and bird sighting opportunities
4. Revegetation planting with local native species on embankments

Bird Hide and Boardwalk

5. Coloured concrete path to boardwalk with native species planting
6. Entry to boardwalk with interpretive signage
7. Boardwalk constructed from UV stabilised Fibre Reinforced Plastic (FRP) decking on a modular pontoon structure
8. Bird hide structure
9. Salvaged logs installed vertically to create perches for Cormorants and similar species
10. Areas alongside boardwalk rehabilitated to encourage use by bird species



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(08) 9430 8955 WWW.ECOSCAPE.COM.AU

AUTHOR: FK/LD
REVISION: B
PROJECT NO: 4530-20
DATE: JULY 2020
SCALE 1:500 @A3

0 2.5 5 7.5 10 12.5 25m

YELLAGONGA BIRD VIEWING STRUCTURES
CITY OF WANNEROO

SITE PLAN

SK02

BIRD HIDE & BOARDWALK

MATERIALS & INSPIRATION

The bird hide and boardwalk will provide the opportunity to view wetland bird species in their natural habitat. It is expected to be used by birders and the general public so the layout has been designed to accommodate both. The location and design is expected to achieve opportunities for sighting and photography during the day including early morning and evening when the light is best.

The hide is sited in an area that has views westward across the lake and north-east towards the shore to access the desired viewing points. The layout responds to this in placement of openings (windows) seating and wall (hide) elements. The entry is a broad opening so that the interior is visible on approach and inviting. The external perimeter deck with steps to the water's edge and bench seating will allow more functionality for the general public during busier times. The interior will include signage boards that show wetland bird species which can be sighted and identified from the hide.

The boardwalk traverses the shoreline from the upper embankment level through *Typha orientalis* to the bird hide. The boardwalk will use durable UV stabilised Fibre Reinforced Plastic (FRP) for the decking surface and be modular in construction to ensure ease of installation. The boardwalk and hide will be constructed on pontoons so they can rise and fall with the seasonal inundation of the wetland. Gangway ramps with handrails will also be incorporated to ensure accessibility to the waters edge during seasonal water level changes.

The installation of the hide will include rehabilitation planting and habitat creation along the impacted boardwalk corridor and hide site. The corridor will be rehabilitated to create habitat for bird species to increase sighting opportunities. Bush log posts installed in the water near the hide may also be incorporated to provide perches for Cormorants, Egrets and Herons.

Bird hide with covered deck surrounds on pontoons allowing hide to move with the changing water level

Signage panels illustrating local bird life located inside the bird hide

Timber battens with spacings to allow air circulation

Horizontal timber clad structure that visually recedes into the wetland environment

UV stabilised Fibre Reinforced Plastic (FRP) grating and kick-rails to be used for the bird hide boardwalk

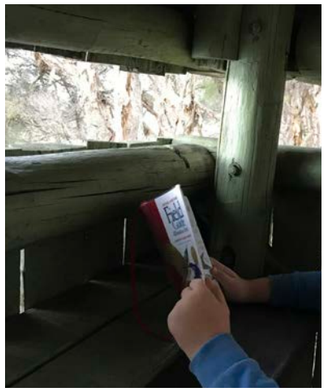
Thermally modified timber boards and structural sections to be used for the bird hide and lake tower cladding

Coloured concrete paving to be used for the Arrival node and access path to bird hide boardwalk

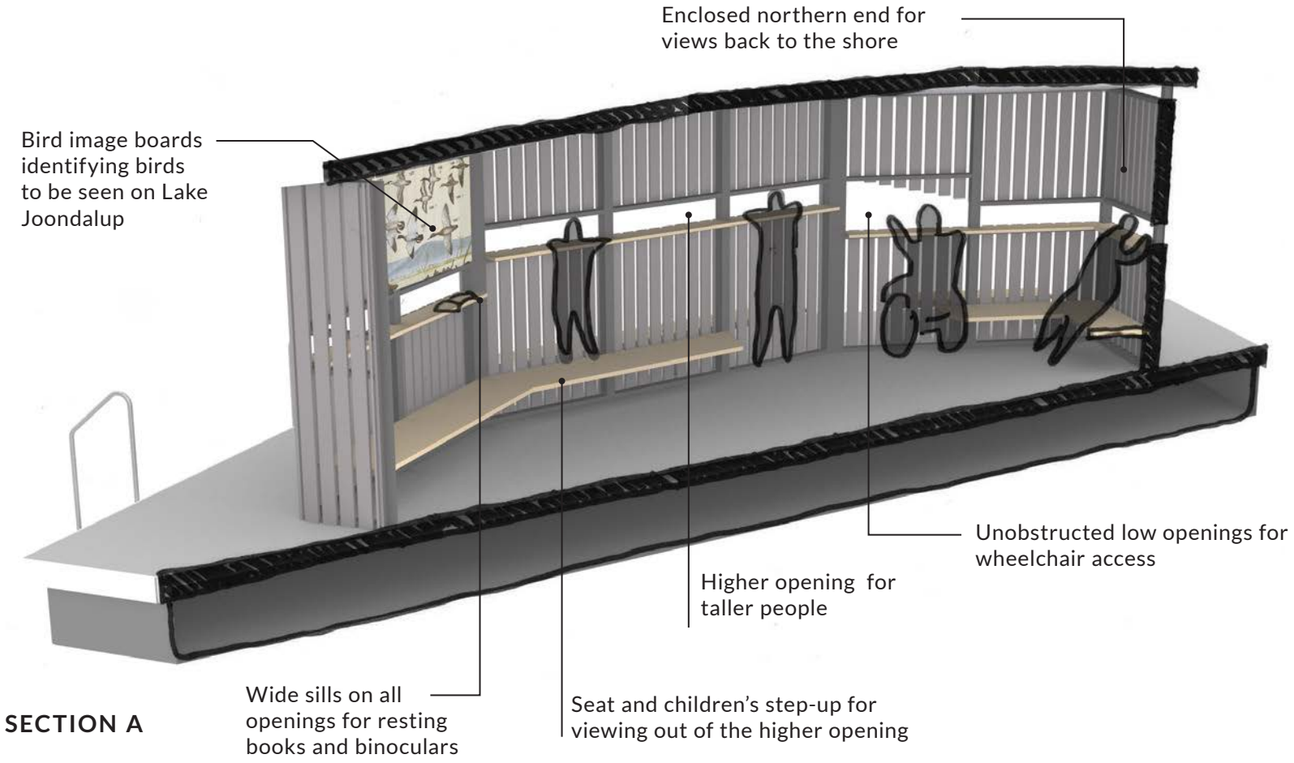
Structural piers for stabilisation at key locations along boardwalk

Concrete-less pile footings to minimise ground disturbance

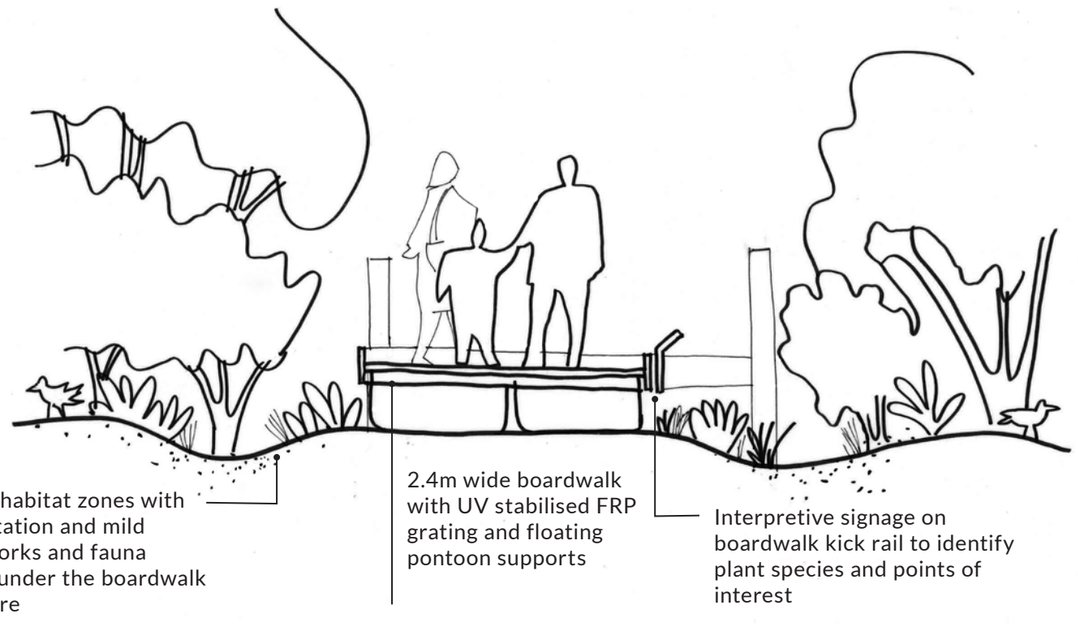
Seating benches on external deck platform



Window sills for cameras, books and binoculars



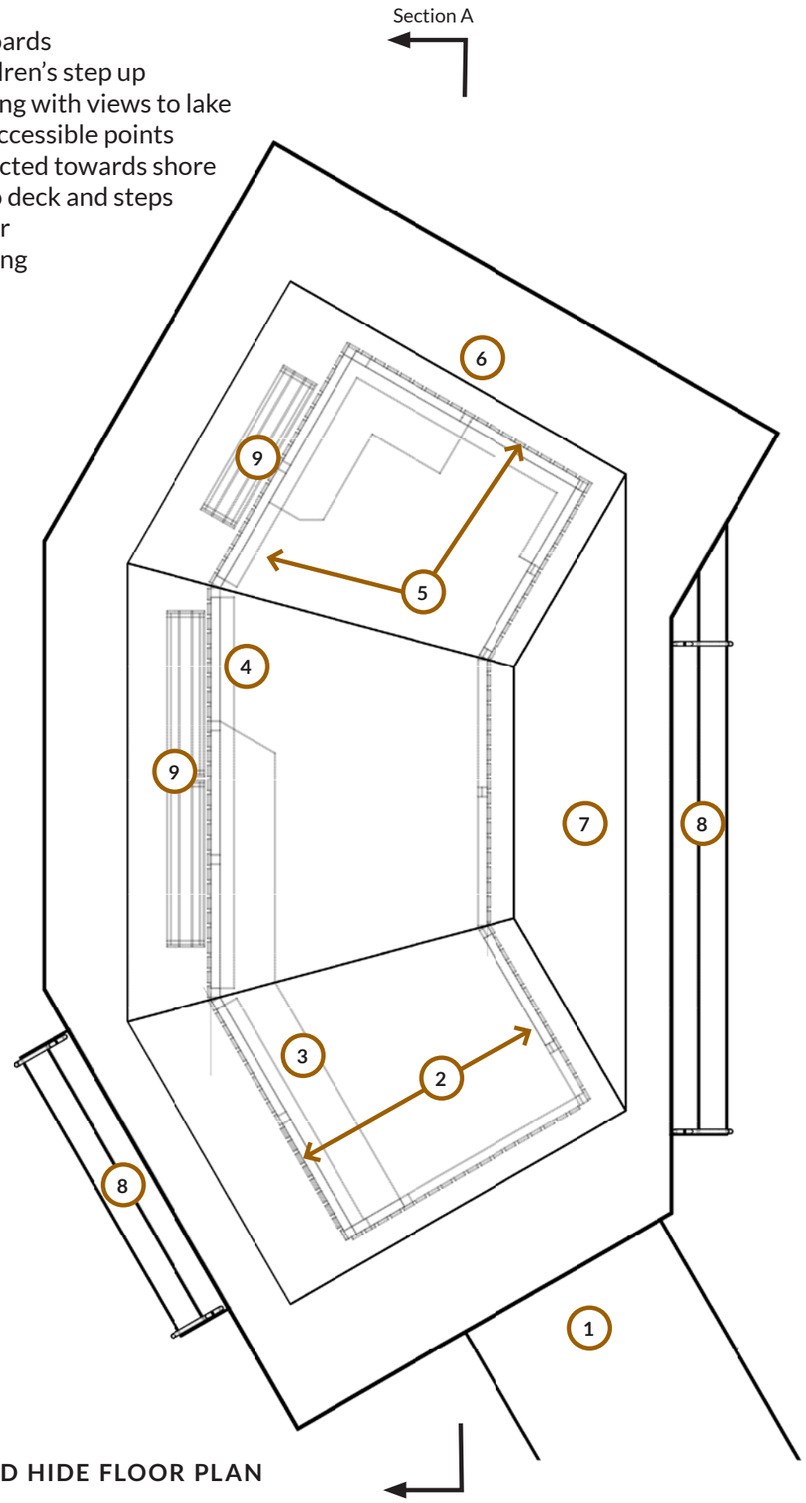
SECTION A



BOARDWALK SECTION

Hide Floor plan :

1 Hide entry
2 Bird image boards
3 Seat and children's step up
4 Higher opening with views to lake
5 Wheelchair accessible points
6 Hide end directed towards shore
7 Opening onto deck and steps
8 Steps to water
9 Exterior seating



BIRD HIDE FLOOR PLAN

ecoscape
9 STIRLING HIGHWAY, NORTH FREMANTLE WA 6159
(08) 9430 8955 WWW.ECOSCAPE.COM.AU

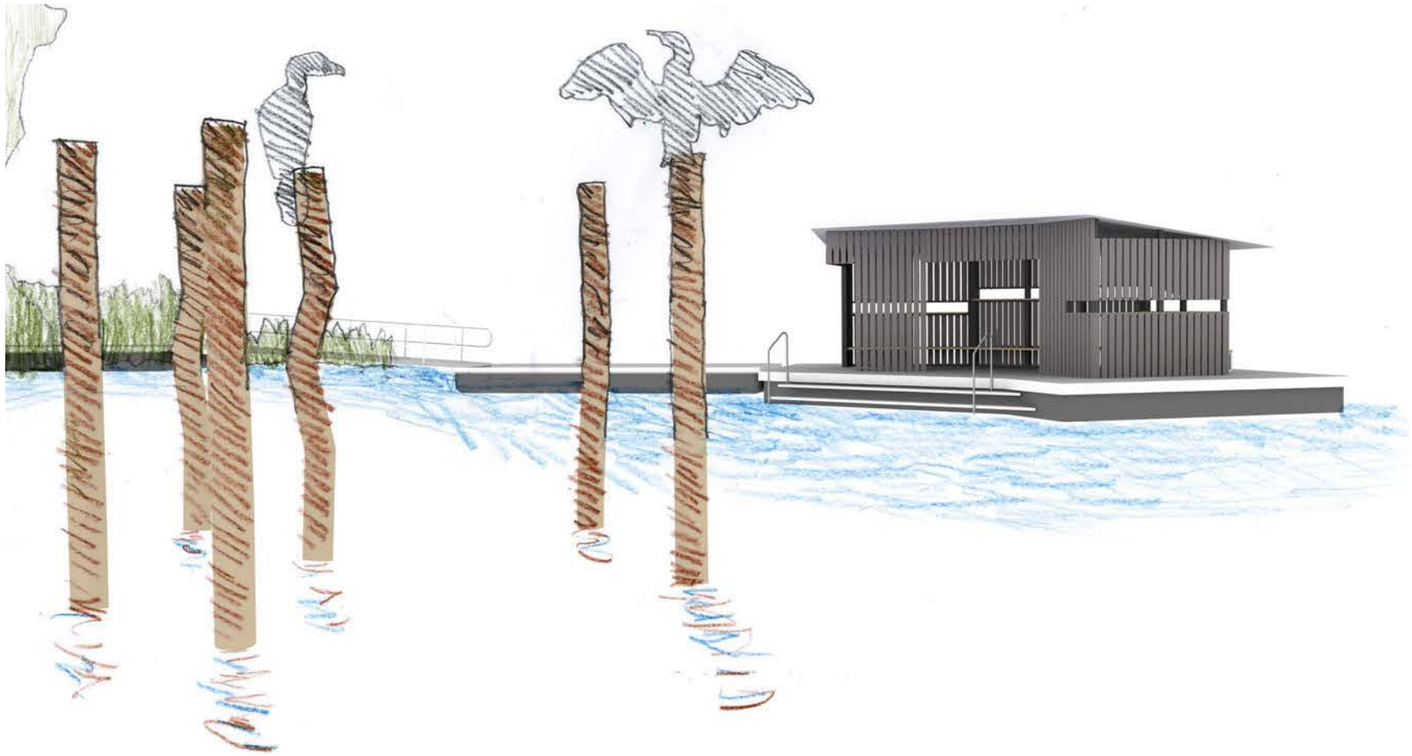
AUTHOR: FK/LD
REVISION: B
PROJECT NO: 4530-20
DATE: JULY 2020
SCALE 1:100 @A3
0 2.5 5m

YELLAGONGA BIRD VIEWING STRUCTURES
CITY OF WANNEROO

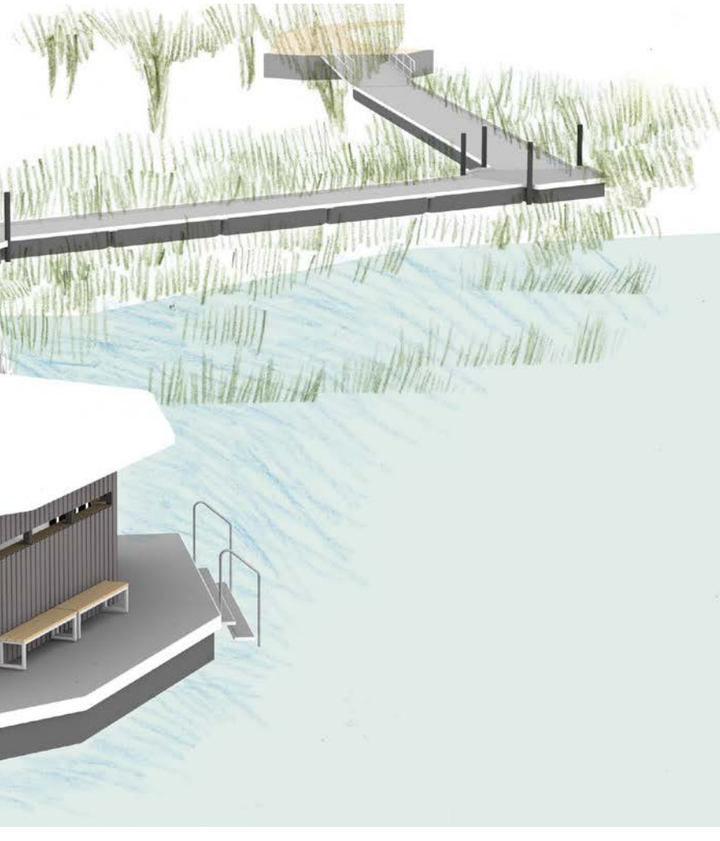
BIRD HIDE AND BOARDWALK DETAILS

SK04

Salvaged timber posts to create landings for cormorants and similar species located near the bird hide



VIEW FROM NORTH



VIEW OF HIDE AND BOARDWALK

VIEW OF HIDE ENTRY

ecoscape

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(08) 9430 8955 WWW.ECOSCAPE.COM.AU

AUTHOR: FK/LD
REVISION: B

PROJECT NO: 4530-20
DATE: JULY 2020

YELLAGONGA BIRD VIEWING STRUCTURES
CITY OF WANNEROO

BIRD HIDE AND BOARDWALK VIEWS

SK05

LAKE LOOKOUT
MATERIALS & INSPIRATION

The Lake Lookout is a location from which to view Lake Joondalup and surrounds. The lookout will be a popular destination for visitors and be a point from which to gain panoramic views and sightings of wetland bird species. It is expected that the design will be architecturally interesting and visually sympathetic to the wetland environment through form and material selections.

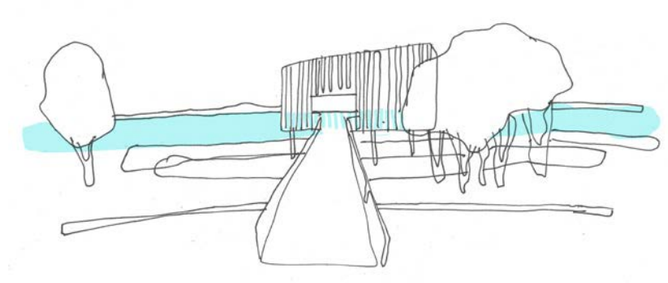
The design has a circular form similar to the nests of wetland bird species and is envisaged to be constructed from materials with a warm appearance that merge with the surrounds.

The lookout has two levels joined by a spiral staircase that is accessed by a boardwalk bridge. The lower level is elevated enough to provide a universally accessible wetland experience. The upper level provides panoramic views westward and to Lake Island. The structure is located on the shore where structural considerations and construction impacts can be minimised whilst still providing the desired experience.

Several interpretive opportunities are proposed for the lookout that would be themed around Lake Joondalup and the other regional wetlands. These include signage at the entry and on the lower level explaining the importance of the wetlands to Wanneroo and an orientation map showing the region and distances to important locations such as Lake Island, other wetlands the coastline and historical routes taken by Aboriginal and Eurpoean people

The proposed materials include thermally modified timber battens and composite decking that provide a timber look and feel whilst beign low maintenance and durable.

It is expected that the lookout will be used by birders and the general public for sightseeing and photo opportunities.



Nest inspiration for lookout structure

Vertical timbers and curved building to create a nest form, Kastrup Sea Bath

Interpretive and way finding signage located at entry node

Upper viewing deck precedent, Koombana Bay in Bunbury

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PROJECT NO: 4530-20
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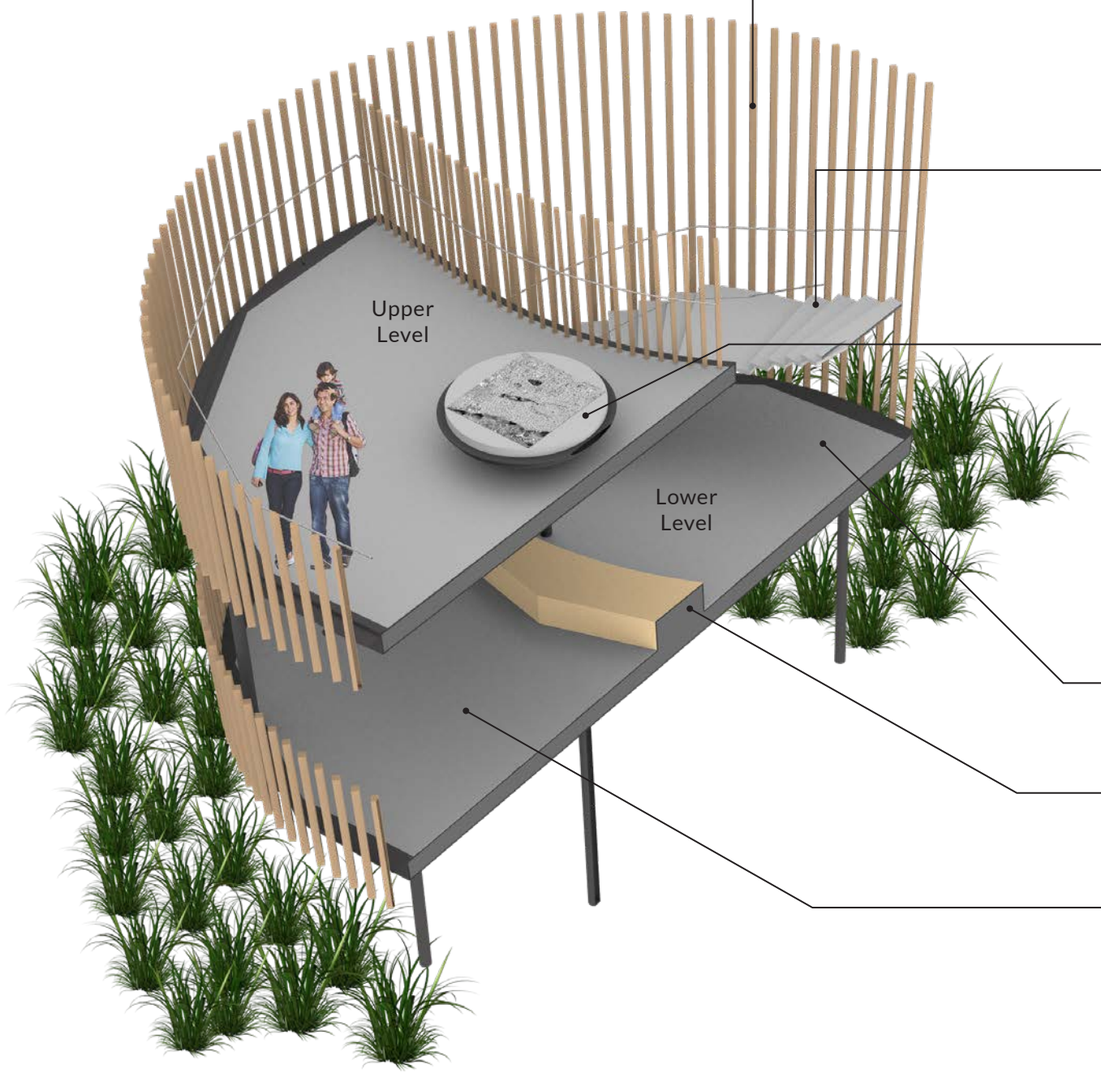
YELLAGONGA BIRD VIEWING STRUCTURES
CITY OF WANNEROO

LAKE LOOKOUT
MATERIALS & INSPIRATION

SK06



CUT-AWAY VIEW

Sculptural timber batten screen creating nest-form providing enclosure to rear face of lookout and balustrade to all other areas.

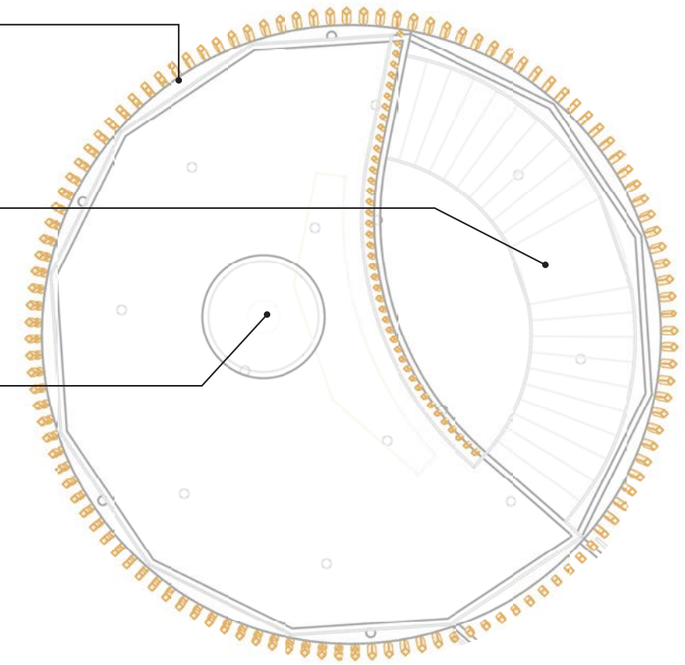
Spiral stair connecting upper and lower levels

Wanneroo map on low plinth showing regional features and distance from the lookout

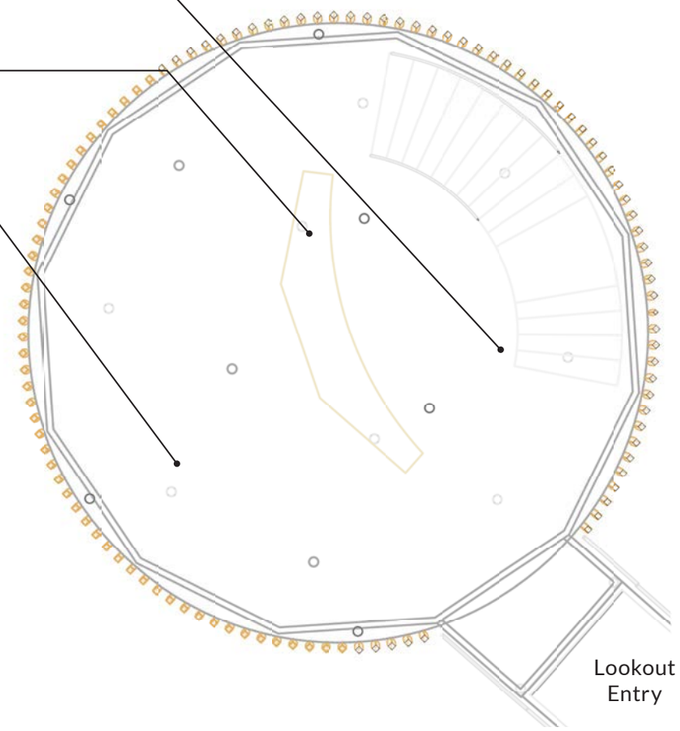
Potential location for wetland ecology interpretive signage panels

Timber bench seat oriented towards the view

Lower level viewing area, wheelchair accessible



UPPER LEVEL FLOOR PLAN



LOWER LEVEL FLOOR PLAN

ecoscape
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(08) 9430 8955 WWW.ECOSCAPE.COM.AU

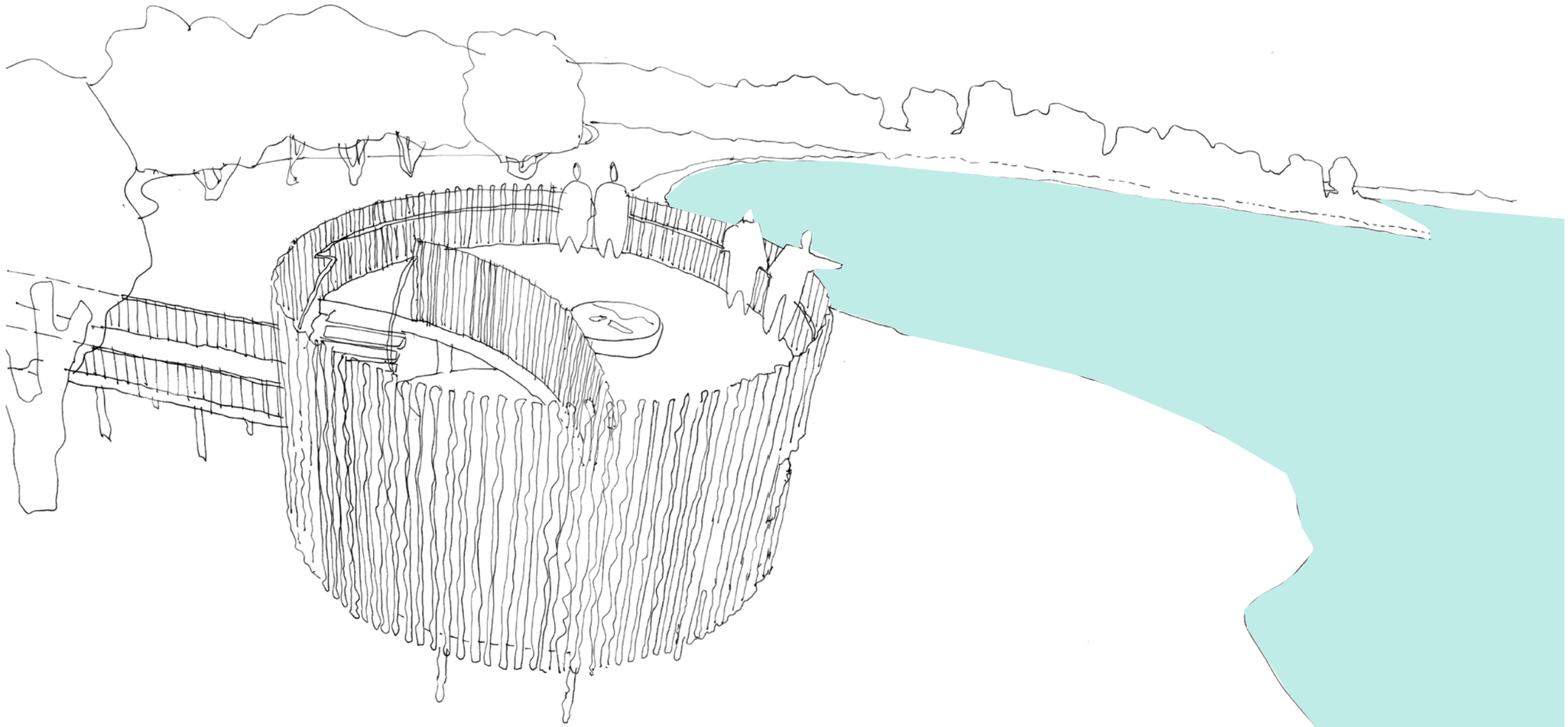
AUTHOR: FK/LD
REVISION: B
PROJECT NO: 4530-20
DATE: JULY 2020
SCALE 1:100 @A3

0 2.5 5m

YELLAGONGA BIRD VIEWING STRUCTURES
CITY OF WANNEROO

LAKE LOOKOUT DETAILS

SK07



OVERVIEW SKETCH, LOOKING TOWARDS LAKE ISLAND

APPROACH VIEW

ecoscape

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AUTHOR: FK/LD
REVISION: B

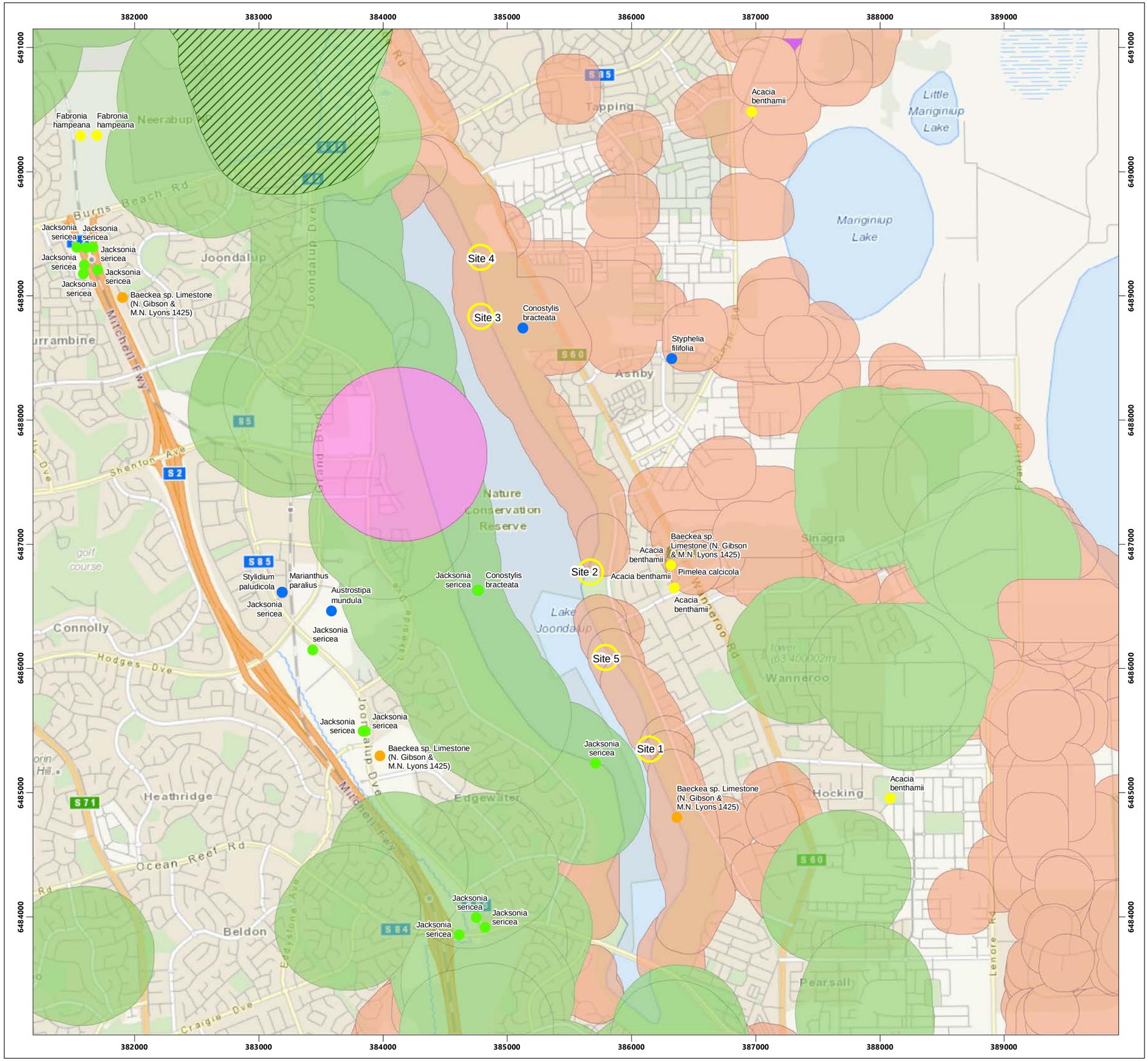
PROJECT NO: 4530-20
DATE: JULY 2020

YELLAGONGA BIRD VIEWING STRUCTURES
CITY OF WANNEROO

LAKE LOOKOUT VIEWS

SK08

MAPS



LEGEND

- Sites with 100m buffer

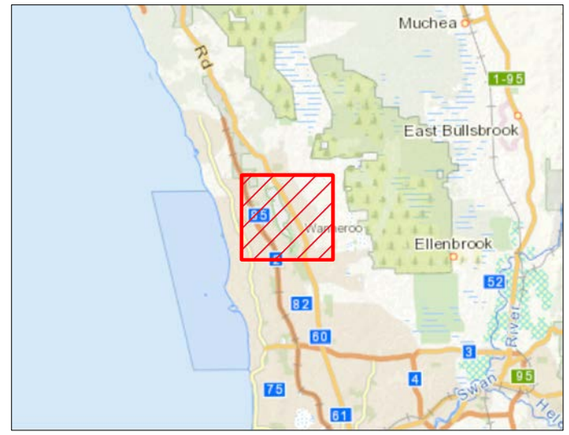
Flora Database Search Results (DBCA 2020)

Conservation Status

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

TEC/PEC Database Search Results (DBCA 2020)

- Banksia WL SCP - Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region (TEC)
- SCP20a - *Banksia attenuata* woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson et al. (1994)) (TEC)
- SCP25 - Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands (PEC)
- Tuart woodlands and forests of the Swan Coastal Plain (TEC)
- SCP24 - Northern Spearwood shrublands and woodlands (PEC)



ecoscape

DESKTOP RESULTS
FLORA AND VEGETATION

YELLAGONGA BIRD VIEWING STRUCTURES

DATASOURCES:
SOURCE DATA:DBCA DATABASE SEARCH
AERIAL: GEOSCIENCE AUSTRALIA
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

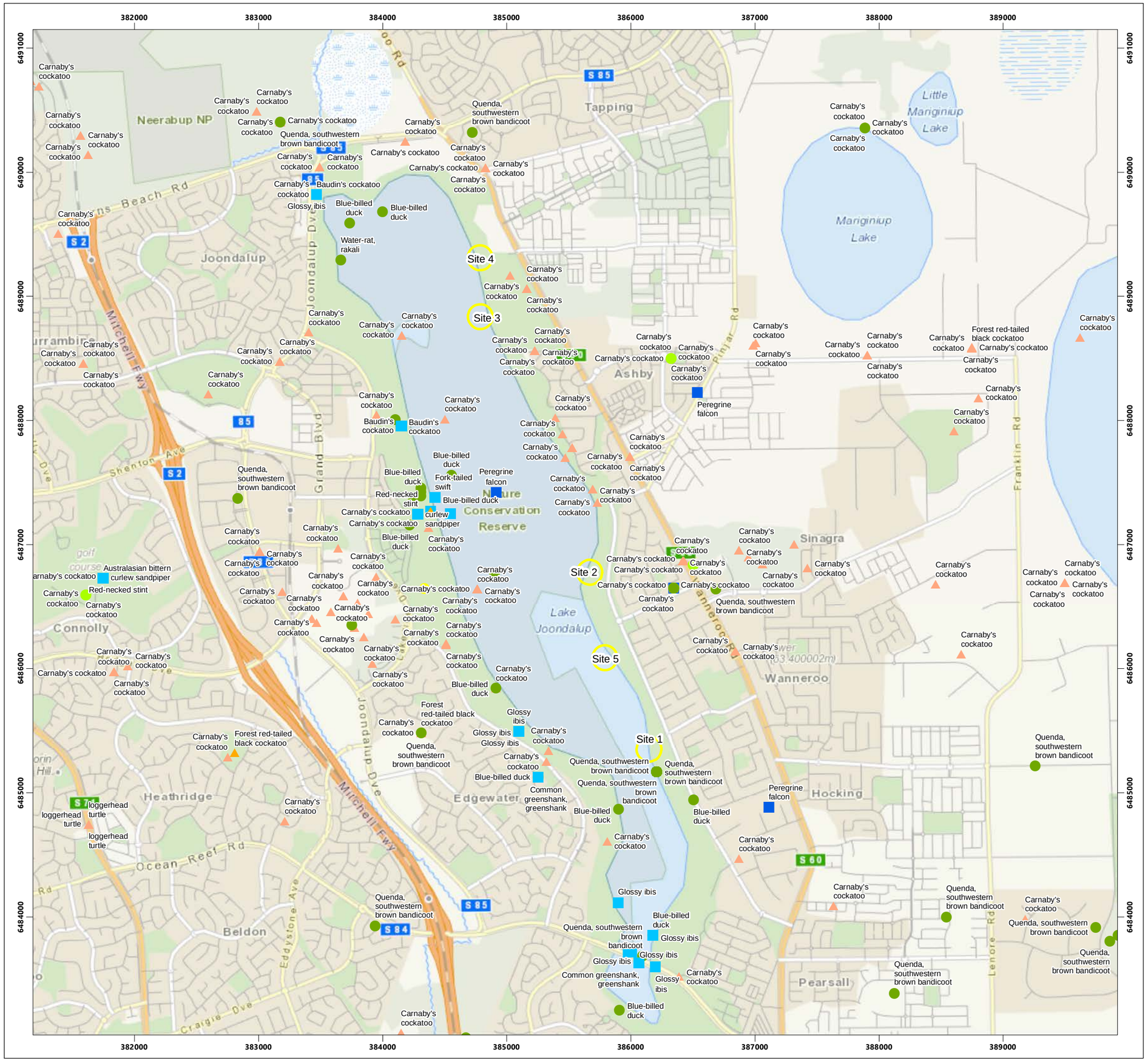
SCALE: 1:30,000 @ A3

N 0 1 Kilometers

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 01



LEGEND

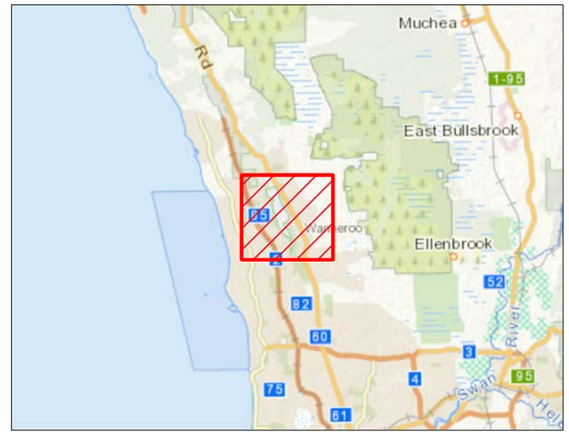
- Sites with 100m buffer

Database Search Results (DBCA 2020)

Conservation Code

- Critically Endangered
- Endangered
- Vulnerable
- Priority 2
- Priority 3
- Priority 4
- International Agreement
- Other Specially Protected

DATASOURCES:
SOURCE DATA: DBCA
AERIAL:GEOSCIENCE AUSTRALIA
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:



ecoscape

DESKTOP RESULTS

FAUNA

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

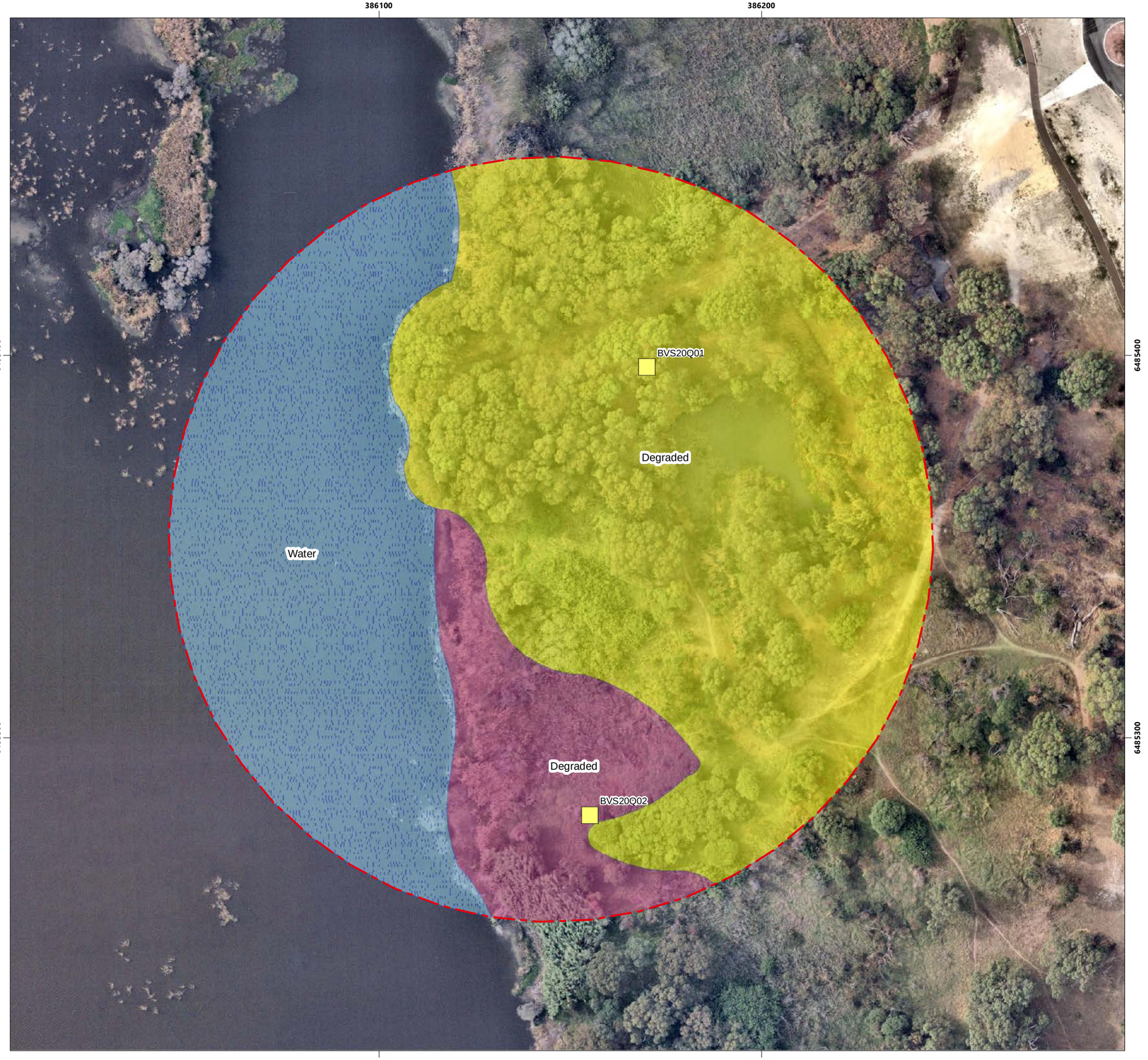
SCALE: 1:30,000 @ A3

N 0 1 Kilometers

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 02



LEGEND

- Quadrat Locations
- Sites with 100m buffer
- Banksia Woodland TEC

Vegetation Types and Condition

- *Baumea articulata, Typha orientalis* rushland
- *Eucalyptus rudis* and *Banksia* woodland
- *Eucalyptus rudis* and *Corymbia calophylla* forest
- *Eucalyptus rudis* woodland over *Melaleuca rhaphiophylla*
- *Melaleuca preissiana, Banksia littoralis* forest
- *Melaleuca rhaphiophylla* tall shrubland over *Typha orientalis* sedgeland
- Parkland
- Water

DATASOURCES:
SOURCE DATA:ECOSCAPE SURVEY
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION RESULTS FLORA AND VEGETATION

SITE 1 - ARITI AVENUE

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

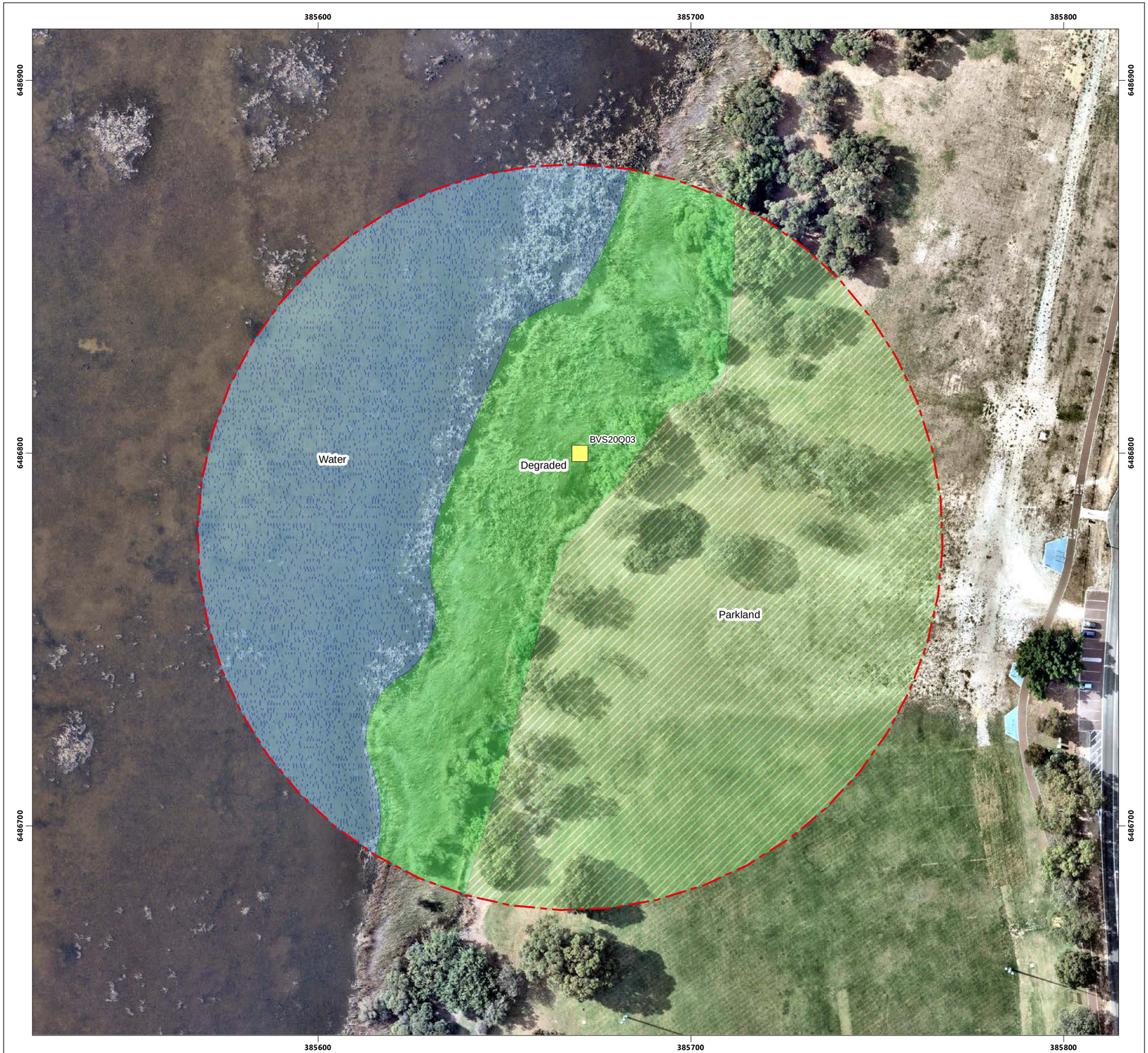
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 03-1



LEGEND

- Quadrat Locations
- Sites with 100m buffer
- Banksia Woodland TEC

Vegetation Types and Condition

- *Baumea articulata, Typha orientalis* rushland
- *Eucalyptus rudis* and *Banksia* woodland
- *Eucalyptus rudis* and *Corymbia calophylla* forest
- *Eucalyptus rudis* woodland over *Melaleuca rhaphiophylla*
- *Melaleuca preissiana, Banksia littoralis* forest
- *Melaleuca rhaphiophylla* tall shrubland over *Typha orientalis* sedgeland
- Parkland
- Water

DATASOURCES:
SOURCE DATA:ECOSCAPE SURVEY
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION RESULTS FLORA AND VEGETATION

SITE 2 - JOONDALUP LAKE PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

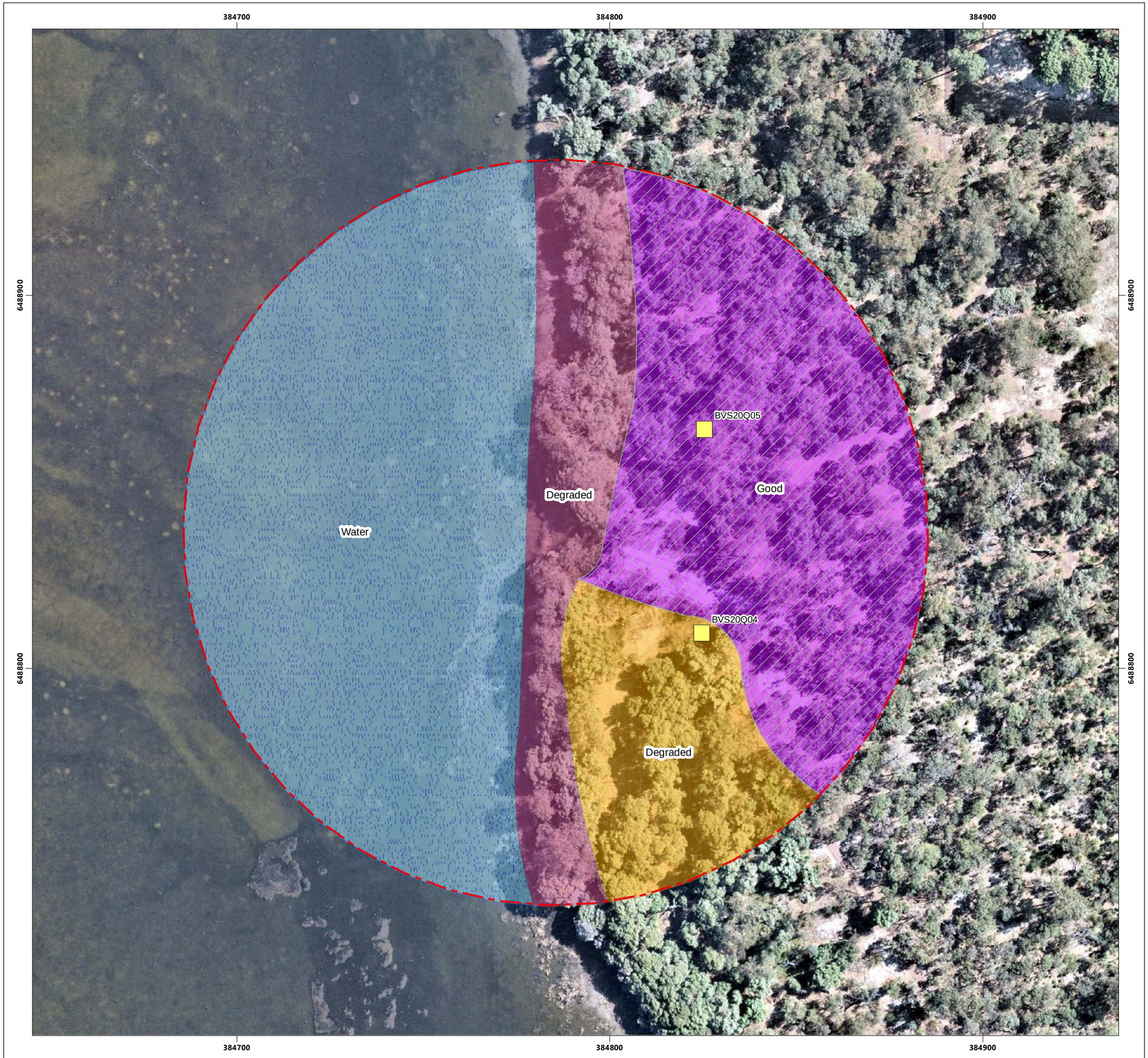
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 03-2



LEGEND

- Quadrat Locations
- Sites with 100m buffer
- Banksia Woodland TEC

Vegetation Types and Condition

- *Baumea articulata, Typha orientalis* rushland
- *Eucalyptus rudis* and *Banksia* woodland
- *Eucalyptus rudis* and *Corymbia calophylla* forest
- *Eucalyptus rudis* woodland over *Melaleuca rhaphiophylla*
- *Melaleuca preissiana, Banksia littoralis* forest
- *Melaleuca rhaphiophylla* tall shrubland over *Typha orientalis* sedgeland
- Parkland
- Water

DATASOURCES:
SOURCE DATA:ECOSCAPE SURVEY
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION RESULTS FLORA AND VEGETATION

SITE 3 - SOUTH WEST PINE SEED ORCHARD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

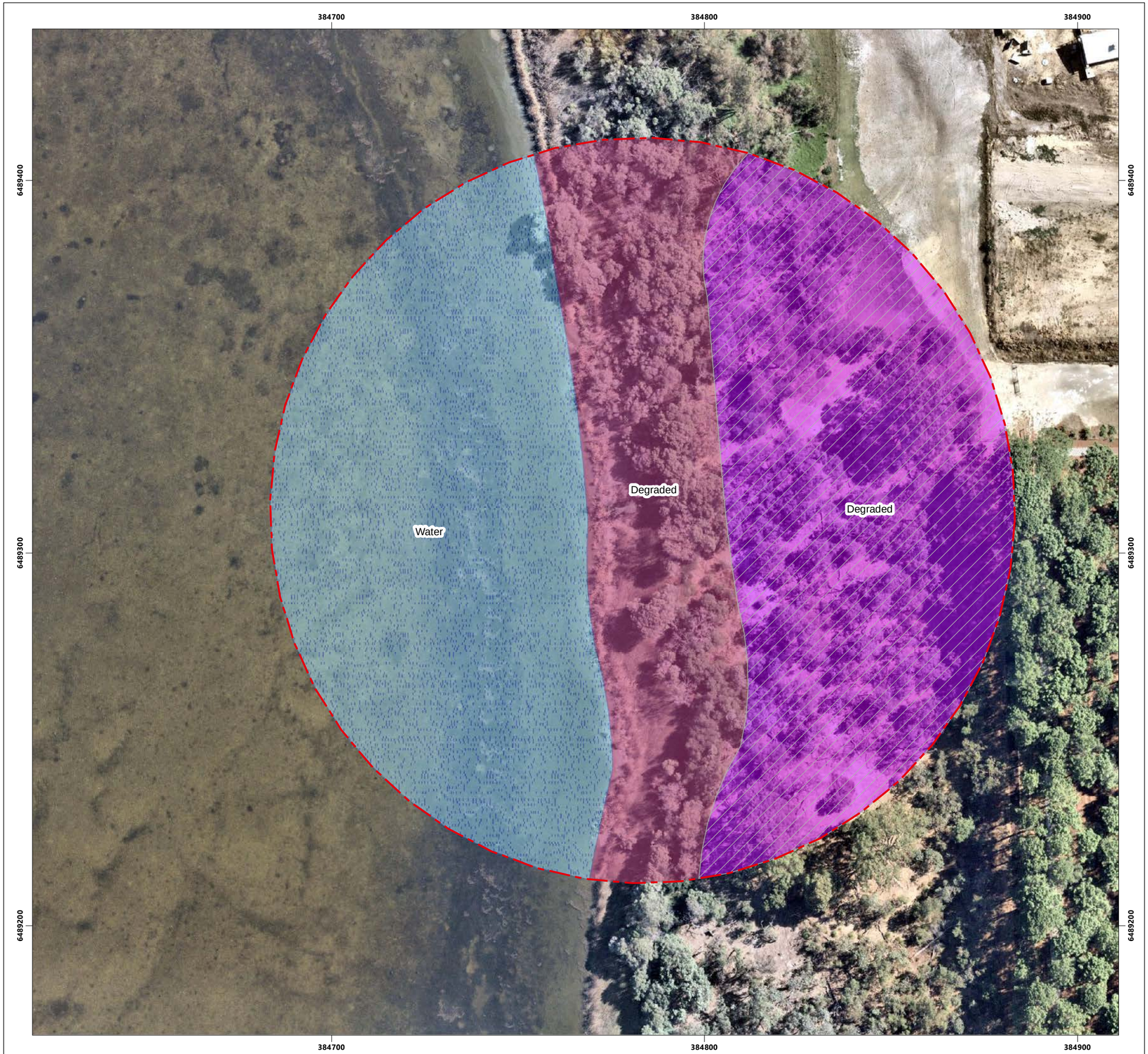
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 03-3



LEGEND

- Quadrat Locations
- Sites with 100m buffer
- Banksia Woodland TEC

Vegetation Types and Condition

- *Baumea articulata, Typha orientalis* rushland
- *Eucalyptus rudis* and *Banksia* woodland
- *Eucalyptus rudis* and *Corymbia calophylla* forest
- *Eucalyptus rudis* woodland over *Melaleuca rhaphiophylla*
- *Melaleuca preissiana, Banksia littoralis* forest
- *Melaleuca rhaphiophylla* tall shrubland over *Typha orientalis* sedgeland
- Parkland
- Water

DATASOURCES:
SOURCE DATA:ECOSCAPE SURVEY
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION RESULTS FLORA AND VEGETATION

SITE 4 – ASHLEY ROAD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP
03-4

LEGEND

- Quadrat Locations
- Sites with 100m buffer
- Banksia Woodland TEC

Vegetation Types and Condition

- *Baumea articulata, Typha orientalis* rushland
- *Eucalyptus rudis* and *Banksia* woodland
- *Eucalyptus rudis* and *Corymbia calophylla* forest
- *Eucalyptus rudis* woodland over *Melaleuca rhaphiophylla*
- *Melaleuca preissiana, Banksia littoralis* forest
- *Melaleuca rhaphiophylla* tall shrubland over *Typha orientalis* sedgeland
- Parkland
- Water

DATASOURCES:
SOURCE DATA:ECOSCAPE SURVEY
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION RESULTS FLORA AND VEGETATION

SITE 5 – ROTARY PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

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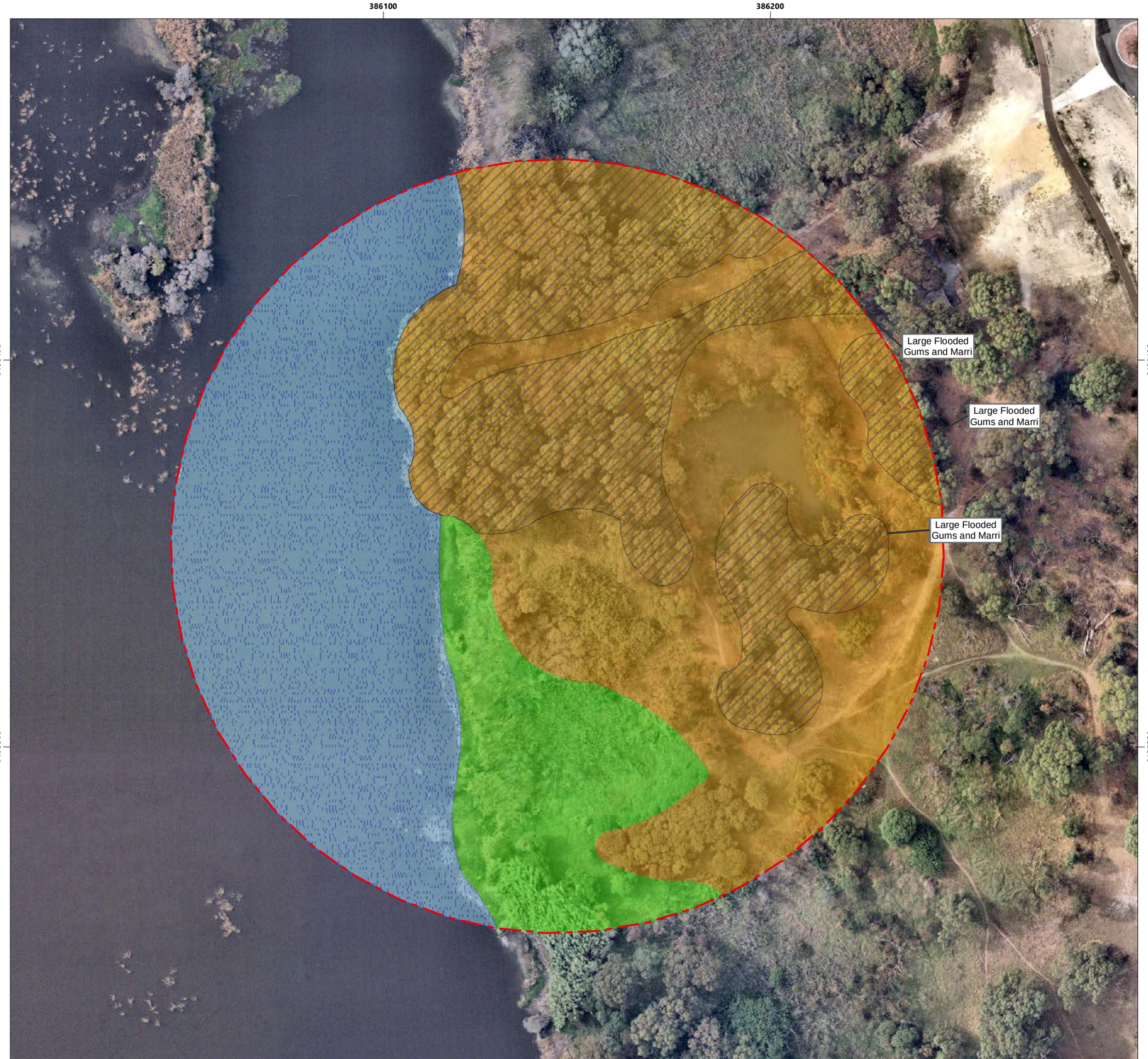
PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP
03-5



LEGEND

- Sites with 100m buffer
- Significant Tree Locations

Fauna Habitat Types

- Open Water
- Parkland
- Segdes and Rushes
- Woodland

DATASOURCES:
SOURCE DATA:
AERIAL:
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION FAUNA AND HABITAT

SITE 1 - ARITI AVENUE

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

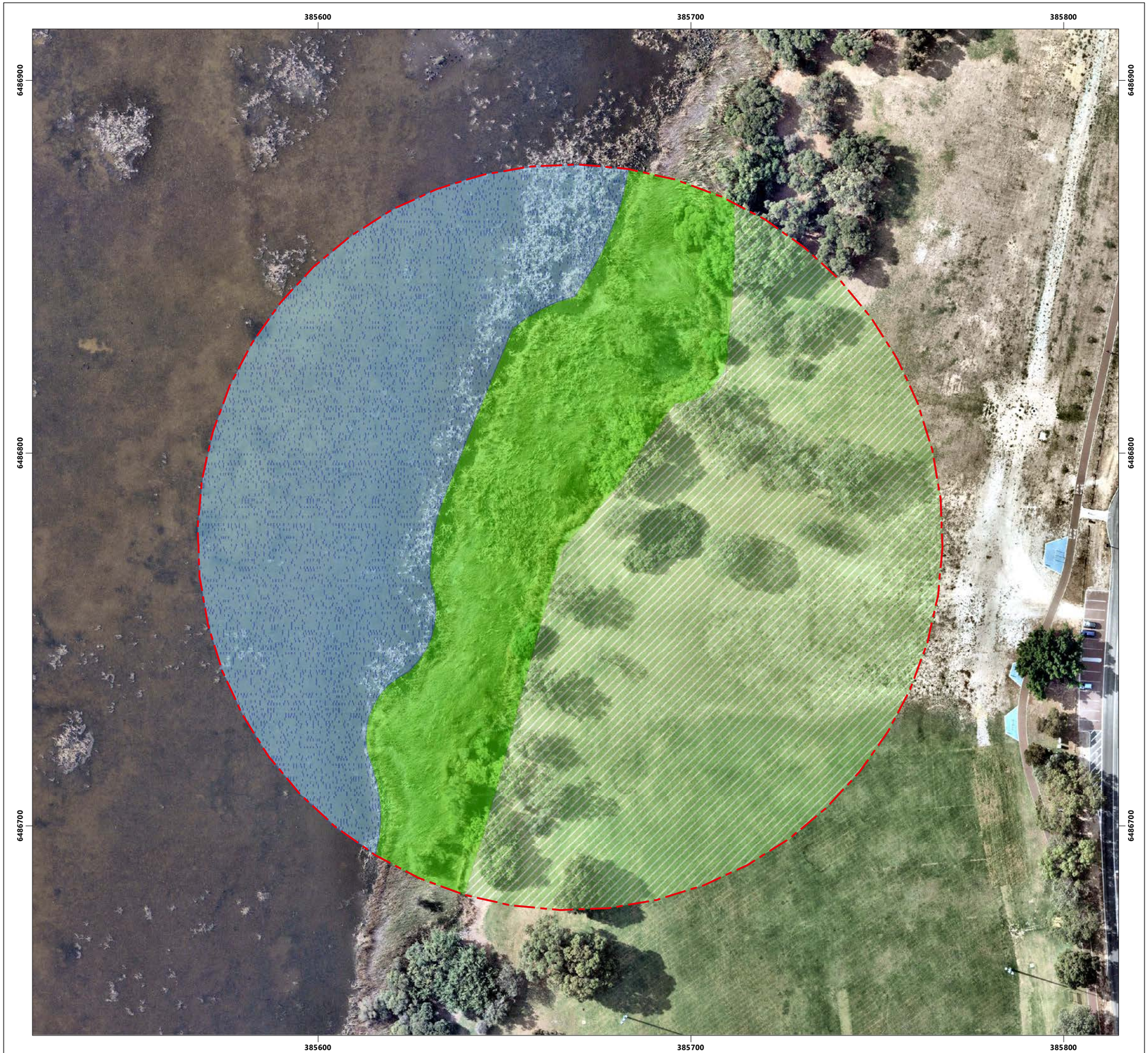
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 04-1



LEGEND

- Sites with 100m buffer
- Significant Tree Locations

Fauna Habitat Types

- Open Water
- Parkland
- Segdes and Rushes
- Woodland

DATASOURCES:
SOURCE DATA:
AERIAL:
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION
FAUNA AND HABITAT

SITE 2 - LAKE JOONDALUP PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

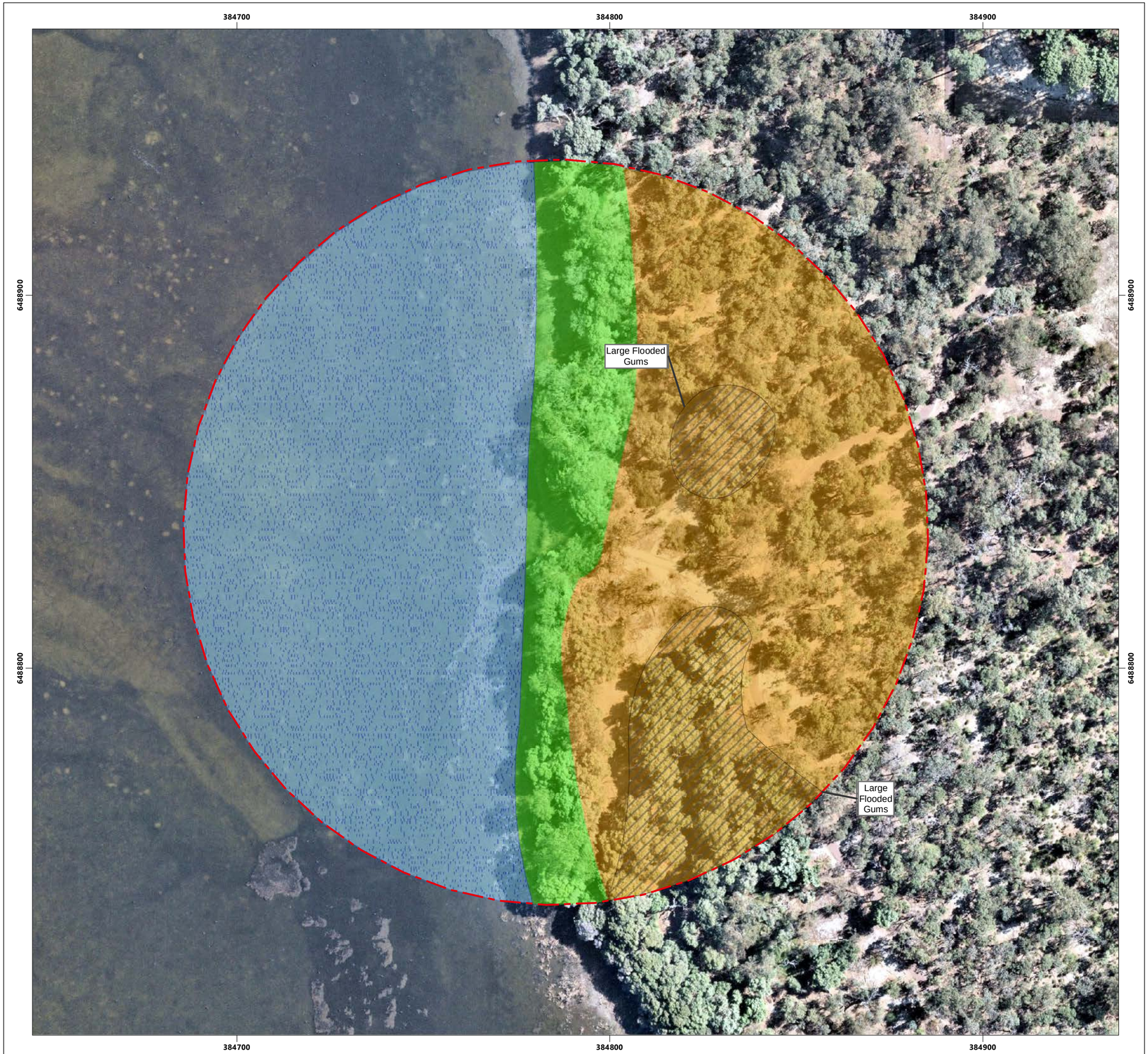
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 04-2



LEGEND

- Sites with 100m buffer
- Significant Tree Locations

Fauna Habitat Types

- Open Water
- Parkland
- Segdes and Rushes
- Woodland

DATASOURCES:
SOURCE DATA:
AERIAL:
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION FAUNA AND HABITAT

SITE 3 - SOUTH WEST PINE SEED ORCHARD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

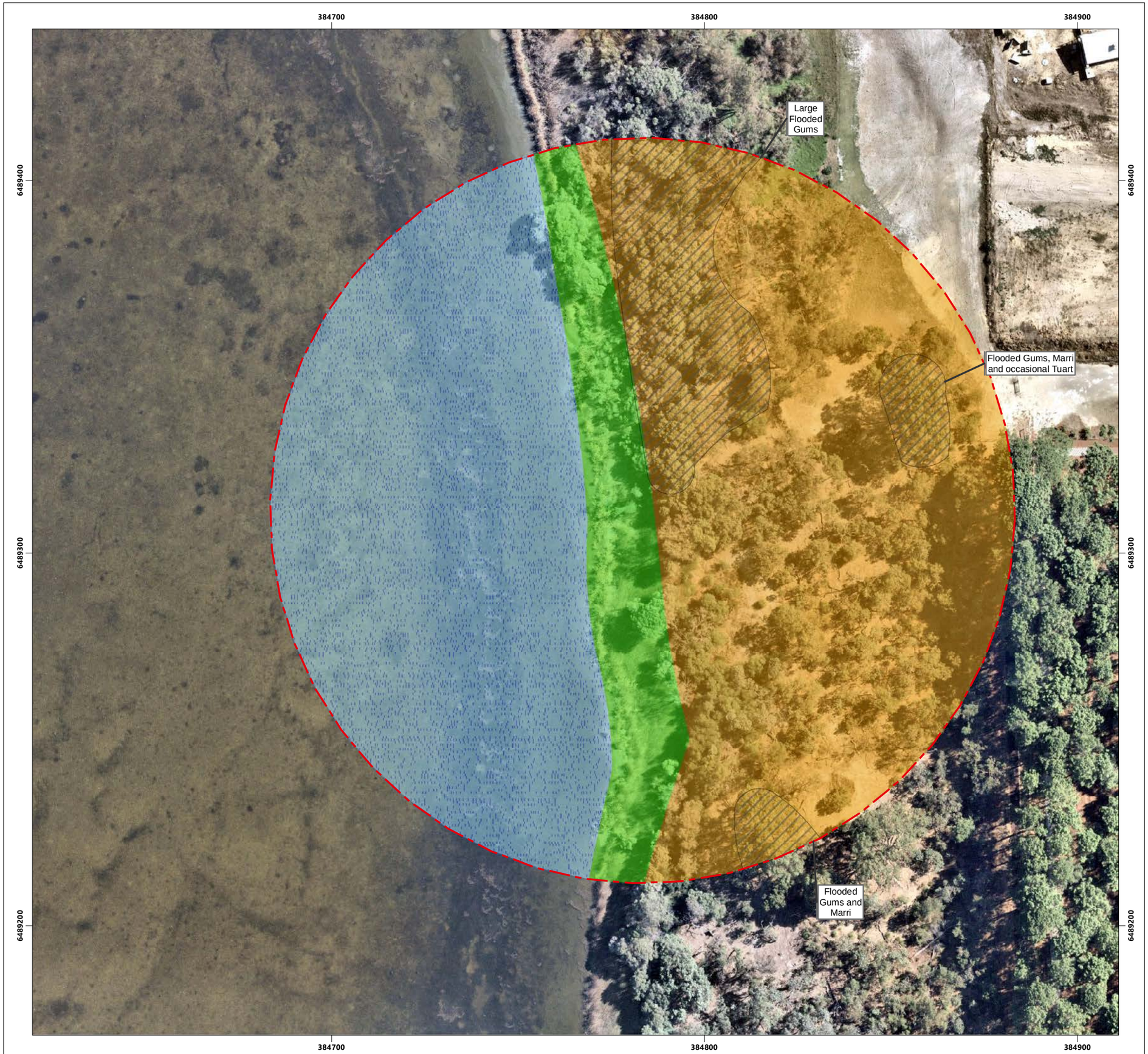
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 04-3



LEGEND

- Sites with 100m buffer
- Significant Tree Locations

Fauna Habitat Types

- Open Water
- Parkland
- Segdes and Rushes
- Woodland

DATASOURCES:
SOURCE DATA:
AERIAL:
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

SITE INVESTIGATION FAUNA AND HABITAT

SITE 4 – ASHLEY ROAD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

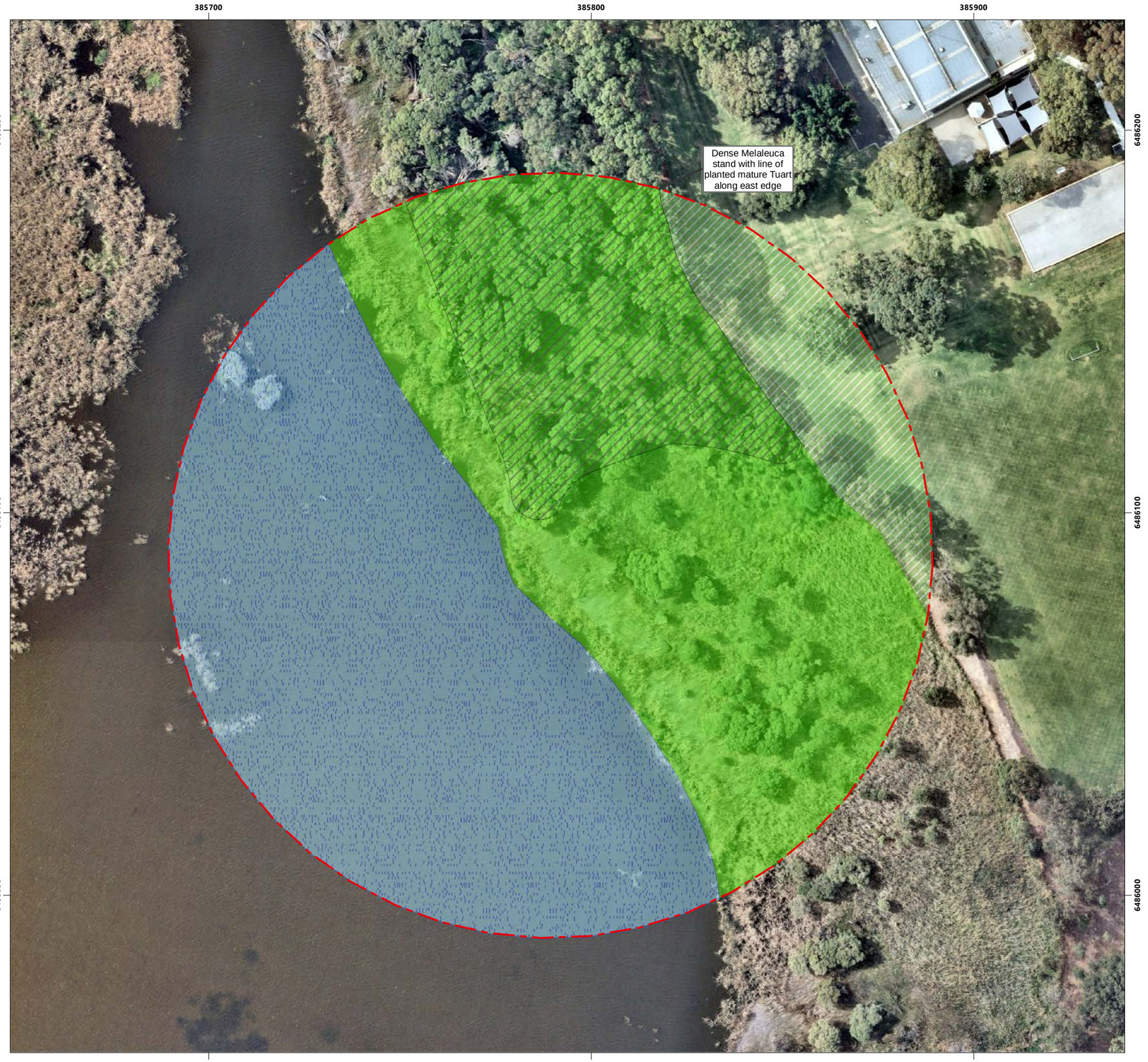
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 04-4



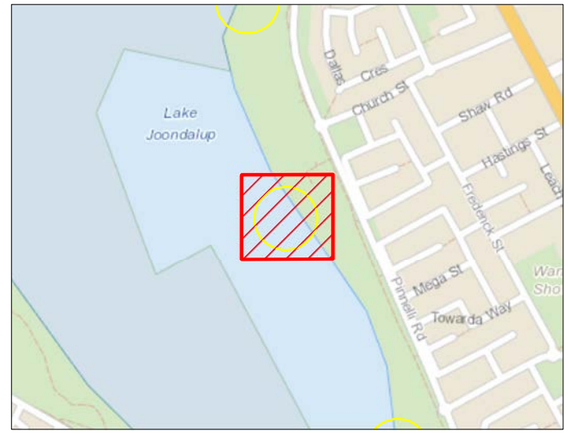
LEGEND

- Sites with 100m buffer
- Significant Tree Locations

Fauna Habitat Types

- Open Water
- Parkland
- Segdes and Rushes
- Woodland

DATASOURCES:
SOURCE DATA:
AERIAL:
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:



ecoscape

SITE INVESTIGATION FAUNA AND HABITAT

SITE 5 – ROTARY PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP
04-5

386100
386200
6485400
6485300

City of Wanneroo
Reserve
Freehold-Ministry for Planning
Public Road
Crown Reserve-vested City Wanneroo
Public Road
Freehold-Ministry for Planning
Freehold-Water Corporation
Public Road
Reserve-City of Wanneroo
Freehold-Water Corporation

LEGEND

- Cadastral Boundaries
- Sites with 100m buffer

DATASOURCES:
SOURCE DATA: DEPARTMENT OF LANDS, PLANNING AND HERITAGE
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

TENURE INVESTIGATION

SITE 1 - ARITI AVENUE

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP
05-1

LEGEND

- Cadastral Boundaries
- Sites with 100m buffer

DATASOURCES:
SOURCE DATA: DEPARTMENT OF LANDS, PLANNING AND HERITAGE
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

TENURE INVESTIGATION

SITE 2 - LAKE JOONDALUP PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

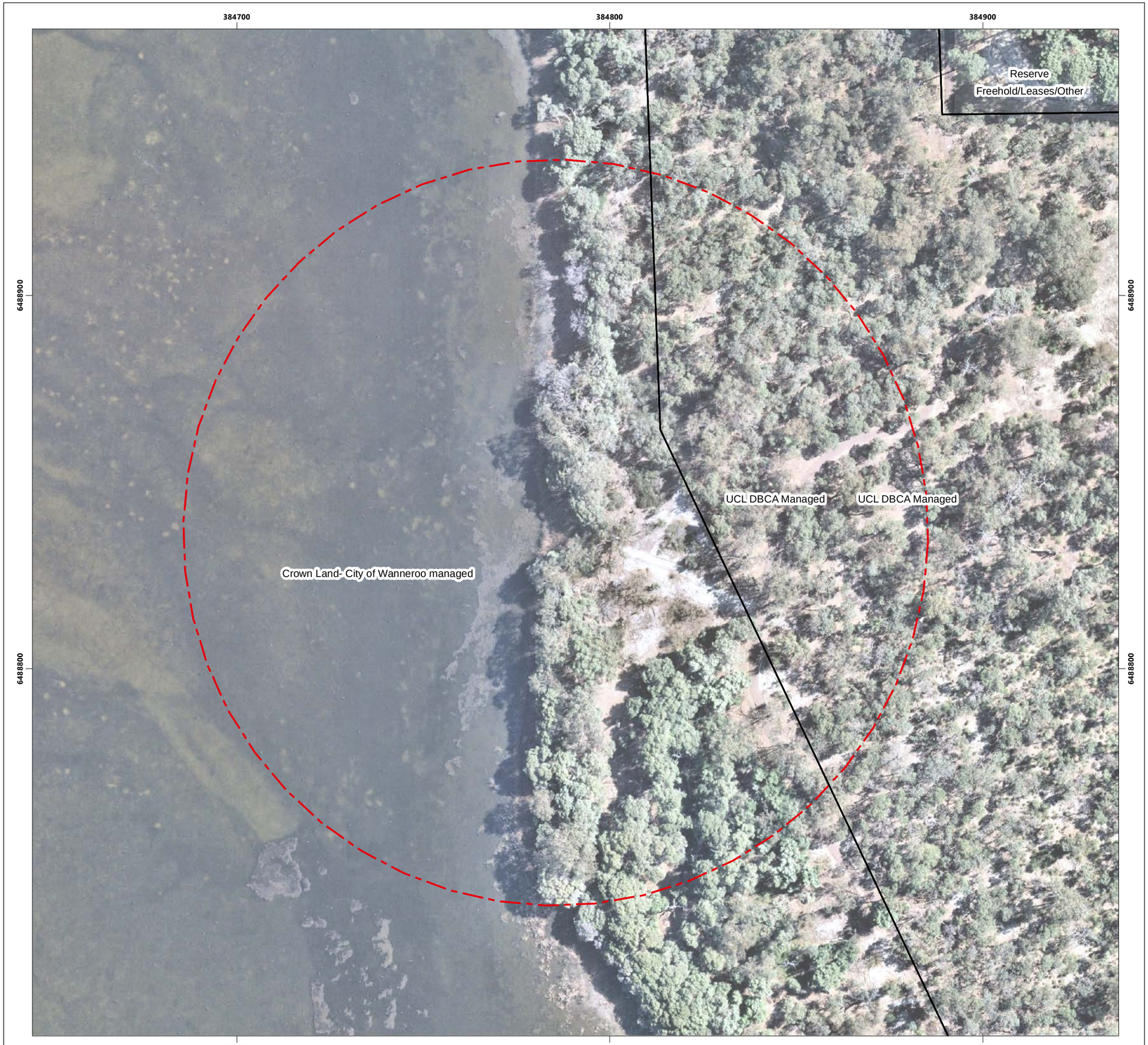
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 05-2



LEGEND

- Cadastral Boundaries
- Sites with 100m buffer

DATASOURCES:
SOURCE DATA: DEPARTMENT OF LANDS, PLANNING AND HERITAGE
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

TENURE INVESTIGATION

SITE 3 - SOUTH WEST PINE SEED ORCHARD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

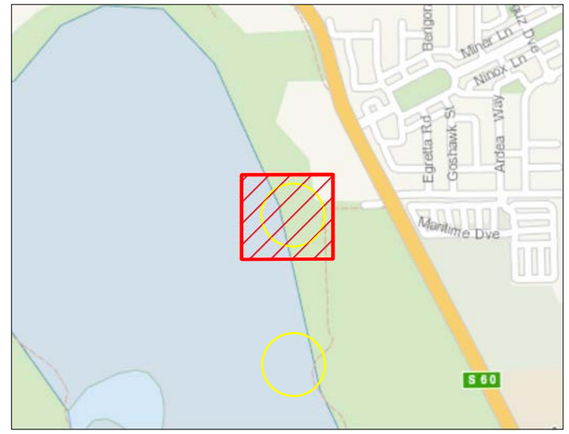
REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 05-3

LEGEND

- Cadastral Boundaries
- Sites with 100m buffer

DATASOURCES:
SOURCE DATA: DEPARTMENT OF LANDS, PLANNING AND HERITAGE
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:



ecoscape

TENURE INVESTIGATION

SITE 4 – ASHLEY ROAD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

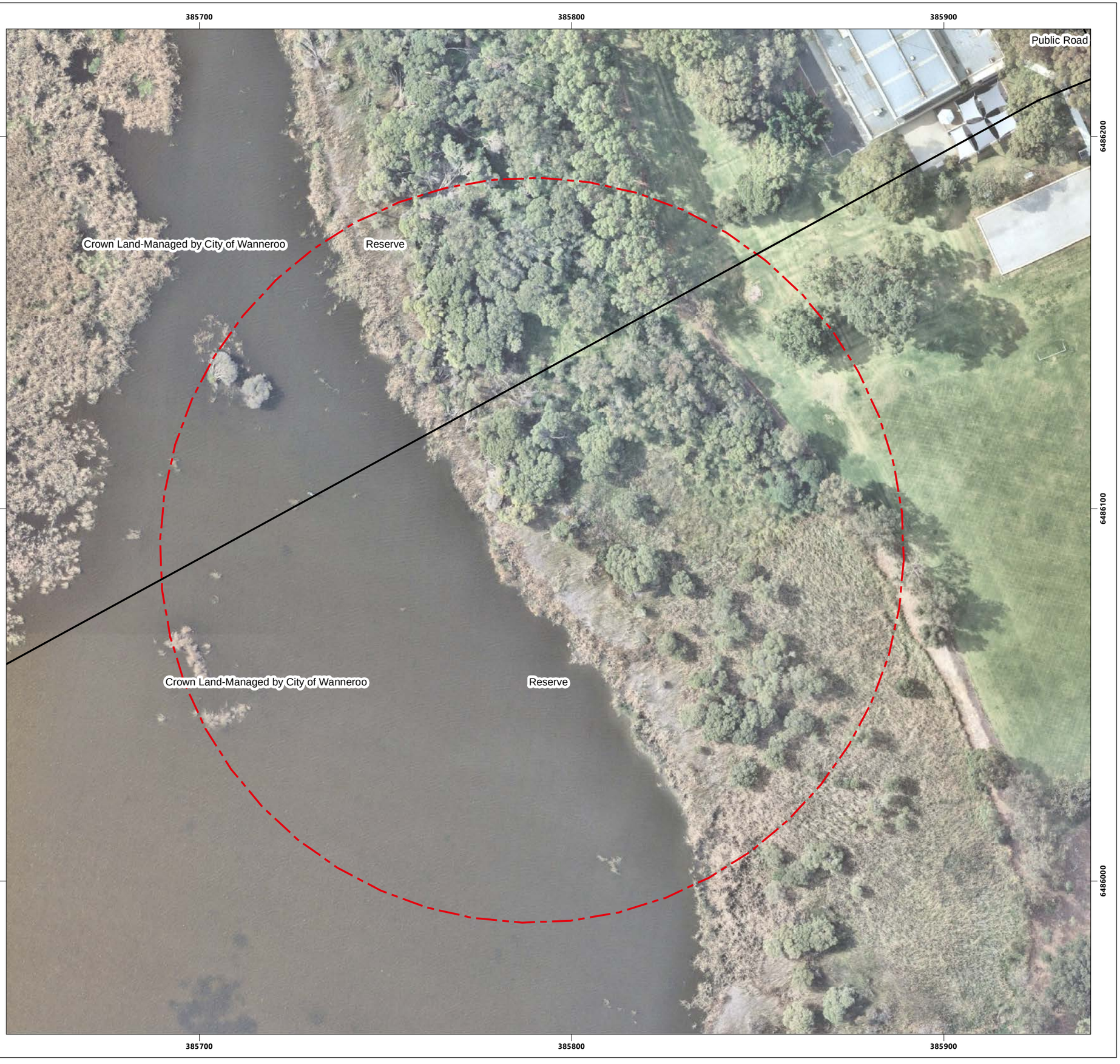
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 05-4



LEGEND

- Cadastral Boundaries
- Sites with 100m buffer

DATASOURCES:
SOURCE DATA: DEPARTMENT OF LANDS, PLANNING AND HERITAGE
AERIAL:NEARMAP
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

TENURE INVESTIGATION

SITE 5 – ROTARY PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 05-5

386100

386200

6485400

6485300

Ariti Ave

19

20

21

22

23

24

25

17

18

19

20

21

22

23

WPT: 19

WPT: 20

WPT: 21

WPT: 22

WPT: 23

WPT: 24

WPT: 25

LEGEND

- Sites with 100m buffer
- Contours
- Photopoints
- Potential Parking Location
- Shared Path
- Access track
- Key View
- View Barrer
- Potential Bird Viewing Struture and Boardwalk Location

DATA SOURCES:
SOURCE DATA: ECOSCAPE SURVEY, CITY WANNEROO
AERIAL:NEARMAP 2019
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

LANDSCAPE ASSESSMENT

SITE 1 - ARITI AVENUE

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 06-1

385600 385700 385800

6486900 6486800 6486700

Scenic Drive

LEGEND

- Sites with 100m buffer
- Contours
- Photopoints
- Parking Location
- Shared Path
- Potential path location
- Key View
- View Barrer
- Potential Bird Viewing Struture and Boardwalk Location

DATASOURCES:
SOURCE DATA: ECOSCAPE SURVEY, CITY WANNEROO
AERIAL:NEARMAP 2019
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

LANDSCAPE ASSESSMENT

SITE 2 - LAKE JOONDALUP PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP
06-2

384700 384800 384900

6488900 6488800

P 37 38 26 27 17 18 19 20 21 22 23 35 34 36 P

LEGEND

- Sites with 100m buffer
- Contours
- Photopoints
- Parking Location
- Shared Path
- Access track
- Key View
- View Barrer
- Potential Bird Viewing Struture and Boardwalk Location

DATASOURCES:
SOURCE DATA: ECOSCAPE SURVEY, CITY WANNEROO
AERIAL:NEARMAP 2019
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

LANDSCAPE ASSESSMENT

SITE 3 - SOUTH WEST PINE SEED ORCHARD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

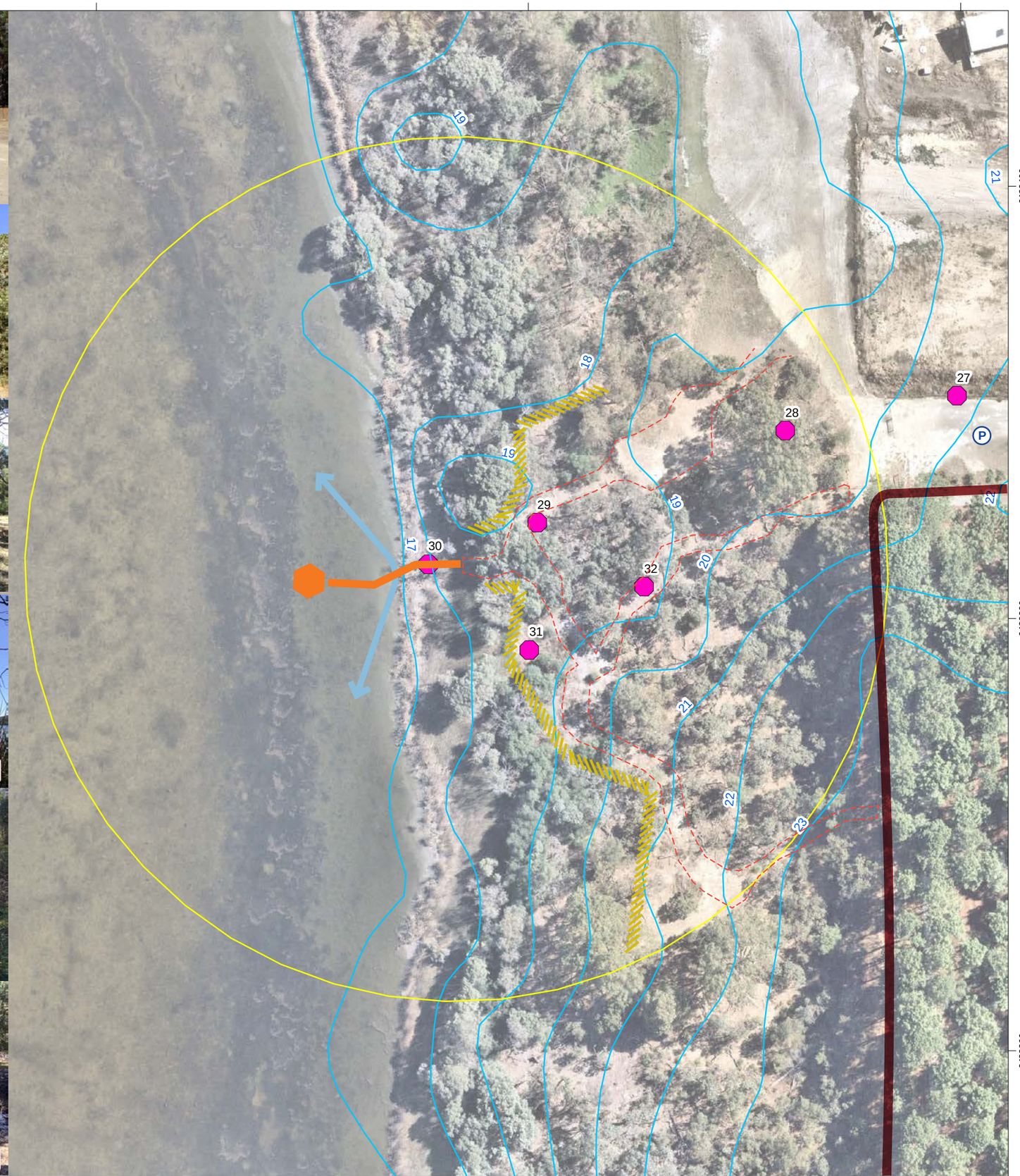
SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP
06-3



LEGEND

- Sites with 100m buffer
- Contours
- Photopoints
- Parking Location
- Shared Path
- Access track
- Key View
- View Barrer
- Potential Bird Viewing Struture and Boardwalk Location

DATASOURCES:
SOURCE DATA: ECOSCAPE SURVEY, CITY WANNEROO
AERIAL:NEARMAP 2019
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

LANDSCAPE ASSESSMENT

SITE 4 – ASHLEY ROAD

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP
06-4

385700 385800 385900

6486200 6486100 6486000

Lake Island

Recreation Centre

17 18 19 20 21 22

09 08 10

WPT:08 WPT:09 WPT:09 WPT: 10 WPT: 10

LEGEND

- Sites with 100m buffer
- Contours
- Photopoints
- Parking Location
- Shared Path
- Potential path location
- Key View
- View Barrer
- Potential Bird Viewing Struture and Boardwalk Location

DATASOURCES:
SOURCE DATA: ECOSCAPE SURVEY, CITY WANNEROO
AERIAL:NEARMAP 2019
BASEMAP: GEOSCIENCE AUSTRALIA
SERVICE LAYERS:

ecoscape

LANDSCAPE ASSESSMENT

SITE 5 – ROTARY PARK

YELLAGONGA BIRD VIEWING STRUCTURES

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:1,000 @ A3

N 0 10 20 30 40 50 M

PROJECT NO: 4530-20

REV	AUTHOR	APPROVED	DATE
01	AF	SB	11/05/2020

MAP 06-5