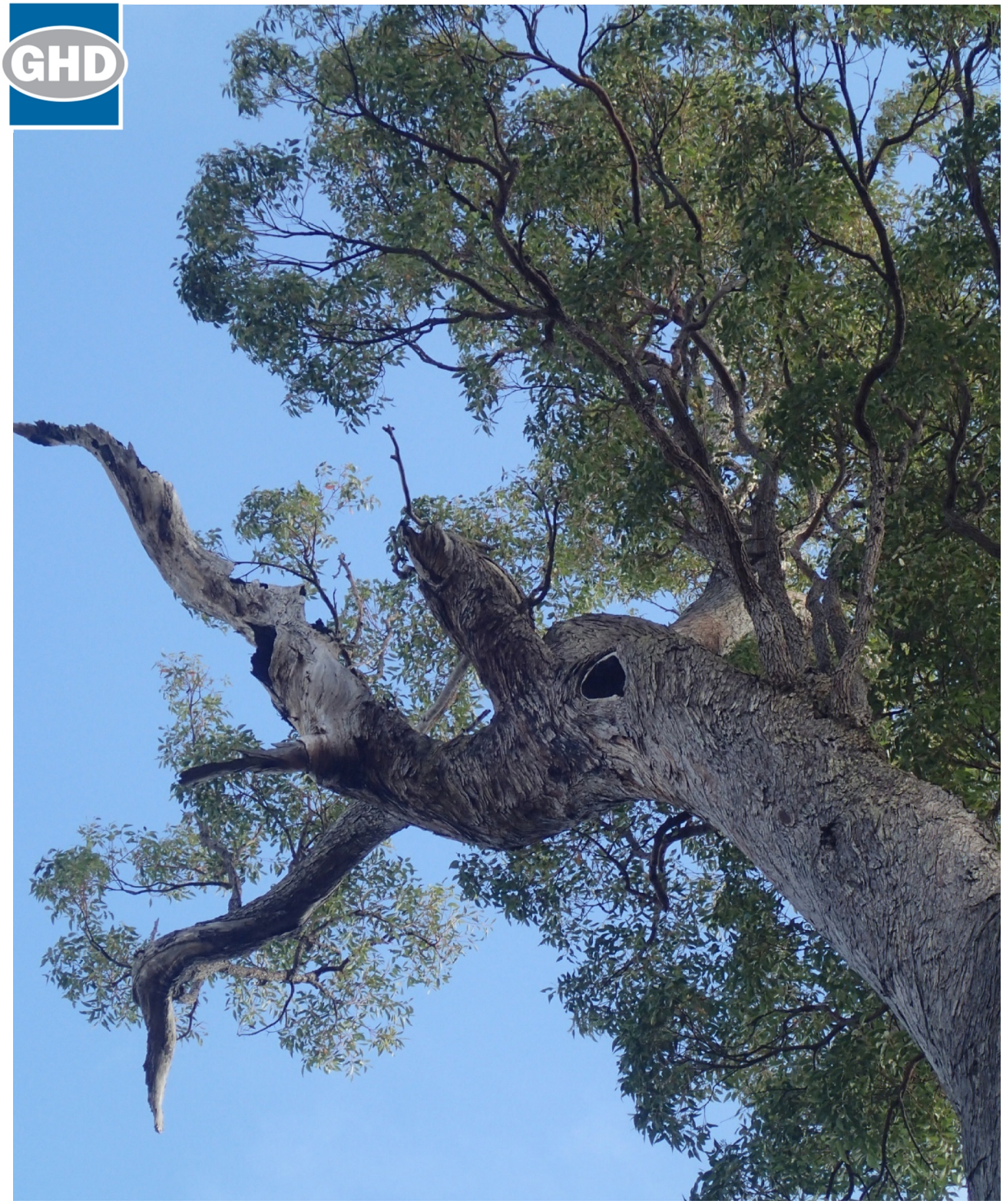

Water Corporation

Greenbushes to Kirup Link
Biological Assessment

August 2017

Executive summary

The Water Corporation proposes to construct new infrastructure to improve the supply of water to the towns of Balingup, Mullalyup and Kirup, as a component of the broader Warren Blackwood Water Supply Scheme. This will potentially involve clearing of vegetation and fauna habitat for the construction and installation of this infrastructure.

A previous Spring Flora and Fauna Survey Report was prepared by Astron Environmental Services in 2013 covering the majority of the project area (Astron 2013), however since that time, the location of some of the components of the project has changed. As a result, further survey of the areas not previously covered is required to identify the key ecological values.

GHD was commissioned by the Water Corporation to undertake a flora and fauna survey for the project. The purpose of the flora and fauna survey is to define the quality and extents of ecological values in the survey area. The results of this assessment will be used to assess the ecological impact of the project and inform the environmental approvals process.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.6 and the assumptions and qualifications contained throughout this report.

Key findings

Vegetation

Regional vegetation mapped by Mattiske and Havel (1998) indicates three vegetation complexes occur within the survey area. One of these complexes, Balingup, has 30.79 % of its extent remaining within the Southern Jarrah Forest subregion. However because this complex is close to the target threshold of 30 % the Local Biodiversity Program (2013) has estimated that this complex has < 30 % of its vegetation extent remaining in the Southern Jarrah Forest subregion. The other two complexes are well represented within the Southern Jarrah Forest subregion with over 60 % of their extents remaining. Based on the statistics from GoWA (2017) the retention of the Balingup complex is considered essential to ensure that Regional Representation and Rarity Local Significance criteria are addressed within the Shires of Donnybrook – Balingup and Greenbushes – Bridgetown.

The desktop study revealed four Department of Biodiversity, Conservation and Attractions (DBCA) managed lands overlap the survey area; Greenbushes State Forest (F 20), CALM Exec Body Freehold (name: 1042/47) (P229098 2298), CALM Exec Body Freehold (name: 1117/388) (P252367 6367) and Mullalyup State Forest (F 21). The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) did not identify any Environmentally Sensitive Areas or federally listed Threatened Ecological Communities (TECs) potentially occurring within the study area. DBCA TEC and Priority Ecological Community (PEC) data obtained by the Water Corporation did not reveal any TECs or PECs occurring in the survey area.

Seven vegetation types were identified and described for the survey area. Six of these vegetation types were Eucalyptus woodlands with variations in the mid and lower storey species. The remaining vegetation type consisted of isolated stands of native and planted trees with scattered natives over weedy grasses. None of the vegetation types described for the survey area are synonymous with any TECs or PECs as defined by the EPBC Act or DBCA.

The vegetation condition within the survey area was rated as Very Good to Completely Degraded condition. The majority of the survey area (54%) was rated as Degraded and Degraded-Completely Degraded condition. Small patches of Very Good and Very Good – Good

vegetation contained a number common bushland weeds, however native vegetation dominated each strata.

Flora

One hundred and six (106) flora taxa (including subspecies and varieties) representing 40 families and 74 genera were recorded from the survey area during the field survey. This total comprised 77 native and 29 introduced flora taxa. No EPBC Act or WC Act listed flora were recorded within the survey area. In addition no DBCA Priority-listed flora or flora of conservation significance were recorded.

The likelihood of occurrence assessment post-field survey concluded that one taxon is likely to occur within the survey area; *Tetraria* sp. Blackwood River (A.R. Annels 3043) (P3). This species has previously been recorded approximately 50 m away from the Mullalyup Tank site. There is very limited suitable habitat for this species, however due to the proximity of the previous known record and its cryptic nature it is still considered to potentially occur.

Of the introduced taxa, two are listed as Declared Pests under the *Biosecurity and Management Act 2007* and as Weeds of National Significance (WONS):

- * *Asparagus asparagoides* (Bridal Creeper)
- * *Rubus ulmifolius* (Blackberry)

Fauna

The survey area comprised four fauna habitat types including Jarrah-Marri Woodland, *Eucalyptus rudis* woodland (riparian), planted vegetation, and cleared or previously disturbed areas. With the exception of the Cirillo Road Option section, these habitats are well-connected at both a local and regional scale to other areas of remnant and contiguous vegetation.

During the survey, three conservation signification fauna species were recorded:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Endangered – WC Act, Endangered – EPBC Act – observed on multiple occasions
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*), Vulnerable – WC Act, Vulnerable – EPBC Act – old foraging evidence recorded
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), Endangered – WC Act, Vulnerable – EPBC Act

An additional nine species are considered likely to occur in the survey area based on previous records and suitability of habitat:

- Chuditch (*Dasyurus geoffroii*), Vulnerable – WC Act, Vulnerable – EPBC Act
- South western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*), Schedule 6 – WC Act
- Western Brush Wallaby (*Macropus irma*), Priority 4 – DBCA listing
- Western False Pipistrelle (*Falsistrellus mackenziei*), Priority 4 – DBCA
- Peregrine Falcon (*Falco peregrinus*), Schedule 7 – WC Act
- Quenda (*Isoodon obesulus fusciventer)*, Priority 4 – DBCA
- Rainbow Bee-eater (*Merops ornatus*) – Migratory
- Barking Owl (southern subspecies) (*Ninox connivens* subsp. *connivens*), Priority 2 – DBCA listing

- Masked Owl (southern subspecies) (*Tyto novaehollandiae* subsp. *novaehollandiae*), Priority 2 – DBCA listing

A total of 253 trees which are potentially suitable for Black Cockatoo breeding (Jarrah, Marri, and Flooded Gum) were recorded within the survey area, including 16 with hollows currently suitable for Black Cockatoo breeding. None of these trees had evidence of current or previous Black Cockatoo use (i.e. old chew marks). Old and fresh Black Cockatoo foraging evidence was recorded scattered throughout the survey area (on Marri nuts) and there is 2.98 ha of suitable foraging habitat.

The majority of the habitats recorded in the survey area are well represented in the immediate vicinity of the survey area and the broader Blackwood district (particularly in the conservation areas and State Forest) and would be utilised by all the conservation significant species known or likely to occur in the area. Furthermore, there is no habitat within the survey area that would be considered specific to, or solely relied upon by, any of the conservation significant species known or likely to occur within the area.

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Appendices

1. Introduction

1.1 Background

The Water Corporation proposes to construct new infrastructure to improve the supply of water to the towns of Balingup, Mullalyup and Kirup, as a component of the broader Warren Blackwood Water Supply Scheme (the project). This infrastructure includes:

- Approximately 5 km of 150 mm nominal diameter water supply main from the Greenbushes summit tank to the Balingup Dam tanks
- Approximately 10.4 km of 150 mm nominal diameter water supply main, from Balingup to the Mullalyup tank
- A pump station for the town of Mullalyup, located in Balingup
- Acquisition of land for a communications repeater station and the future tank site at Lot 8115, south of Dearle Street, Balingup
- A 225 m^3 reinforced concrete water storage tank, overflow storage sump, pump station to Kirup, chlorination module and associated site work at the Mullalyup tank site
- A 66 m, 125 mm nominal diameter bypass main near Kirup Dam site
- A reinforced concrete water storage tank, with a capacity of 225 m^3, overflow storage sump, chlorination module and associated site work at the Kirup tank site.

The construction and installation of this infrastructure will potentially involve clearing of vegetation and fauna habitat. A previous Spring Flora and Fauna Survey Report was prepared by Astron Environmental Services (Astron) in 2013 covering the majority of the project area (Astron 2013). However since that time, the location of some of the components of the project has changed. As a result, further survey of the areas not previously covered is required to identify the key ecological values.

1.2 Purpose of report

GHD Pty Ltd (GHD) was commissioned by the Water Corporation to undertake a flora and fauna survey for the project. The purpose of the flora and fauna survey is to define the quality and extents of ecological values in the survey area.

The information collected will enable the Water Corporation to consider the site's environmental constraints and opportunities. The report is likely to support a Native Vegetation Clearing Permit under the *Environmental Protection Act 1986* (EP Act) and referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This report may also be included in correspondence to the Department of Water and Environmental Regulation (DWER), the Department of the Environment and Energy (DotEE) and other regulators and/ or stakeholders as required.

1.3 Project location

1.3.1 Survey area

The survey area is located within the Shires of Donnybrook – Balingup and Bridgetown – Greenbushes, between the towns of Kirup and Greenbushes (Figure 1, Appendix A) and is approximately 5.76 hectares.

The survey area comprises four distinct sections, identified as follows:

- Kirup Dam Bypass
- Mullalyup Tank
- Cirillo Road Option
- Southern Alignment

Some areas of the survey area have previously been surveyed as part of the Astron 2013 Flora and Fauna Survey (Astron 2013). GHD undertook a flora and fauna assessment of the entire survey area, which therefore included a re-survey of some of the Astron (2013) survey area.

1.3.2 Study area

The study area used for biological based desktop database searches included a 5 km buffer around the survey area in order to provide information on the context for the project within the wider area.

1.4 Scope of works

The scope of works, as undertaken by GHD, was to conduct an out of season flora and vegetation assessment (reconnaissance survey) in parallel with a Level 1 fauna assessment. The following actions were completed to fulfil the scope:

- A desktop assessment of relevant literature (as provided by the Water Corporation), databases and spatial datasets was completed to determine the environmental values and potential issues
- A field survey of the area was completed during Autumn, using quadrats where possible
- Vegetation communities, condition, conservation significant species and fauna habitat were mapped where present
- The vegetation types were described and classified to determine their conservation significance based on an analysis of the floristic data collected
- The vegetation complex mapping of the area was referenced to determine the pre-European extent remaining to assess the significance of the proposed native vegetation clearing
- The significance of any Threatened Ecological Communities (TEC), Priority Ecological Communities (PEC) and any other areas of ecological importance was identified, mapped and discussed based on the results of the field survey
- An inventory of plant taxa (including weed species) was compiled
- Conservation significant flora species were actively searched for based on habitat requirements, and the population extents or locations of any potential Threatened flora, Priority flora and any other flora of local or taxonomic significance were mapped where identified
- An inventory of vertebrate fauna species was compiled through opportunistic recording of species, tracks, scats, bones, diggings and feeding areas
- Potentially occurring significant fauna species (giving specific consideration to Black Cockatoos, Western Ringtail Possum, Chuditch and the Southern Brush-tailed Phascogale) and their habitat were identified, where possible mapped and discussed
- Relevant photograph and figures were included in the reporting, with spatial shapefiles supplied separately
- A concise technical report was produced (this document).

1.5 Relevant legislation, conservation codes and background information

In Western Australia (WA) some communities, flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory bodies also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this Project is provided in Appendix B.

1.6 Report limitations and assumptions

This report has been prepared by GHD for Water Corporation and may only be used and relied on by Water Corporation for the purpose agreed between GHD and the Water Corporation as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Water Corporation arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Water Corporation and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of infrastructure, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey a desktop assessment was undertaken to identity relevant environmental information pertaining to the survey area and to assist in survey design. This included a review of:

- The DotEE Protected Matters Search Tool (PMST) to identify communities and species listed under the EPBC Act potentially occurring within a 5 km buffer of the survey area (DotEE 2017a) (Appendix C)
- The Department of Biodiversity, Conservation and Attractions (DBCA) *NatureMap* database for flora and fauna species previously recorded within a 5 km buffer of the survey area (DBCA 2017) (Appendix C)
- DBCA TEC and PEC database searches – provided by the Water Corporation - to determine the potential for TECs or PECs present within the survey area
- Previous report – Greenbushes to Kirup Pipeline Route Vegetation, Flora and Fauna Assessment (Astron 2013).

2.2 Field survey

2.2.1 Vegetation and flora

GHD Botanist (Angela Benkovic, SL012111) conducted a single season vegetation and flora assessment of the survey area on 16-18 May 2017. Sections of the survey area were located within DBCA managed lands (Figure 2, Appendix A), therefore a Regulation 4 Authority was issued to Angela Benkovic (CE005559) authorising her to survey in these areas. This assessment was undertaken out of the main flowering season because the majority of the survey area had previously been surveyed (Level 2) by Astron in 2013.

The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition and identify and record vascular flora taxa present at the time of survey. Searches for conservation significant or other significant ecological communities and flora taxa were also undertaken.

The survey methods employed by GHD were performed with reference to *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016a).

Data collection

Field survey methods involved a combination of sampling quadrats located in identified vegetation units and traversing the survey area by foot and vehicle. Two non-permanent quadrats and three relevés were described throughout the survey area.

Quadrats (measuring 10 metre (m) x 10 m – area of 100 m^2) were located within key native vegetation units where space allowed. For areas that were either too small to establish a quadrat or too degraded to warrant one, a relevé was conducted. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Quadrat and relevé data are provided in Appendix D.

Table 1 Quadrat data collected during the flora and vegetation field survey

Aspect	Measurement
Collection attributes	Personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale devised by EPA and DBCA 2015.
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, infrastructure works).
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including average height and cover (using a modified Braun-Blanquet scale).

A flora inventory was compiled from taxa listed in described quadrats, relevés and from opportunistic floristic records throughout the survey area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow the National Vegetation Information System (NVIS) and are consistent with NVIS Level V (Association), and are grouped within NVIS Level III (Broad Floristic Formation). At Level V up to three taxa per stratum are used to describe the association (Executive Steering Committee for Australian Vegetation Information (ESCAVI 2003).

Vegetation condition

The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA 2016a). This scale recognises the intactness of vegetation, which is defined by the following:

- Completeness of structural levels
- Extent of weed invasion
- Historical disturbance from tracks and other clearing or dumping
- The potential for natural or assisted regeneration.

The scale consists of six rating levels as outlined in Appendix B.

Flora identification

Species well known to the survey botanist were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All plant specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Plant species were identified by the use of taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–) and the EPBC Act Threatened species database provided by DotEE (2017b).

Nomenclature used in this report follows that used by the WA Herbarium (WAHERB) as reported on *FloraBase* (WA Herbarium 1998–).

Surveys for conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. aerial photography, geology, soils and topography data, EPBC Act PMST, *NatureMap*) was reviewed to determine conservation significant flora taxa potentially present within the survey area and locations. Additionally, ecological information (e.g. habitat, associated flora taxa and phenology) was sourced from *FloraBase* (WA Herbarium 1998–) and other relevant publications where available, to provide further details.

Potential habitats were searched by opportunistic sampling. Locations within the survey area with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

The following data was recorded when any known or potential threatened, priority or significant flora was located: GPS location, height in metres (m), number of plants and corresponding area of population, reproductive state and plant condition.

2.2.2 Fauna

A Level 1 fauna assessment (reconnaissance survey) of the survey area was undertaken on the 16-18 May 2017. The fauna survey was undertaken in conjunction with the vegetation and flora assessment and with reference to *Technical Guide – Terrestrial Fauna Surveys* (EPA 2016b). The purpose of the reconnaissance survey was to verify the accuracy of the desktop study, and to characterise the fauna and faunal assemblages present in the survey area.

The majority of the survey area was traversed on foot and by vehicle over the course of three days to identify and describe the dominant fauna habitat types present and their condition, assess habitat connectivity, identify and record fauna species within the survey area. An assessment of the likelihood of conservation significant fauna and their habitats occurring within the survey area was also undertaken.

Habitat assessment

A fauna habitat assessment was undertaken to document the type, condition and extent of habitats within the survey area. The following information was recorded:

- Habitat structure (e.g. vegetation type, presence/absence of structural layers such as ground cover and mid storey
- Presence/absence of refuge including: density of ground covers, fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways including type, extent and habitat quality within waterway
- Location of the habitat within the survey area in comparison to the habitat within the surrounding landscape
- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey area
- Current land use and disturbance history
- Evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance
- Evaluation of the likelihood of occurrence of conservation significant fauna within the habitat (based on presence of suitable habitat).

Opportunistic fauna searches

Opportunistic fauna searches were also conducted across the survey area. Opportunistic searches involved:

- Searching the survey area for tracks, scats, bones, diggings and feeding areas for both native and feral species
- Searching through microhabitats including turning over leaf litter and examining tree hollows and hollow logs
- Visual and aural surveys for species potentially utilising the survey area.

Targeted habitat assessment for Black Cockatoo species

A habitat assessment for Black Cockatoo species was conducted in accordance with the EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (Vulnerable) *Calyptorhynchus baudinii*, Forest Red-tailed Black Cockatoo (Vulnerable) *Calyptorhynchus banksii naso*, (Department of Sustainability, Environment, Water, Populations, and Communities (DSEWPaC 2012). The assessment included the identification, description and recording of:

- Potential and actual breeding habitat (relevant tree species with a DBH of >500 mm for Jarrah, Marri and Flooded Gum (*Eucalyptus rudis*) or DBH of >300 mm for Wandoo or Salmon Gum
- Existing tree hollows and any evidence of use by Black Cockatoos (a suitable nesting hollow currently able to support breeding was defined as a tree hollow with an entrance diameter greater than 100-150 mm which would allow entry of a Black Cockatoo)
- The diameter at breast height (DBH) of trees with existing hollows
- Potential night roosting and foraging habitat.

In addition, an inspection was undertaken of the two known existing hollows to assess for current and potential future usage by Black Cockatoos (locations as per Figure 3 in the RFQ documentation). Both of these trees are outside the survey area, and were previously assessed during the Astron (2013) survey.

Targeted habitat assessment for Western Ringtail Possum

A targeted assessment for Western Ringtail Possum habitat was also undertaken, which included identification of suitable habitat for the species where it occurred in the survey area (e.g. tree hollows, peppermint trees), searches for dreys (nests) and scats.

Camera trap survey

Motion sensor cameras (Reconyx-Hyperfire) were deployed for a period of two nights each at three locations adjacent to the survey area. Cameras were positioned in areas where good value habitat was identified, particularly for conservation significant fauna. Cameras were baited with sardines to attract fauna species, particularly carnivorous marsupials within the survey area. For each camera location the time and date deployed and recovered, a GPS coordinate, and brief habitat description were recorded. Camera locations are displayed in Figure 5, Appendix A. Data from the cameras was downloaded to a computer and analysed for the presence of animals following the field survey.

Fauna nomenclature

Nomenclature used in this report follows that used by the WA Museum and the DBCA NatureMap database (DBCA 2017) with the exception of birds, where by Christidis and Boles (2008) was used.

2.3 Limitations

2.3.1 Desktop limitations

Desktop investigations use a variety of online resources such as the WA Museum and DBCA *NatureMap* database (DBCA 2017), and the EPBC Act PMST. The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DBCA searches of threatened flora and fauna provide more accurate information for the general area. However, some records of collections, sightings or trappings cannot be dated and often misrepresent the current range of threatened species.

2.3.2 Field survey limitations

The EPA (2016a; 2016b) Technical Guides state that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 2. Based on this assessment, the present survey effort has not been subject to any constraints which affect the thoroughness of the assessment and the conclusions which have been formed.

Table 2 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information	Minor	Adequate information is available for the survey area; this includes: • Broad scale (1:250,000) mapping by Smith (1974) and digitised by Shepherd *et al.* (2002) • Regional biogeography (Hearn *et al.* 2002)
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not surveyed.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Minor / moderate	The vegetation and flora survey was undertaken in late Autumn 2017. The flora recorded from the field survey is detailed in section 4.1.3 and a full flora species list is provided in Appendix D. The portion of flora collected and identified was considered moderate; and it is possible that the survey under-recorded some grass species (Poaceae) and Orchids (Orchidaceae) due to an autumn field assessment. The fauna survey was undertaken in Autumn 2017 and was a reconnaissance survey only. The fauna assessment sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Many cryptic species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year. Of the fauna species recorded during the survey, all species were identified to species level. The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the survey area. No sampling for invertebrates or aquatic species occurred. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.
Flora determination	Minor	Flora determination was undertaken by the GHD ecologist in the field and from online and published references for collected specimens. Five native taxa could only be identified to genus level, one of these with tentative species identification due to lack of flowering or fruiting material required for identification. None are likely to be conservation significant species. Two introduced grass and a number of planted Eucalyptus species were not identified to species level as this was not considered to be necessary. The taxonomy and conservation status of WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time of report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The entire survey area was accessed on foot or traversed by vehicle. The access tracks created as a result of infrastructure development (e.g. road, water and railway) allowed access to the entire survey area.

Aspect	Constraint	Comment
Mapping reliability	Minor	The vegetation was mapped at a scale ranging from 1:1,000 to 1:5,000 using high resolution Environmental Systems Research Institute aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Smith 1974) and field data. Data was recorded in the field using hand-held GPS tools (e.g. Nomad Juno and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ±5 metres on average. Therefore the data points consisting of coordinates recorded from the GPS may contain inaccuracies.
Timing/weather/ season/cycle	Minor	The field survey was conducted during autumn (16-18 May 2017). In the three months prior to the survey (February-April), Donnybrook weather station (No. 009534, BoM 2017) recorded a total of 112 mm of rainfall. This total is approximately 20% higher than the long term average of 89.7 mm for the same period (BoM 2017). The weather conditions recorded during the field survey were: • Daily maximum temperature of 21.9 °C (Donnybrook weather station No. 009534; 19 km north-west from survey area). • Daily minimum temperature of 9.1 °C (Donnybrook weather station) • Daily rainfall 0.8 mm.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	Much of the survey area has been subjected to historical disturbance events (e.g. clearing); however, these disturbances did not impact the survey.
Intensity (in retrospect, was the intensity adequate)	Nil	The vascular flora of the survey area was sampled in accordance with EPA (2016a) and terrestrial fauna sampled in accordance to EPA (2016b). The survey area was sufficiently covered during the survey.
Resources	Nil	Adequate resources were employed during the field survey. A total of 6 person days was spent undertaking the survey.
Access restrictions	Nil	No access problems were encountered during the survey.
Experience levels	Nil	The GHD staff who executed the survey are practitioners suitably qualified and experienced in their respective fields. Angela Benkovic (Botanist) has 10 years' and Laura Zimmermann (Zoologist) has over 5 years' experience undertaking surveys within WA.

3. Desktop assessment

3.1 Climate

The study area is located in the South Western Province of WA and experiences a temperate climate with distinctly dry, hot summers and cool, wet winters.

The BoM Donnybrook station (site number 009534) is the nearest weather station to the study area with continuous long-term data (19.0 km from the study area). Climatic data from this site indicates the mean maximum temperature of the area ranges from 16.5 °C in July to 30.6 °C in January and the mean minimum temperature ranges from 5.7 °C in July to 14.4 °C in February. The mean annual rainfall is 974 mm with an average of 134.5 rain days per year (BoM 2017). Climate statistics for the region are summarised in Plate 1.

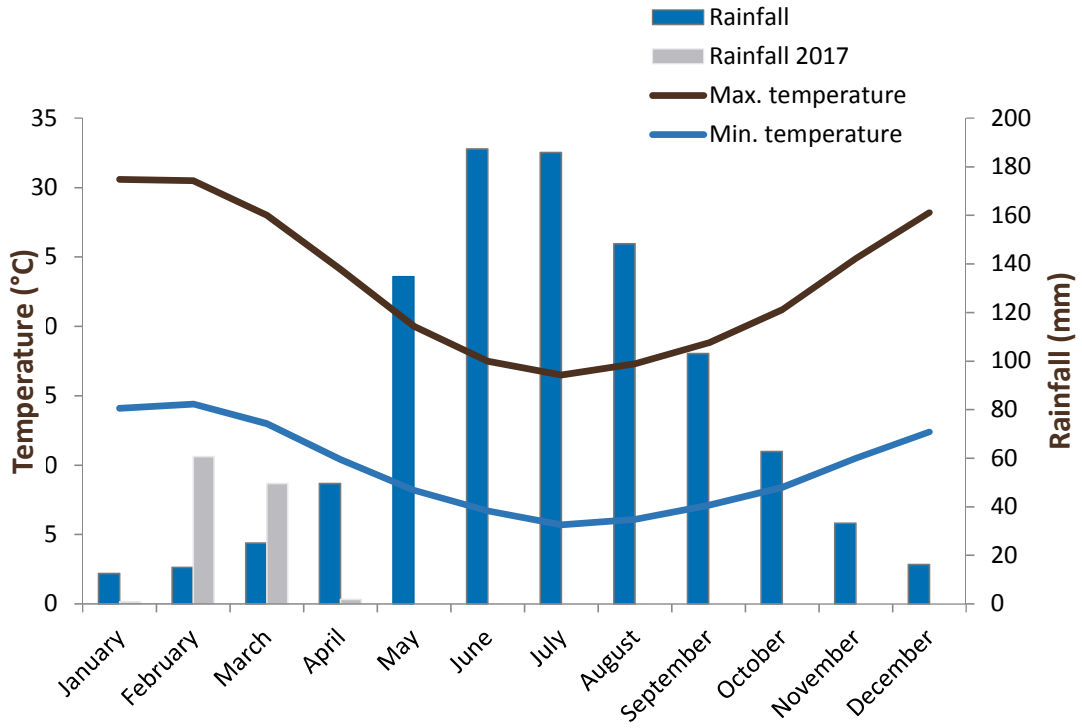


Plate 1 Mean climate statistics for Donnybrook

3.2 Geology, Landform and Soils

The survey area is situated in the South West Botanical Province of WA (Beard 1990) within the Jarrah Forest Bioregion and Southern Jarrah Forest sub-region described by the Interim Biogeographic Regionalisation of Australia (IBRA) (DotEE 2016c).

The Southern Jarrah Forest is described as duricrusted plateau of the Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part by Wandoo – Marri woodlands on clayey soils. Elluvial and alluvial deposits support *Agonis* shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands (Hearn *et al.* 2002).

The Department of Agriculture and Food Western Australia (DAFWA) (2007) soil mapping indicates there are four different soil types within the survey area:

1. Kirup low slopes phase; duplex sandy gravels, Loamy gravels and Yellow deep sands (255LvKR3)

2. Mumballup upstream flats phase; Wet soils, Semi-wet soils, Friable red/brown loamy earths and Brown loamy earths (255LvMLu)
3. Balingup moderate slopes phase; Friable red-brown loamy earths, Brown loamy earths, Brown deep loamy duplexes and Loamy gravels (255LvBL4)
4. Dwellingup subsystem; Duplex sandy gravels and Loamy gravels with pockets of deep sands, often gravelly, and minor Shallow gravels (255DpDW)

3.3 Hydrology

A summary of the Department of Water (DoW) Geographic Data Atlas (DoW 2017) queries for the survey area are provided in Table 3.

Table 3 Department of Water geographic atlas queries for the survey area

Aspect	Details	Result
Groundwater areas	Groundwater areas proclaimed under the *Rights in Water and Irrigation Act* 1914 (RIWI Act)	None present
Surface water areas	Surface water areas proclaimed under the RIWI Act.	Dumpling Gully Surface Water Area and Mullalyup Surface Water Area
Irrigation district	Irrigation Districts proclaimed under the RIWI Act.	None present
Rivers	Rivers proclaimed under the RIWI Act.	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947*.	Mullalyup Water Reserve and Greenbushes Catchment Area
Waterway Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*.	None present

3.3.1 Watercourses

Watercourses that occur in or around the survey area are listed in Table 4.

Table 4 Watercourse occurrences in and around the survey area

Site	Watercourses
Kirup Dam Bypass	Closest watercourse occurs ~95 m south of site
Mullaylup Tank	Closest watercourse occurs ~260 m north east of site
Cirillo Road Option	Mullaylup Brook intersects ~200 m from the northern end of the site Balingup Brook intersects at the southern end of the site
South Alignment West	Intersects ~320 m from the northern end of the site
South Alignment East	Intersects ~60 m from the southern end of the site

3.3.2 Wetlands

The EPBC Act PMST did not identify any International significant listed wetlands within 5 km of the survey area (DotEE 2017a).

3.4 Land use

3.4.1 DBCA managed lands

There are four DBCA managed lands which overlap with the survey area, mapped in Figure 2, Appendix A:

- Greenbushes State Forest (F 20)
- CALM Exec Body Freehold (name: 1042/47) (P229098 2298)
- CALM Exec Body Freehold (name: 1117/388) (P252367 6367)
- Mullalyup State Forest (F 21).

3.4.2 Environmentally Sensitive Areas

There are no Environmentally Sensitive Areas (ESAs) within the survey area. The nearest ESA is located approximately 8.5 km to the south-west (Figure 2, Appendix A).

3.5 Vegetation and flora

3.5.1 Broad vegetation mapping and extents

Broad scale (1:250,000) pre-European vegetation mapping of the survey area was completed by Smith (1974) at an association level. The mapping indicates that one vegetation association is present within the survey area:

- Medium forest; jarrah-marri (association 3)

As part of the Regional Forest Agreement, Mattiske and Havel (1998) mapped vegetation complexes of the forest regions of south west WA at a scale of 1:50,000. Mattiske and Havel (1998) mapping indicates three vegetation complexes are present within the survey area:

- Swamp (S) Mosaic of low open woodland of *Melaleuca preissiana-Banksia littoralis*, closed scrub of Myrtaceae sp. closed heath of Myrtaceae sp. and sedgelands of *Baumea* and *Leptocarpus* sp. on seasonally wet or moist sand, peat and clay soils on valley floors in climatic zones
- Kirup (KR) Open forest to woodland of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-Banksia attenuata-Xylomelum occidentale* on sandy slopes in the humid zone
- Balingup (BL) Open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla* on slopes and woodland of *Eucalyptus rudis* on the valley floor in the humid zone

The Smith (1974) pre-European mapping has been adapted and digitised by Shepherd *et al.* (2002). The extent of the vegetation associations has been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (latest update October 2016 – Government of WA (GoWA) 2016). As shown in Table 5, the current extent of vegetation association 3 is greater than 50 % of its pre-European extent at all levels (State, IBRA bioregion, IBRA subregion and LGA), and is therefore above the 30 % threshold level [1].

[1] The 30 % threshold level is the level below which species loss appears to accelerate exponentially at an ecosystem level (ANZECC 2000).

The Local Biodiversity Program (2013) and Molloy *et al.*, (2007) have assessed vegetation complexes described and mapped by Mattiske and Havel (1998) against presumed pre-European extents within the Southern Jarrah Forest IBRA subregion. In Table 6 the vegetation extents of all three complexes are shown to be above the 30 % threshold level[1] for the Southern Jarrah Forest region. However the BL complex is close to the target threshold, therefore the Local Biodiversity Program (2013) has classified it as having < 30% of its extent remaining within the Southern Jarrah Forest region.

Recently, Webb *et al*. (2016) reviewed the vegetation complex mapping datasets of the Swan Coastal Plain (Heddle *et al.* 1980) and the South West Forest Region (Mattiske and Havel 1998). The reviewed mapping (referred to as GoWA 2017) does not extend to IBRA sub-region boundaries, but can be used for vegetation complex extents within the Local Government Area.

Based on this updated data, vegetation complex S is below the 30 % threshold level for the Shire of Donnybrook-Balingup but has not been classified as essential to retain (Table 7). Complexes close to meeting the regional criteria target thresholds are indicated with an N and are not essential to retain. This is in comparison to the BL complex that does have over 30 % of its extent remaining within the Shire, yet has been classed essential to retain due to its regional representation (Table 6). Table 8 shows the extents for complexes BL and KR within the Shire of Bridgetown-Greenbushes. Both complexes have less than the 30 % remaining within the Shire, however only the BL complex is essential to retain.

3.5.2 Conservation significant ecological communities

The EPBC Act PMST did not identify any federally listed TECs potentially occurring within the study area (DotEE 2017a) (Appendix C). DBCA TEC and PEC data obtained by the Water Corporation did not reveal any TECs or PECs occurring near the survey area. The closest known records of TECs and PECs occur approximately 27 km north-west and 25 km east of the survey area respectively.

Table 5 Extents of vegetation associations mapped within the survey area (Smith 1974, GoWA 2016)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DBCA managed lands
Jarrah Forest IBRA bioregion		4,506,660.26	2,422,782.9	53.61	69.01
Southern Jarrah Forest IBRA sub-region		2,607,879.53	1,312,477.9	50.33	68.87
3	State: WA	2,661,405.06	1,806,812.2	67.89	81.22
	IBRA bioregion: Jarrah Forest	2,390,591.42	1,607,399.7	67.24	80.70
	IBRA sub-region: Southern Jarrah Forest	1,482,491.74	884,324.68	59.65	78.12
	LGA: Donnybrook-Balingup	93,347.33	61,205.73	65.57	89.96
	LGA: Bridgetown-Greenbushes	121,152.70	68,442.75	56.49	86.65

Table 6 Extent of vegetation complexes in the Southern Jarrah Forest subregion within the project area (Mattiske and Havel 1998, Local Biodiversity Program 2013)

Vegetation Complex	Pre-European extent (ha)	2013 extent (ha)	% of pre-European extent	% of pre-European extent with formal protection
BL	59446.57	18303.33	30.79*	1.51
KR	3459.18	2082.40	60.2	3.91
S	53658.36	40934.28	76.29	21.73

Table 7 Extent of vegetation complexes in the Shire of Donnybrook-Balingup within the project area (GoWA 2017)

Vegetation complex	Pre-European total (ha)	Remaining extent total (ha)	Remaining extent (%)	Proportion of the Vegetation Complex within the LGA (%)	Complexes that meet Regional Representation and Rarity, Local Significance Criteria†
BL	42835	13097	30.58	72.06	Y
KR	3424	2031	59.34	98.98	N
S	425	35	8.35	0.79	N

Table 8 Extent of vegetation complexes in the Shire of Bridgetown-Greenbushes within the project area (GoWA 2017)

Vegetation complex	Pre-European total (ha)	Remaining extent total (ha)	Remaining extent (%)	Proportion of the Vegetation Complex within the LGA (%)	Complexes that meet Regional Representation and Rarity, Local Significance Criteria†
BL	12913	2830	21.92	21.72	Y
KR	35	5	15.31	1.02	N

* Complex is close to the criteria target threshold, therefore it is estimated <30 % of its extent remains (Local Biodiversity Program 2013)

† Vegetation complexes that are considered essential for retention to ensure that Regional Representation and Rarity Local Significance criteria are addressed are indicated with Y

3.5.3 Flora diversity

The *Naturemap* (DBCA 2007-) database identified 295 flora taxa representing 74 families and 178 genera that have previously been recorded within the study area. This total comprised 239 native taxa and 56 naturalised (introduced) taxa. Dominant families included Fabaceae (43 taxa), Orchidaceae (19 taxa) and Myrtaceae (17 taxa). The *NatureMap* database search is provided in Appendix C.

3.5.4 Conservation significant flora

Desktop searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 12 conservation significant flora taxa within the study area. The desktop searches recorded:

- Six taxa listed as Threatened under the EPBC Act and/or as Declared Rare Flora under the WC Act
- One Priority 2 taxon
- Four Priority 3 taxa
- One Priority 4 taxon

The locations of eight conservation significant flora registered on the DBCA databases and provided by the Water Corporation are mapped in Figure 2, Appendix A- species names were not provided with the data.

3.6 Fauna

3.6.1 Fauna diversity

NatureMap (DBCA 2007-) identified 152 native fauna taxa previously recorded within the study area. This total included six amphibians, 107 birds, 17 mammals and nine reptiles, the remaining native fauna were non-vertebrate taxa and fish which were excluded from this assessment.

3.6.2 Conservation significant fauna

The EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 18 conservation significant fauna species (Appendix C). Species identified by the PMST as marine, migratory marine or migratory wetland were excluded from this assessment as no marine or wetland habitat was present within or nearby the survey area. However, species identified by the PMST as migratory terrestrial were considered as part of this assessment.

3.7 Previous survey results

A previous field survey by Astron (2013) was completed in October 2013 to identify the environmental values of a similar alignment to the current survey area.

Vegetation and flora

The previous survey did not identify any TECs or PECs within the survey area. Additionally no Threatened or Priority flora were recorded. A total of 206 plant taxa were recorded, comprising of 178 natives and 28 introduced species.

Fauna

The previous survey (Astron 2013) identified 34 vertebrate fauna species including 28 birds, three amphibians and three mammal species in the survey area. Of these, one species, the red fox was introduced.

Four species of conservation significance were recorded in 2013 including Baudin's Black Cockatoo, Forest Red-tailed Black Cockatoo, Quenda and the Eastern Great Egret. Baudin's Black Cockatoo and the Forest Red-tailed Black Cockatoo are listed as Vulnerable under the EPBC Act and WC Act. Quenda is listed Priority 4 under DBCA and the Eastern Great Egret is migratory S3 under the EPBC Act and WC Act. The Eastern Great Egret has since been removed from the migratory list under the EPBC Act (June 2016) and is now only listed as marine.

4. Field survey results

4.1 Vegetation and flora

4.1.1 Vegetation types

Seven vegetation types were mapped and described for the survey area (Table 9 and Figures 3.1 –3.5, Appendix A). Six vegetation types were variations in *Eucalyptus* dominated woodlands; five of these were Jarrah-Marri woodlands differentiated by mid and lower storey species and one was a small pocket of Flooded Gum woodland. The seventh vegetation type consisted of isolated stands of native and planted trees with scattered natives over weedy grasses.

All vegetation types were consistent with the vegetation mapped by Smith (1974); medium forest Jarrah-Marri (association 3). *Eucalyptus* spp. - Marri - Pine isolated trees (VT07), located at Cirillo Road was the dominant vegetation type within the survey area (2.04 ha). Jarrah-Marri woodland over *Hibbertia* shrubland (VT01) located at the Kirup Dam Bypass was the most restricted vegetation type within the survey area, occupying less than 0.03 ha.

Areas identified as cleared are devoid of native vegetation. These areas are represented by gravel roads and/or fire breaks.

Table 9 Vegetation types recorded within the survey area

Vegetation type	Vegetation type description (NIVIS)	Extent (ha)	Vegetation complex alignment and quadrat/relevé reference	Photograph
Jarrah-Marri woodland over *Hibbertia* shrubland (VT01)	*Eucalyptus marginata Corymbia calophylla* open forest *Hibbertia hypericoides Hakea lissocarpha* shrubland *Patersonia occidentalis Lepidosperma leptostachyum* open herbland	0.03 ha	Kirup complex Relevé 1	
Marri-Jarrah woodland over *Taxandria* shrubland (VT02)	*Corymbia calophylla Eucalyptus marginata* open forest *Banksia grandis* isolated trees *Taxandria parviceps Hibbertia hypericoides Podocarpus drouynianus* shrubland *Lomandra sericea Desmocladus fasciculatus* open herbland	0.29 ha	Kirup complex Quadrat 1	

Vegetation type	Vegetation type description (NIVIS)	Extent (ha)	Vegetation complex alignment and quadrat/relevé reference	Photograph
Jarrah-Marri woodland over *Bossiaea* shrubland (VT03)	*Eucalyptus marginata Corymbia calophylla Banksia grandis* open forest *Bossiaea linophylla* shrubland *Pteridium esculentum Lomandra sericea Desmocladus fasciculatus* open fernland/herbland.	0.46 ha	Balingup complex Quadrat 2	
Jarrah-Marri woodland over blackberry (VT04)	*Eucalyptus marginata Corymbia calophylla *Pinus radiata* open forest *Xanthorrhoea preissii* isolated shrubs **Rubus ulmifolius* shrubland	1.79 ha	Balingup complex Relevé 2	

Vegetation type	Vegetation type description (NIVIS)	Extent (ha)	Vegetation complex alignment and quadrat/relevé reference	Photograph
Flooded gum woodland over blackberry (VT05)	*Eucalyptus rudis* open woodland *Xanthorrhoea preissii* isolated shrubs **Rubus ulmifolius* shrubland.	0.12 ha	Balingup complex Relevé 3	
Jarrah-Marri woodland over Bugle Lily (VT06)	*Eucalyptus marginata Corymbia calophylla *Pinus radiata* woodland *Xanthorrhoea preissii* isolated shrubs *Watsonia meriana var. bulbillifera* herbland	0.29 ha	Balingup complex Relevé 4	

Vegetation type	Vegetation type description (NIVIS)	Extent (ha)	Vegetation complex alignment and quadrat/relevé reference	Photograph
Eucalyptus spp.-Marri-Pine isolated trees (VT07)	*Eucalyptus* spp. *Corymbia calophylla* * *Pinus radiata* isolated trees	0.64 ha	Too altered by disturbance to align with a complex Relevé 5	
Cleared	Areas devoid of native vegetation – turf, roads, gravel and firebreaks	2.15 ha	NA	

4.1.2 Vegetation condition

The vegetation condition within the survey area was rated as Very Good to Completely Degraded condition. The extents of the vegetation condition ratings mapped within the survey area are detailed in Table 10 and mapped in Figures 4.1 – 4.5, Appendix A.

The majority of the survey area (54%) was rated as Degraded and Degraded-Completely Degraded condition. Degraded areas were dominated by weeds, whilst Degraded-Completely Degraded areas lacked a native mid and lower storey; these areas were commonly characterised by isolated stands of native and introduced trees over grass.

The small patches of Very Good and Very Good – Good vegetation contained a number common bushland weeds, however native vegetation dominated each strata. Good – Degraded vegetation were areas that had been affected by 'edge effects' due to the proximity to roads and other disturbance. The Completely Degraded/Cleared areas were devoid of native vegetation and are associated with firebreaks and gravel roads (33 % of the survey area).

Table 10 Extent of vegetation condition ratings mapped within the survey area

Vegetation Condition	Kirup Dam Bypass	Mullalyup Tank	Cirillo Road Option	South Alignment East	South Alignment West	Total
Very Good	-	0.149	-	-	-	0.149
Very Good - Good	-	-	-	0.157	-	0.157
Good - Degraded	0.027	0.060	-	0.308	-	0.402
Degraded	-	0.077	0.326	0.051	1.796	2.25
Degraded – Completely Degraded	-	-	0.885	-	-	0.885
Completely Degraded/ Cleared	0.093	0.053	1.40	0.358	0.021	1.915
Total	**0.12 ha**	**0.34 ha**	**2.61 ha**	**0.87 ha**	**1.82 ha**	**5.76 ha**

4.1.3 Flora diversity

One hundred and six (106) flora taxa (including subspecies and varieties) representing 40 families and 74 genera were recorded from the survey area during the field survey. This total comprised 77 native and 29 introduced flora taxa (Appendix D contains the flora species list). Dominant families recorded from the survey area included:

- Fabaceae (17 taxa)
- Myrtaceae (10 taxa)
- Asparagaceae (8 taxa).

Only two sites within the survey area were of suitable size and condition to establish quadrats, the remaining sites were surveyed by relevés. Species diversity from relevés ranged from 8 – 38 species (average 22). However high diversity in some of these relevés was due to opportunistic weeds and/or planted species The species diversity of the two quadrats was 24 species in quadrat 1 (VT03) and 43 species in quadrat 2 (VT02). The species diversity of the quadrats is comparative to that recorded by Astron (2013) within the same area (26 species WC10 and 35 species in WC14, respectively) and a previous survey in the Balingup area that averaged 32 species per quadrat (Sandiford & Wildflower Society of WA 2001). Based on these comparisons the survey assessment was considered representative of the floristic diversity in the survey area.

The highest floristic diversity for the survey area was recorded in VT02, with 43 species. Quadrat and relevé data is presented in Appendix D.

4.1.4 Conservation significant flora

No EPBC Act or WC Act listed flora were recorded within the survey area. In addition no DBCA Priority-listed flora or flora of conservation significance, as defined in EPA 2016c, were recorded within the survey area during the field survey,

Likelihood of occurrence

A likelihood of occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and the cryptic nature of species.

The likelihood of occurrence assessment post-field survey concluded that one taxon is likely to occur, one taxon may possibly occur and the remaining 10 taxa are unlikely or highly unlikely to occur within the survey area. The taxon likely to occur, *Tetraria* sp. Blackwood River (A.R. Annels 3043) (P3) is a cryptic species that has previously been recorded approximately 50 m away from the Mullalyup Tank site. This species is known to occur in wetlands and on river edges, so has the potential to occur in parts of the survey area in these habitats.

4.1.5 Introduced flora

Twenty nine (29) introduced flora taxa were recorded in the survey area. Of the introduced taxa, two are listed as Declared Pests under the *Biosecurity and Management Act 2007* and as Weeds of National Significance (WONS):

- * *Asparagus asparagoides* (Bridal Creeper)
- * *Rubus ulmifolius* (Blackberry)

The remaining introduced taxa are considered environmental weeds and all have been previously recorded on in the Jarrah Forest. The locations of * *Asparagus asparagoides* and * *Rubus ulmifolius* within the survey area are mapped in Figure 4.4 Appendix A

4.2 Fauna

4.2.1 Fauna habitats

Four fauna habitat types were identified and described within the survey area (Table 11), and include Jarrah-Marri woodland, *Eucalyptus rudis* woodland (riparian), planted vegetation and existing cleared areas. The majority of the survey area comprises Jarrah-Marri Woodland in relatively good condition (Kirup Dam Bypass, Mullalyup Tank site and Southern Alignment), with a small section of *Eucalyptus rudis* woodland along the minor drainage line in the Southern Alignment. The habitat in the Cirillo Road Option section is highly altered and transitions between planted roadside vegetation, cleared areas and Jarrah-Marri over a weedy understorey.

The Jarrah-Marri Woodland is well represented in the local area, as well as in the broader region (including throughout the surrounding State Forest). The *Eucalyptus rudis* woodland occurs along watercourses, drainage lines and lower lying areas in the region and therefore is less common at both a local and regional scale.

Habitat types are mapped in Figure 5, Appendix A and the value of each type discussed below in Table 11.

Table 11 Fauna habitat types

Habitat description	Indicative images
Jarrah-Marri woodland This habitat is comprised of: VT01, VT02, VT03, VT04, VT06. Jarrah/Marri woodland is the dominant habitat type throughout the survey area and typically comprises Jarrah and Marri trees of multiple age classes, over Peppermint trees along the mid and upper slopes. The canopy is open, with a relatively sparse mid-storey shrub layer (e.g. *Banksia*, *Acacia* and *Xanthorrhoea*) over a moderately open lower shrub layer and understorey of grasses/herbs. The leaf litter is thick (~10 cm) in places. There are numerous micro-habitat features such as hollow logs, woody debris, hollow bearing trees, embedded rocks (mostly small), and moss. Scattered larger tree hollows were also recorded (mainly stags). The area is long unburnt (>10 years). The quality of this habitat is variable throughout the survey area, depending on the level of previous disturbance. Disturbances include previous clearing (roads, tracks and agriculture), weeds and historical logging. There is evidence of timber harvesting throughout this habitat, which has limited the number of mature trees (particularly with hollows) in some parts of the survey area. Areas of high quality habitat have minimal impacts from weeds. Jarrah and Marri are recognised as valuable habitat for Black Cockatoos for breeding, feeding and roosting. Scattered large hollows were observed within this habitat type. <u>Conservation Significant Species</u> All three species of Black Cockatoos (Forest Red-tailed, Carnaby's and Baudin's Black Cockatoos) were observed feeding and loafing in this habitat type. This habitat could also support several other conservation significant fauna species: Chuditch (*Dasyurus geoffroii*), Southern Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*), Western Brush Wallaby (*Macropus irma*), Southern Brown Bandicoot *(Isoodon obesulus fusciventer*), Western False Pipistrelle (*Falsistrellus mackenziei)*and the Masked Owl (southern subspecies) (*Tyto novaehollandiae* subsp. *novae-hollandiae)*. The Peregrine Falcon (*Falco peregrinus*) may utilise the area opportunistically. This fauna habitat type covers approximately 2.86 ha and is of high value to fauna.	 

Habitat description	Indicative images
***Eucalyptus rudis* woodland** This habitat is comprised of: VT05. A small area of the Southern Alignment West comprises Flooded Gum (*Eucalyptus rudis*) woodland along a minor drainage line north of the railway crossing. This habitat consists of predominantly Flooded Gum and scattered Marri trees over an understorey dominated by weeds and grasses. This habitat type is very degraded, with high weed occurrence and density. In particular, this area is substantially impacted by Blackberry (**Rubus ulmifolius*). Although degraded, this woodland provides moderate value to fauna including a dense understorey as cover for ground dwelling species (e.g. Southern Brown Bandicoot). Flooded Gum and Marri are recognised as valuable habitat for Black Cockatoos for breeding, feeding and roosting. No large hollows suitable for nesting were observed within this habitat type. Conservation Significant Species No conservation significant fauna species were observed in this habitat, however it provides resources for several species including Chuditch, Southern Brush-tailed Phascogale, Western Brush Wallaby and Southern Brown Bandicoot. This fauna habitat type covers approximately 0.12 ha and is of moderate value to fauna.	
Planted This habitat is comprised of: VT07. Some sections of the survey area contain planted vegetation (introduced species), including pine plantation, orchards and garden plants (e.g. in Cirillo Road section). These areas provide some habitat value to fauna species such as foraging and refuge for birds. There was also the occasional isolated Eucalyptus species, including Marri (*C. calophylla*). The planted vegetation may also be used as corridors for fauna movement throughout the landscape e.g. Western Grey Kangaroos (*Macropus fuliginosus*). Conservation Significant Species This habitat provides suitable foraging species for Black Cockatoos (Forest Red-tailed, Carnaby's and Baudin's Black Cockatoos) including *Pinus* sp., *C. calophylla* and *Eucalyptus* spp. This fauna habitat type covers approximately 0.64 ha and is of low value to fauna.	
Cleared areas This habitat type is comprised of previously cleared areas for roads and tracks This habitat provides very few resources for fauna, although may be used for foraging by mammals, reptiles and birds. This fauna habitat type covers approximately 2.15 ha and is of low value to fauna.	

4.2.2 Habitat connectivity and linkages

The majority of the habitats present in the survey area are well-connected at both a local and regional scale to the large tracts of vegetation in the vicinity and other surrounding remnant vegetation (including State Forest). The survey area forms part of a large regional area of remnant forest in the Blackwood region and is well-connected to other remnant vegetation to the south and east. At a fine scale, the Cirillo Road Option section does not retain good connectivity to surrounding areas of remnant vegetation, due to previous clearing and infrastructure development.

4.2.3 Fauna diversity

During the field survey 46 fauna species were recorded, including 33 birds, nine mammals, and four amphibians. Eight of these species are introduced.

The fauna species list is provided in Appendix E.

4.2.4 Conservation significant fauna

Three conservation significant species were recorded during the field survey. These were:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Endangered – WC Act, Endangered – EPBC Act – observed on multiple occasions, old foraging evidence recorded (see Plate 1)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*), Vulnerable – WC Act, Vulnerable – EPBC Act – observed on multiple occasions, old and fresh foraging evidence recorded throughout survey area (see Plate 1)
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), Endangered – WC Act, Vulnerable – EPBC Act – observed on one occasion

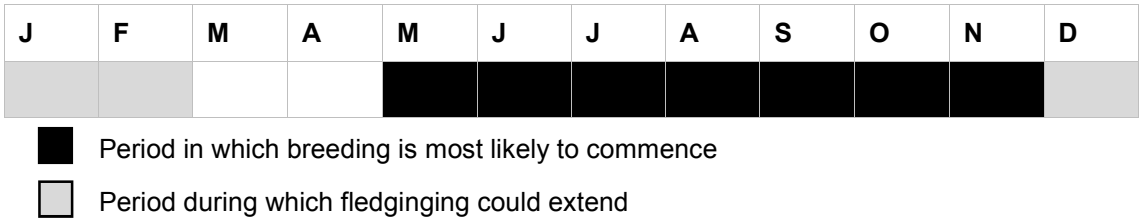
Plate 1 Old Forest Red-tailed Black Cockatoo and Carnaby's Black Cockatoo foraging evidence on Marri nuts

Black Cockatoos

All three species of Black Cockatoo were observed in the survey area during the survey, and may utilise the habitats present for feeding or breeding. Information regarding the species distribution and breeding are provided below, with the outcome of the targeted Cockatoo habitat assessment presented in Section 4.3.

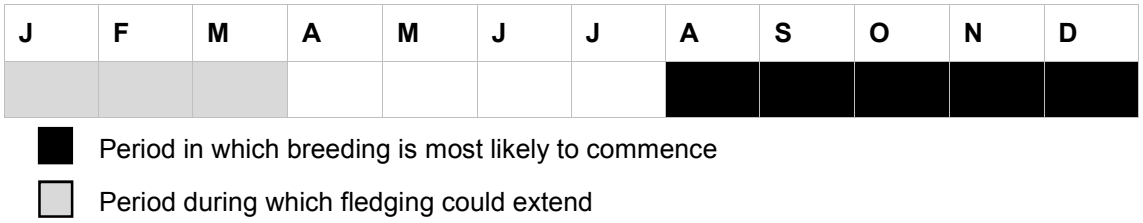
Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is endemic to the south-west of WA with a wide-spread distribution. Carnaby's Black Cockatoo nest in hollows of live or dead eucalypts, primarily smooth-barked Salmon Gum and Wandoo (Saunders 1979, 1982) though breeding has been reported in other wheatbelt tree species and some tree species on the Coastal Plain and Jarrah forest (Saunders 1979, 1982; Storr 1991; Johnstone and Storr 1998). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Saunders 1977, 1986; Saunders and Ingram 1987). Along with the trees that provide nest hollows, the protection, management and increase of this feeding habitat that supports the breeding of Carnaby's Black Cockatoo is a critical requirement for the conservation of the species.



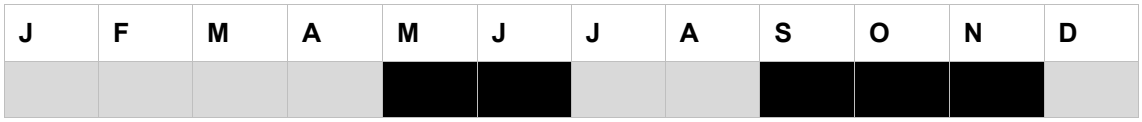
Baudin's Black Cockatoo

Baudin's Black Cockatoo is endemic to a 2,000 km² area (Garnett and Crowley 2000) of the humid and sub-humid zones of south-west WA (Johnstone and Storr 1998). The current distribution of Baudin's Cockatoo is from Albany extending north to Gidgegannup, east to Mount Helena, Wandering, Quindanning, Kojonup, Frankland and King River and to the eastern margin of the Swan Coastal Plain. Baudin's Cockatoo mainly feeds on the seeds of Marri, in the forested regions of south-west WA (Saunders 1974). In addition to Marri, Baudin's Cockatoo feeds on the seeds of Bull Banksia (*Banksia grandis)*, Swamp Banksia (*B. littoralis),* Holly-leaved Banksia *(B. ilicifolia),* Wavy-leaved Hakea *(Hakea undulata),* Harsh Hakea *(H. prostrata),* Two-leaf Hakea *(H. trifurcata)*, Long Storksbill (*Erodium botrys)* (Saunders 1979) and Jarrah (Sedgwick 1964). Baudin's Cockatoo nests in mature trees such as Marri, Karri (*E. diversicolor*), Jarrah and Wandoo in the lower south-west of WA.



Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and sub-humid zones of WA (Mawson and Johnstone 1997). It inhabits the dense Jarrah, Karri and Marri forests receiving more than 600 mm of annual average rainfall. The current distribution is north of Perth and east to Mount Helena, Christmas Tree Well, North Banister, Mt Saddleback, Rocky Gully and the upper King River (Johnstone and Storr 1998). Habitats in which the Forest Red-tailed Black Cockatoo occurs at Bungendore Park and Jarrahdale have an understorey of Bull Banksia, Snottygobble (*Persoonia longifolia)*, Sheoak (*Allocasuarina fraseriana)* and *Hakea* spp., with scattered Blackbutt (*E. patens)* and Wandoo (Johnstone and Kirkby 1999). The Forest Red-tailed Black Cockatoo roosts in Jarrah-Marri-Blackbutt habitat on roadsides, paddocks or forest blocks. While the Forest Red-tailed Black Cockatoo feeds on the seeds of other species, around 90 % of its diet is made up of the seeds from Marri and Jarrah fruits (Johnstone and Kirkby 1999).



Period in which breeding is most likely to commence

Period during which fledging could extend

Likelihood of occurrence assessment

An assessment on the likelihood of conservation significant fauna species occurring in the survey area was conducted (Appendix E). This assessment was based on species biology, habitat requirements, the quality and availability of suitable habitat. The likelihood of occurrence assessment and parameters used to determine it is described in Appendix E.

In addition to the species identified during the field survey (the three species of Black Cockatoo), the assessment identified the likely presence of nine (Table 12) fauna species of conservation significance within the survey area. The likelihood of occurrence assessment revealed that other fauna species of conservation significance could occasionally occur within the habitats of the survey area (e.g. species deemed unlikely). However, it is considered unlikely the survey area provides important habitat (e.g. breeding habitat or key foraging habitat) for any of these species and that these other species may occasional use the habitats of the survey area for temporary refuge and dispersal between other areas of habitat.

Table 12 Summary of fauna species considered likely to occur within the survey area

Name	Status		Likelihood of occurrence justification
	EPBC Act	WC Act / DBCA Priority	
Birds			
Baudin's Black Cockatoo *Calyptorhynchus baudinii*	Vulnerable	Endangered	Known – observed loafing during field survey
Carnaby's Black Cockatoo *Calyptorhynchus latirostris*	Endangered	Endangered	Known – observed foraging and loafing during field survey
Forest Red-tailed Black Cockatoo *Calyptorhynchus banksia naso*	Vulnerable	Vulnerable	Known – observed loafing and numerous foraging evidence recorded during field survey
Australian Peregrine Falcon *Falco peregrinus subsp. macropus*		Schedule 7 - Other Specially Protected Fauna	Likely – hunting habitat, irregular visitor
Rainbow Bee-eater *Merops ornatus*		Schedule 5 - Migratory	Likely – seasonal visitor
Barking Owl (southern subspecies) *Ninox connivens* subsp. *connivens*		Priority 2	Likely – occasional visitor, low value habitat
Masked Owl (southern subspecies)*Tyto novaehollandiae* subsp. *novaehollandiae*		Priority 3	Likely – foraging habitat, limited nesting habitat
Mammals			
Chuditch, Western Quoll *Dasyurus geoffroii*	Vulnerable	Vulnerable	Likely – potential habitat

Name	Status		Likelihood of occurrence justification
	EPBC Act	WC Act / DBCA Priority	
South-western Brush-tailed Phascogale *Phascogale tapoatafa* subsp. *wambenger*		Schedule 6 – Conservation Dependent	Likely – potential habitat
Quenda or Southern Brown Bandicoot *Isoodon obesulus* subsp. *fusciventer*		Priority 4	Likely – potential habitat (limited to areas with dense groundcover)
Western Brush Wallaby *Macropus Irma*		Priority 4	Likely – potential habitat
Western False Pipistrelle *Falsistrellus mackenziei*		Priority 4	Likely – foraging habitat and may potential use tree hollows for roosting

Chuditch (*Dasyurus geoffroii*), Schedule 3, Vulnerable (WC Act) Vulnerable (EPBC Act)

The Chuditch inhabits eucalypt forest (especially Jarrah), dry woodland and mallee shrublands. In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Most diurnal resting sites in sclerophyll forest consist of hollow logs or earth burrows (Van Dyke and Strahan 2008). The species can travel large distances, has a large home range and is sparsely populated through a large portion of its range.

The Chuditch is known from Wellington National Park and inhabits forests and woodlands in the Blackwood region. The Jarrah-Marri woodland and riparian area within the survey area would provide habitat for the Chuditch. The *Naturemap* database identified nine records of Chuditch occurring within 5 km of the survey area, of which one of the records occurs less than 300 m south of the Cirillo Road Option (roadkill along SW Highway 1992) and another approximately 700 m east of South Alignment (SW Highway 1987). There are numerous records in the surrounding region.

There is 2.98 ha of potential Chuditch habitat within the survey area.

Quenda (*Isoodon obesulus fusciventer*), Priority 4 – DBCA listing

The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan 2008).

The Quenda was not recorded during the field assessment, however was previously recorded during the Astron (2013) survey. The species is likely to utilise areas with dense understorey within the survey area (particularly in the riparian zone in the Southern Alignment).

There is 2.98 ha of potential Quenda habitat.

Peregrine Falcon (*Falco peregrinus*), Schedule 7 – WC Act

The Peregrine Falcon is seen occasionally anywhere in the south-west of WA. It is found in a range of habitats from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions. The species nests primarily on ledges of cliffs, in shallow tree hollows, and on ledges of building in cities (Morcombe 2004).

This species was not recorded during the field assessment, however is likely to utilise all habitats within the survey area as a foraging resource.

Western Southern Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*), Schedule 6 – WC Act

Southern Brush-tailed Phascogale prefers dry sclerophyll forests and open woodlands with a generally sparse ground-storey, which contain suitable nesting resources such as tree hollows, rotted stumps and tree cavities (Van Dyck and Strahan 2008). The species is widespread in the south west, ranging from Perth and the hills to the Albany region.

Phascogales are known from the region, and within the survey area would primarily utilise the woodland areas as habitat. No nocturnal surveys were undertaken for this species.

There is 2.98 ha of potential phascogale habitat.

Western Brush Wallaby (*Macropus irma*), Priority 4 – DBCA listing

The Western Brush Wallaby is a grazer found primarily in open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest. This species was once very common in the south-west of WA but has undergone a reduction in range and a significant decline in abundance (Van Dyke and Strahan 2008).

The Western Brush Wallaby is known to occur in the region and would utilise all the terrestrial habitats within the survey area. The Western Brush Wallaby is likely to utilise the Jarrah-Marri woodland and riparian area within the survey area (2.98 ha).

Western False Pipistrelle (*Falsistrellus mackenziei*), Priority 4 – DBCA

The Western False Pipistrelle is listed as Priority 4 by the DBCA and is confined to the southwest of WA. The species occurs in wet sclerophyll forest dominated by Karri, and in the high rainfall zones of the Jarrah and Tuart forests. The species is restricted to areas in or adjacent to stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri, Sheoak and Peppermint trees are often co-dominant at its collection localities (Churchill 2008; McKenzie and Start 1999).

The Western False Pipistrelle is known to occur in the region and is likely to utilise the Jarrah-Marri woodland within the survey area (2.86 ha).

Rainbow Bee-eater (*Merops ornatus*) – Migratory

The Rainbow Bee-eater inhabits a variety of habitat types including open forests and woodlands, sandpits, riverbanks, mangroves, rainforest shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. They also inhabit sand dune systems in coastal areas and at inland sites that are in close proximity to water (Morcombe 2004; Pizzey and Knight 2012). They dig out nests in open areas where there is relatively soft but firm sands, either on flat ground or in the side of a sandy bank (Nevill 2013). The Bee-eater in a seasonal breeding migrant to the south-west of WA.

The Rainbow Bee-eater is likely to seasonally utilise the Jarrah-Marri woodland and riparian area within the survey area (2.98 ha).

Barking Owl (southern subspecies) (*Ninox connivens* subsp. *connivens*), Priority 2 – DBCA listing

The southwest subspecies of the Barking Owl is found in the deep south-west region and is very scarce (Nevill 2013). Barking Owls are found in open woodlands and the edges of forests, often adjacent to farmland. They are less likely to use the interior of forested habitat. They are usually

found in habitats that are dominated by eucalyptus species, particularly Marri. Barking Owls prefer woodlands and forests with a high density of large trees and particularly sites with hollows that are used by the owls as well as their prey.

The Barking Owl is known to occur in the region and is likely to utilise the Jarrah-Marri woodland within the survey area (2.98 ha). The low density of hollow-bearing trees in the survey area would limit the occurrence of this species.

Masked Owl (southern subspecies) (*Tyto novaehollandiae* subsp. *novaehollandiae*), Priority 3 – DBCA listing

The Masked Owl is found across a range of habitats from wet sclerophyll forest, dry sclerophyll forest, non-eucalypt dominated forest, scrub and cleared land with remnant old growth trees. The species typically large hollows in old growth eucalypts for nesting and often favours areas with dense understorey or ecotones comprising dense and sparse ground cover (Bell and Mooney 2002).

The Masked Owl is known to occur in the region and is likely to utilise the Jarrah-Marri woodland within the survey area (2.98 ha). The low density of hollow-bearing trees in the survey area would limit the nesting of this species in the survey area.

4.3 Targeted Cockatoo Habitat Assessment

4.3.1 Foraging habitat

The majority of the survey area contains native vegetation representing suitable foraging habitat for Black Cockatoos, including Jarrah-Marri woodland and *Eucalyptus rudis* woodland. Overall there is approximately 2.98 ha of suitable foraging habitat in the survey area.

4.3.2 Potential breeding habitat

The habitat assessment identified 253 potential breeding trees of suitable DBH (Jarrah, Marri, Flooded Gum > 500 mm) from within the survey area (see Table 13). Trees of this size are considered to have nesting potential now, or will develop hollows within 100 years. Of the 253 trees, 16 were identified with potentially suitable hollows for Black Cockatoo nesting (with a hollow diameter greater than 100-150 mm, to allow entry of Black Cockatoo). The size of a hollow is an estimate as the assessment was undertaken from ground level, there is the potential for the actual hollow size to be greater than 100 mm. None of these trees showed signs of Black Cockatoo use.

Inspection of two known existing hollows revealed no evidence of current usage by Black Cockatoos (e.g. chew marks around the edge of the hollow). Both of these hollows still have the potential for future usage by Black Cockatoos (Coordinates – 402038.43E, 6265639.63N and 403818.01E, 6263922.82N).

Examples of tree hollows from the survey area are shown in Plate 2.

Plate 2 Tree hollows potentially suitable for Black Cockatoo nesting in the survey area

Table 13 Summary of the different types of Black Cockatoo habitat within the survey area

Habitat type	Presence within survey area	Evidence
Foraging habitat	Yes	There is 2.98 ha of foraging habitat for Black Cockatoos within the survey area consisting of the following: • Jarrah-Marri woodland = high quality • *Eucalyptus rudis* woodland = low quality Plentiful old and fresh foraging evidence was recorded throughout the survey area (Forest Red-tailed Black Cockatoo feeding evidence on Marri nuts).
Actual breeding habitat	No	No breeding events were recorded within the survey area of any species of Black Cockatoo during the current survey. It is noted that the survey was conducted outside the main known breeding season for Carnaby's, Baudin's and Forest Red-tailed Black Cockatoos, and a survey would need to be conducted during breeding season to determine known breeding in the area.
Potential breeding habitat	Yes	253 potential breeding habitat trees with DBH ≥ 500 mm (2.98 ha for Jarrah/Marri/Flooded Gum). Of the 253 trees, 16 had hollows suitable for Black Cockatoo nesting. No evidence of recent use of suitable hollows by Black Cockatoo (e.g. chews) was recorded.
Roosting habitat	No	No roosting sites were recorded as being used by Black Cockatoos within the survey area. The survey area provides limited potential roosting habitat

4.4 Targeted Western Ringtail Possum Habitat Assessment

The majority of the survey area provides suitable habitat for the Western Ringtail Possum. Jarrah-marri woodland (with hollow-bearing trees) is known to support the Western Ringtail Possum, particularly where peppermint trees (*Agonis flexuosa*) are present. No individuals were recorded on the camera traps during the survey. The survey area was thoroughly searched for dreys (nests) and scats however no evidence of Western Ringtail Possum was observed during the survey.

Previous records of Western Ringtail Possums are sparsely scattered in the local region, with populations more densely concentrated along the coast between Bunbury and Augusta and further south of Bridgetown, around Manjimup (DBCA 2007-). There are three known records of this species within 5 km of the survey area, one approximately 4 km south-west of Mullalyup (recorded in 1997) and two approximately 4.5 km south of the southern end of the survey area (recorded in 2014) (DBCA 2007-).

The Western Ringtail Possum potentially occurs in native vegetation surrounding the survey area however the population density is likely to be low. Given the linear and fragmented nature of the survey area and lack of evidence recorded during the survey, the survey area is not considered significant habitat for this species.

5. Conclusions

5.1 Key findings

5.1.1 Vegetation and flora

Vegetation

Seven vegetation types were identified and described for the survey area. Six of these vegetation types were Eucalyptus woodlands with variations in the mid and lower storey species. The remaining vegetation type consisted of isolated stands of native and planted trees with scattered natives over weedy grasses. None of the vegetation types described for the survey area are synonymous with any TECs or PECs as defined by the EPBC Act or DBCA.

The vegetation condition within the survey area was rated as Very Good to Completely Degraded condition. The majority of the survey area (54%) was rated as Degraded and Degraded-Completely Degraded condition. Small patches of Very Good and Very Good – Good vegetation contained a number common bushland weeds, however native vegetation dominated each strata.

Flora

One hundred and six (106) flora taxa (including subspecies and varieties) representing 40 families and 74 genera were recorded from the survey area during the field survey. This total comprised of 77 native taxa and 29 introduced flora taxa. No EPBC Act or WC Act listed flora were recorded within the survey area. In addition no DBCA Priority-listed flora or flora of conservation significance were recorded.

The likelihood of occurrence assessment post-field survey concluded that one taxon is likely to occur within the survey area; *Tetraria* sp. Blackwood River (A.R. Annels 3043) (P3). This species has previously been recorded approximately 50 m away from the Mullalyup Tank site. There is very limited suitable habitat for this species, however due to the proximity of the previous known record and its cryptic nature it is still considered to potentially occur.

Of the introduced taxa, two are listed as Declared Pests under the *Biosecurity and Management Act 2007* and as WONS:

- * *Asparagus asparagoides* (Bridal Creeper)
- * *Rubus ulmifolius* (Blackberry)

5.1.2 Fauna

The survey area comprised four fauna habitat types including Jarrah-Marri Woodland, *Eucalyptus rudis* woodland (riparian), planted vegetation, and cleared or previously disturbed areas. With the exception of the Cirillo Road Option section, these habitats are well-connected at both a local and regional scale to other areas of remnant and contiguous vegetation.

During the survey, three conservation signification fauna species were recorded:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Endangered – WC Act, Endangered – EPBC Act – observed on multiple occasions
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*), Vulnerable – WC Act, Vulnerable – EPBC Act – old foraging evidence recorded
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), Endangered – WC Act, Vulnerable – EPBC Act

An additional nine species are considered likely to occur in the survey area based on previous records and suitability of habitat:

- Chuditch (*Dasyurus geoffroii*), Vulnerable – WC Act, Vulnerable – EPBC Act
- South western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*), Schedule 6 – WC Act
- Western Brush Wallaby (*Macropus irma*), Priority 4 – DBCA listing
- Western False Pipistrelle (*Falsistrellus mackenziei*), Priority 4 – DBCA
- Peregrine Falcon (*Falco peregrinus*), Schedule 7 – WC Act
- Quenda (*Isoodon obesulus fusciventer)*, Priority 4 – DBCA
- Rainbow Bee-eater (*Merops ornatus*) – Migratory
- Barking Owl (southern subspecies) (*Ninox connivens* subsp. *connivens*), Priority 2 – DBCA listing
- Masked Owl (southern subspecies) (*Tyto novaehollandiae* subsp. *novaehollandiae*), Priority 2 – DBCA listing

A total of 253 trees which are potentially suitable for Black Cockatoo breeding (Jarrah, Marri, and Flooded Gum) were recorded within the survey area, including 16 with hollows currently suitable for Black Cockatoo breeding. None of these trees had evidence of current or previous Black Cockatoo use (i.e. old chew marks). Old and fresh Black Cockatoo foraging evidence was recorded scattered throughout the survey area (on Marri nuts) and there is 2.98 ha of suitable foraging habitat.

The majority of the habitats recorded in the survey area are well represented in the immediate vicinity of the survey area and the broader Blackwood district (particularly in the conservation areas and State Forest) and would be utilised by all the conservation significant species known or likely to occur in the area. Furthermore, there is no habitat within the survey area that would be considered specific to, or solely relied upon by, any of the conservation significant species known or likely to occur within the area.

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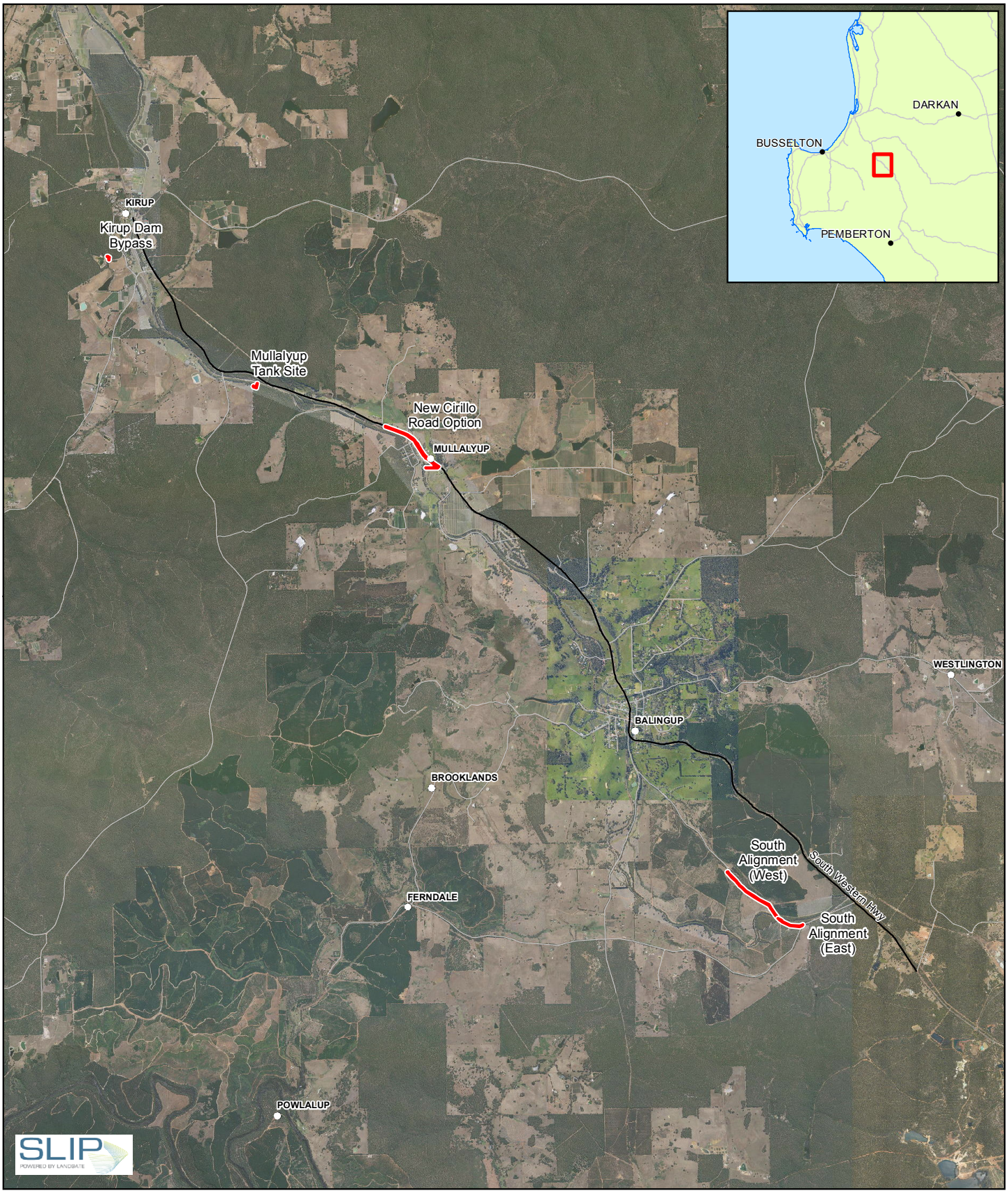
Appendices

Appendix A – Figures



LEGEND

Survey Area

Paper Size A4

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Kilometres

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Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763
Revision 0
Date 16 Aug 2017

Project Locality

Figure 1

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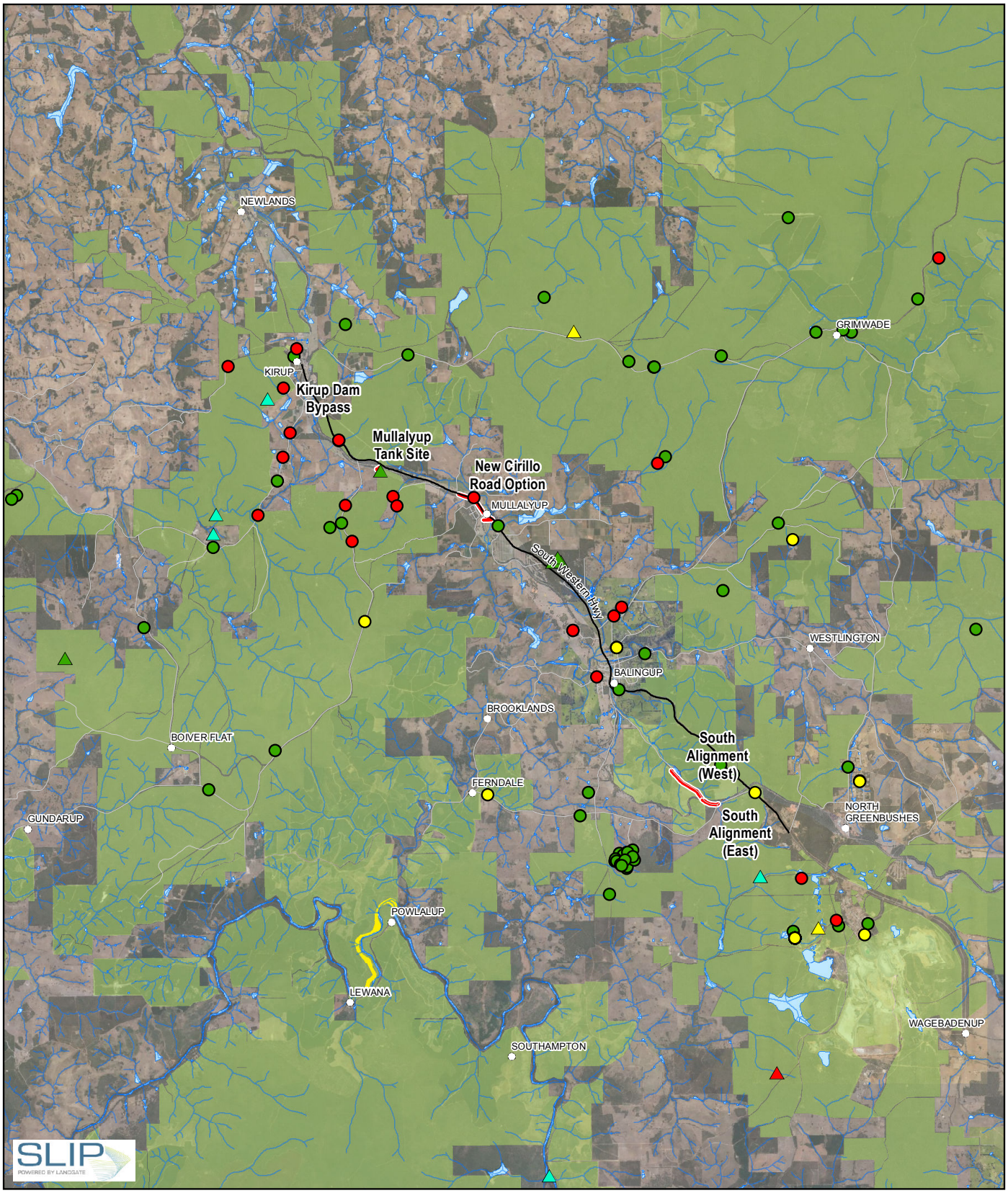
999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Imagery (Virtual Mosaic), Roads - 20170525; Water Corporation: Survey Area - 20170511; GA: Geodata Topo Series III - 2006 Created by:krawlinson



LEGEND

Declared Rare and Priority Flora

- (T) Threatened Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Threatened Fauna

- Priority Fauna
- Schedule 2 - Fauna that is rare or is likely to become extinct as endangered fauna
- Schedule 3 - Fauna that is rare or is likely to become extinct as vulnerable fauna

- Watercourses & drainage lines
- Local Road
- State Road
- ESA
- Waterbody
- DPaW Managed Lands

Paper Size A4

0 2.5 5

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Biological Constraints

Figure 2

G:\61\35763\GIS\Maps\MXD\6135763_002_BioConstraints_Rev0_Fig2.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads, Waterbody, Watercourse - 20170525; Water Corporation: Survey Area - 20170511, Threatened Fauna, Declared Rare and Priority Flora - 20170510; GA: Place Name - 2006; DER: ESA - 20160508; DPaW: DPaW Managed Lands - 20161003. Created by:krawlinson

LEGEND

- Relevè
- Survey Area
- Cleared

Vegetation Type

- Jarrah-Marri woodland over Hibbertia shrubland (VT01)

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Type
Kirup Dam Bypass

Figure 3. 1

G:\61\35763\GIS\Maps\MXD\6135763_003_VegAssociation_Rev0_Fig3.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

- Relevè
- Local Road
- Survey Area

Vegetation Type

- Eucalyptus spp.-Marri-Pine isolated trees (VT07)
- Jarrah-Marri woodland over Bugle Lily (VT06)
- Cleared

Paper Size A4

0 35 70 140

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Type
New Cirillo Road Option

Figure 3. 3

G:\61\35763\GIS\Maps\MXD\6135763_003_VegAssociation_Rev0_Fig3.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

- Quadrat
- Local Road
- Survey Area

Vegetation Type

- Jarrah-Marri woodland over Blackberry (VT04)
- Jarrah-Marri woodland over Bossiaea shrubland (VT03)
- Cleared

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Type South Alignment (East)

Figure 3. 5

G:\61\35763\GIS\Maps\MXD\6135763_003_VegAssociation_Rev0_Fig3.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

- Relevè
- Local Road
- Survey Area

Vegetation Type

- Flooded gum woodland over Blackberry (VT05)
- Jarrah-Marri woodland over Blackberry (VT04)
- Cleared

Paper Size A4

0 35 70 140

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Type
South Alignment (West)

Figure 3. 4

G:\61\35763\GIS\Maps\MXD\6135763_003_VegAssociation_Rev0_Fig3.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

- Quadrat
- Survey Area
- Cleared

Vegetation Type

- Marri-Jarrah woodland over Taxandria shrubland (VT02)

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

WATER CORPORATION

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Type Mullalyup Tank

Figure 3. 2

G:\61\35763\GIS\Maps\MXD\6135763_003_VegAssociation_Rev0_Fig3.mxd

999 Hay Street, Perth WA 6000 Australia **T** 61 8 6222 8555 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

Survey Area

Vegetation Condition

Good - Degraded

Cleared

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

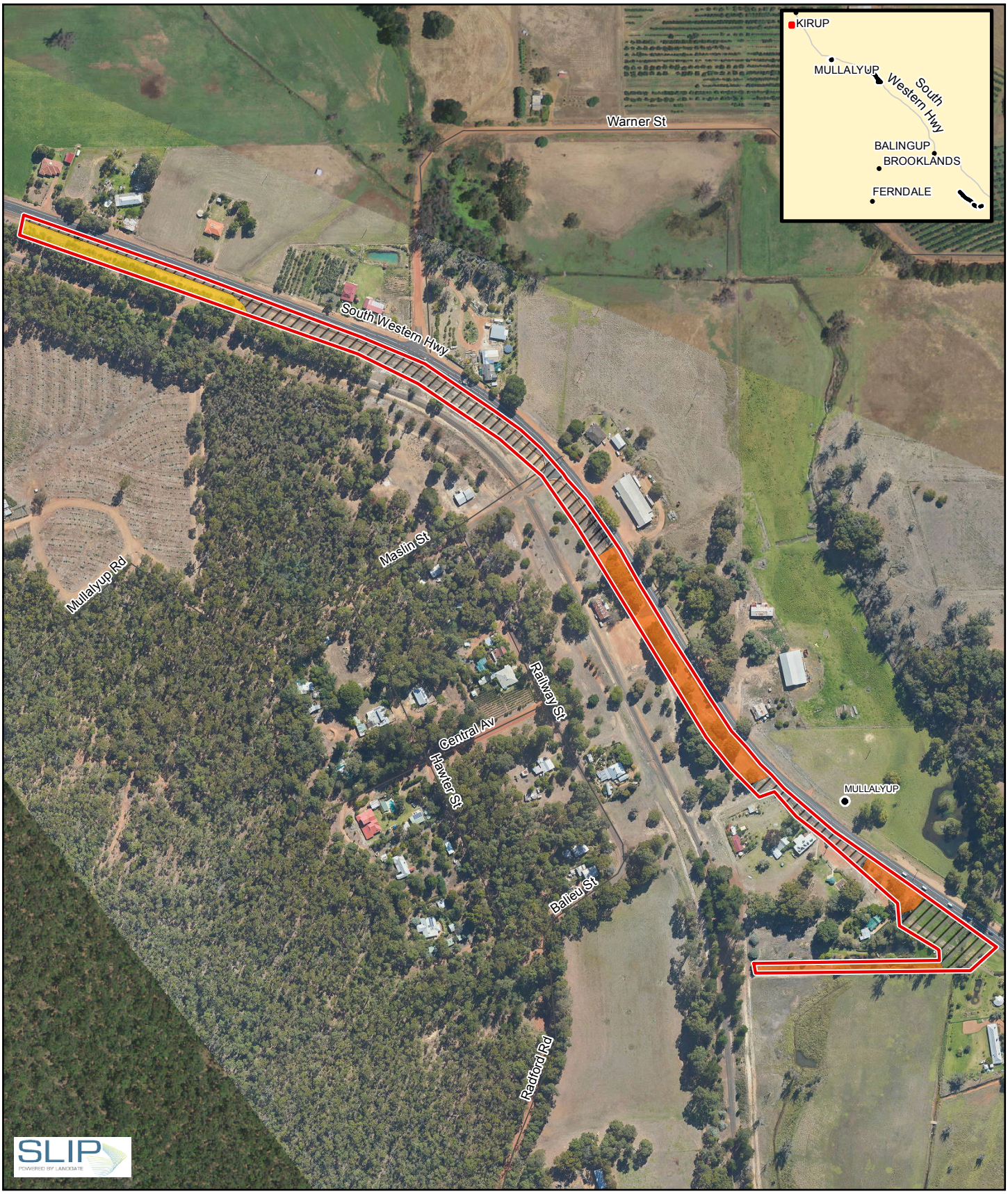
Vegetation Condition
Kirup Dam Bypass

Figure 4. 1

G:\61\35763\GIS\Maps\MXD\6135763_004_VegCondition_Rev0_Fig4.mxd

999 Hay Street, Perth WA 6000 Australia **T** 61 8 6222 8555 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson



LEGEND

- Survey Area
- Local Road

Vegetation Condition

- Degraded
- Degraded - Completely degraded
- Cleared

Paper Size A4

0 35 70 140

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Condition
New Cirillo Road Option

Figure 4. 3

G:\61\35763\GIS\Maps\MXD\6135763_004_VegCondition_Rev0_Fig4.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

- Survey Area
- Local Road

Vegetation Condition

- Very good - Good
- Good - Degraded
- Degraded
- Cleared

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Condition
South Alignment (East)

Figure 4. 5

G:\61\35763\GIS\Maps\MXD\6135763_004_VegCondition_Rev0_Fig4.mxd

999 Hay Street, Perth WA 6000 Australia **T** 61 8 6222 8555 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

- Survey Area
- Local Road

Significant Weeds

- **Asparagus asparagoides* (Bridal Creeper)
- <ITA>*Rubus ulmifolius</ITA> (Blackberry) 30%<70% cover

Vegetation Condition

- Degraded
- Cleared

Paper Size A4

0 35 70 140

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

WATER CORPORATION

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Condition
South Alignment (West)

Figure 4. 4

G:\61\35763\GIS\Maps\MXD\6135763_004_VegCondition_Rev0_Fig4.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

- Survey Area
- **Vegetation Condition**
  - Very good
  - Good - Degraded
  - Degraded
  - Cleared

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Vegetation Condition
Mullalyup Tank

Figure 4. 2

G:\61\35763\GIS\Maps\MXD\6135763_004_VegCondition_Rev0_Fig4.mxd

999 Hay Street, Perth WA 6000 Australia **T** 61 8 6222 8555 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

Black Cockatoo Habitat

- Jarrah (*Eucalyptus marginata*) – no hollows
- Marri (*Corymbia calophylla*) – no hollows

Fauna Observations

- Forest Red-tailed Black Cockatoo feeding evidence on Marri

Sample Locations

- Camera trap
- Habitat assessment
- Black Cockatoo Foraging Habitat

- Survey Area

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Fauna Habitat Types, Observations and Black Cockatoo Habitat
Kirup Dam Bypass

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Figure 5. 1

G:\61\35763\GIS\Maps\MXD\6135763_005_Fauna_Rev0_Fig5.mxd

999 Hay Street, Perth WA 6000 Australia **T** 61 8 6222 8555 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

Black Cockatoo Habitat

- Jarrah (*Eucalyptus marginata*) – no hollows
- Marri (*Corymbia calophylla*) – no hollows
- Flooded Gum (*Eucalyptus rudis*) – no hollows

Fauna Observations

- Carnaby's Black Cockatoo *Calyptorhynchus latirostris*
- Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*
- Black Cockatoo Foraging Habitat
- Survey Area
- Local Road

Paper Size A4

0 35 70 140

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Fauna Habitat Types, Observations and Black Cockatoo Habitat
New Cirillo Road Option

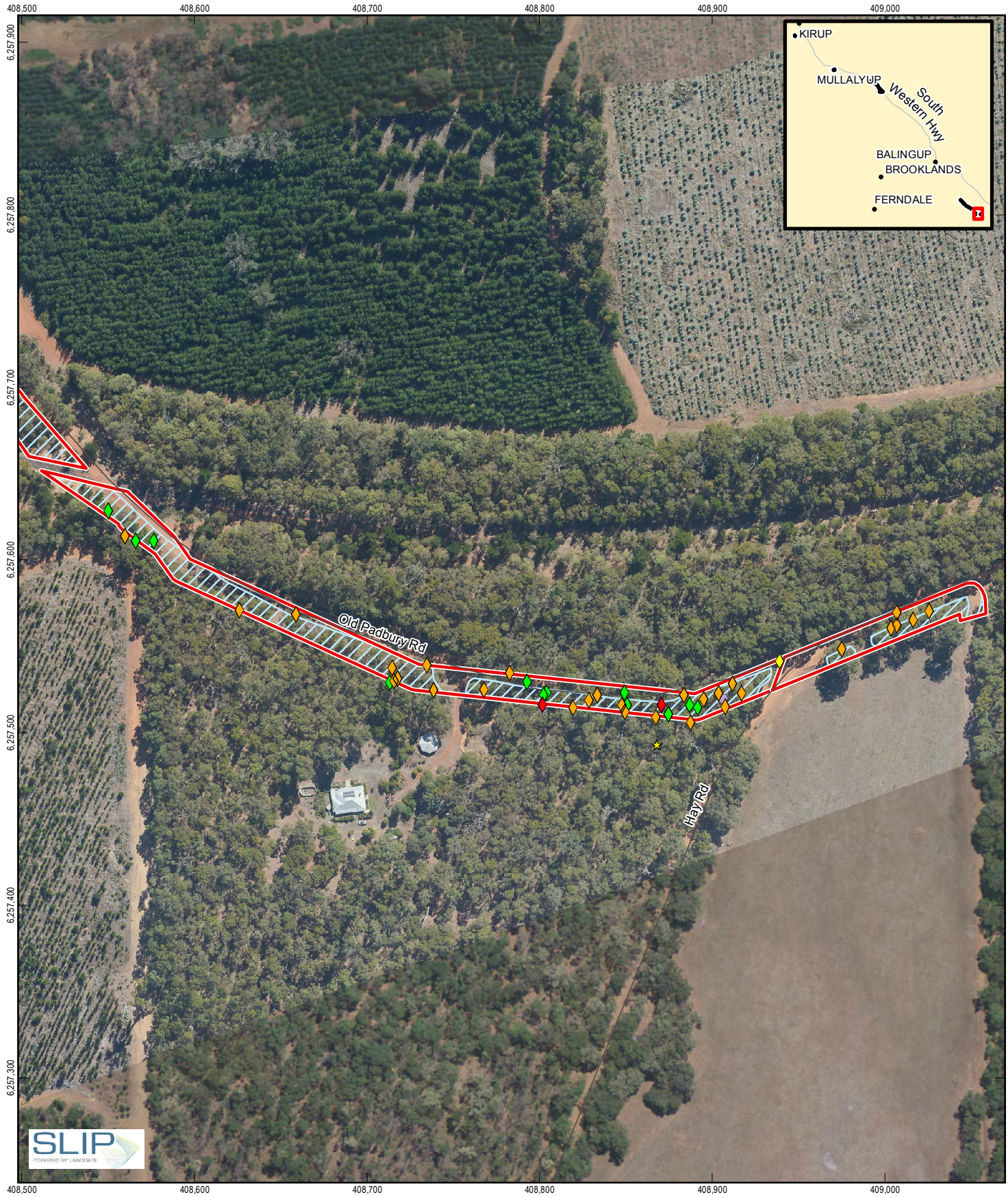
Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Figure 5. 2

G:\61\35763\GIS\Maps\MXD\6135763_005_Fauna_Rev0_Fig5.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson



LEGEND

Black Cockatoo Habitat

- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Marri (*Corymbia calophylla*) – no hollows
- Marri (*Corymbia calophylla*) – hollows

Fauna Observations

- Carnaby's Black Cockatoo *Calyptorhynchus latirostris*

Sample Locations

- Camera trap

- Black Cockatoo Foraging Habitat
- Survey Area
- Local Road

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Fauna Habitat Types, Observations and Black Cockatoo Habitat South Alignment (East)

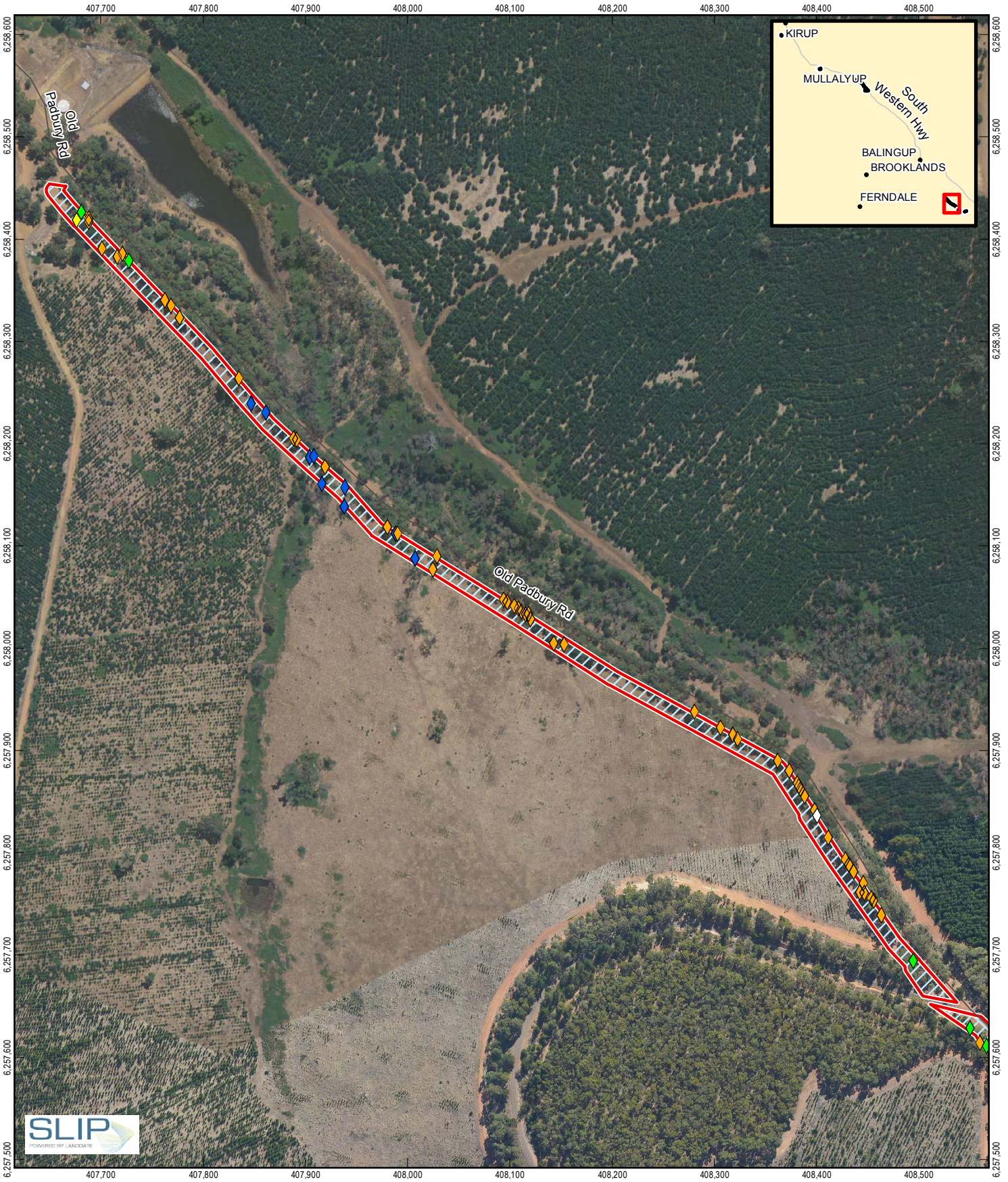
Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Figure 5. 3

G:\61\35763\GIS\Maps\MXD\6135763_005_Fauna_Rev0_Fig5.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson



LEGEND

Black Cockatoo Habitat

- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Marri (*Corymbia calophylla*) – no hollows
- Flooded Gum (*Eucalyptus rudis*) – no hollows
- Stag

Fauna Observations

- Forest Red-tailed Black Cockatoo feeding evidence on Marri
- Black Cockatoo Foraging Habitat
- Survey Area
- Local Road

Paper Size A4

0 35 70 140

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Fauna Habitat Types, Observations and Black Cockatoo Habitat South Alignment (West)

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Figure 5. 4

G:\61\35763\GIS\Maps\MXD\6135763_005_Fauna_Rev0_Fig5.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

LEGEND

Black Cockatoo Habitat

- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Marri (*Corymbia calophylla*) – no hollows
- Marri (*Corymbia calophylla*) – hollows

Fauna Observations

- Carnaby's Black Cockatoo *Calyptorhynchus latirostris*
- Forest Red-tailed Black Cockatoo feeding evidence on Marri

Sample Locations

- Camera trap
- Habitat assessment
- Black Cockatoo Foraging Habitat
- Survey Area

Paper Size A4

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Water Corporation
Greenbushes to Kirup Link EIA and Approvals

Fauna Habitat Types, Observations and Black Cockatoo Habitat
Mullalyup Tank

Job Number 61-35763-01
Revision 0
Date 16 Aug 2017

Figure 5. 5

G:\61\35763\GIS\Maps\MXD\6135763_005_Fauna_Rev0_Fig5.mxd

999 Hay Street, Perth WA 6000 Australia T 61 8 6222 8555 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson

Appendix B – Relevant legislation, conservation codes and background information

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DotEE).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Environment Regulation (DER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.

c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

g) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The Biodiversity Conservation Bill 2015 was introduced to State Parliament in November 2015, and passed in September 2016. The Bill became the *Biodiversity Conservation Act 2016* (BC Act) upon receiving Assent on 21 September 2016. The BC Act will eventually fully replace both the *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act).

Several parts of the BC Act were proclaimed by the State Governor in the Government Gazette and came into effect on 3 December 2016. However, provisions that replace those existing under the WC Act and Sandalwood Act (including threatened species listings and controls over the taking and keeping of native species) and their associated Regulations cannot be brought into effect until the necessary Biodiversity Conservation Regulations have been made. It is hoped the new Regulations will be completed and ready to commence by late 2017.

State *Wildlife Conservation Act 1950*

The WC Act provides for the conservation and protection of wildlife. It is administered by the Department of Parks and Wildlife (DPaW) and applies to both flora and fauna. Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Agriculture and Food Western Australia (DAFWA) and replace the repealed *Agriculture and Related Resources Protection Act 1976.* The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DAFWA Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the *Australian Heritage Commission Act 1975* of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in “Bush Forever” Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*.
The areas covered by the *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002*.
The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) applies.
Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.

Reserves and conservation areas

Department of Parks and Wildlife managed lands and waters

DPaW manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DPaW managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DPaW managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DPaW managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DPaW managed lands will generally be referred to DPaW throughout the assessment process.

Wetlands

Wetlands include not only lakes with open water, but areas of seasonally, intermittently or permanently waterlogged soil.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance” (DotEE 2017b). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DotEE 2017b).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DotEE 2017a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia’s Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2016), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated at least every two years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA 2016). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale for the South West and Interzone Botanical Provinces

Condition	South West and Interzone Botanical Provinces description
Pristine	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as ‘parkland cleared’ with the flora comprising weed or crop species with isolated native trees or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The DPaW also maintains a list of TECs for Western Australia; some of which are also protected under the EPBC Act. TECs are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable.

Possible TECs that do not meet survey criteria are added to the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Conservation codes and definitions for TECs listed under the EPBC Act or endorsed by the WA Minister for the Environment

Categories	Definition
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Endangered (EN)	An ecological community if, at that time: A) is not critically endangered; and B) is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Vulnerable (VU)	An ecological community if, at that time: A) is not critically endangered or endangered; and B) is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Western Australia Conservation Categories	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

Categories	Definition
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Conservation categories and definitions for PECS as listed by the DPaW

Category	Description
Priority 1	Poorly known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Poorly known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	Poorly known ecological communities. (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Category	Description
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	Conservation Dependent ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in ‘pristine’ condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range)
- Being poorly reserved

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Flora and fauna

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DotEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act are those recommended by the International Union for Conservation of Nature (IUCN).

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of Threatened flora and fauna has been published as Specially Protected under the WC Act, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2015 for Threatened Fauna and under Schedules 1 to 4 of the Wildlife Conservation (Rare Flora) Notice 2015 for Threatened (Declared Rare) Flora. The schedules align with the categories of the EPBC Act Threatened Fauna and Threatened Flora Lists. Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act listed flora and fauna species

Conservation category	Definition
Extinct	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A) A species known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or B) A species that has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	A species facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000).
Endangered	A) A species not critically endangered; and B) A species facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

Conservation category	Definition
Vulnerable	A) A species not critically endangered or endangered; and B) A species facing a high risk of extinction in the wild in the medium-term, as determined in accordance with the prescribed criteria.
Conservation Dependent	A) The species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or B) The following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that Section 180 provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Conservation codes and descriptions for WC Act listed flora and fauna species

Conservation category	Schedule and definition
Threatened species (T)	Published as Specially Protected under the WC Act, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora. **Threatened fauna** is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the WC Act. **Threatened flora** is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the WC Act.
Critically Endangered (CR)	Schedule 1: Threatened species considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Schedule 2: Threatened species considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Schedule 3: Threatened species considered to be facing a high risk of extinction in the wild.
Presumed Extinct (EX)	Schedule 4: Species which have been adequately searched for and there is no reasonable doubt that the last individual has died.
International Agreement (IA)	Schedule 5: Migratory birds protected under an international agreement
Conservation Dependent (CD)	Schedule 6: Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other Specially Protected (OS)	Schedule 7: Fauna otherwise in need of special protection to ensure their conservation.

Conservation codes for DPaW listed Priority flora and fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring A. Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. B. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. C. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
- Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)

- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems)
- Being poorly reserved

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007.*

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

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English, V and Blyth, J 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, Perth, Department of Conservation and Land Management.

EPA 2010, *Technical Guide – Terrestrial Fauna Surveys*, EPA, Perth, WA.

EPA 2016, *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment*, EPA, Perth, WA.

GoWA 2016, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report)*, Current as of October 2016, Perth Western Australia, Department of Environment and Conservation, retrieved 2017, from https://www2.landgate.wa.gov.au/web/guest/downloader.

Shepherd, DP, Beeston, GR & Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status, Resource Management Technical Report 249*, Perth, Department of Agriculture.

Appendix C – Desktop searches

EPBC Act PMST Report (5 km buffer)

NatureMap Flora Report (5 km buffer)

NatureMap Fauna Report (5 km buffer)

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

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

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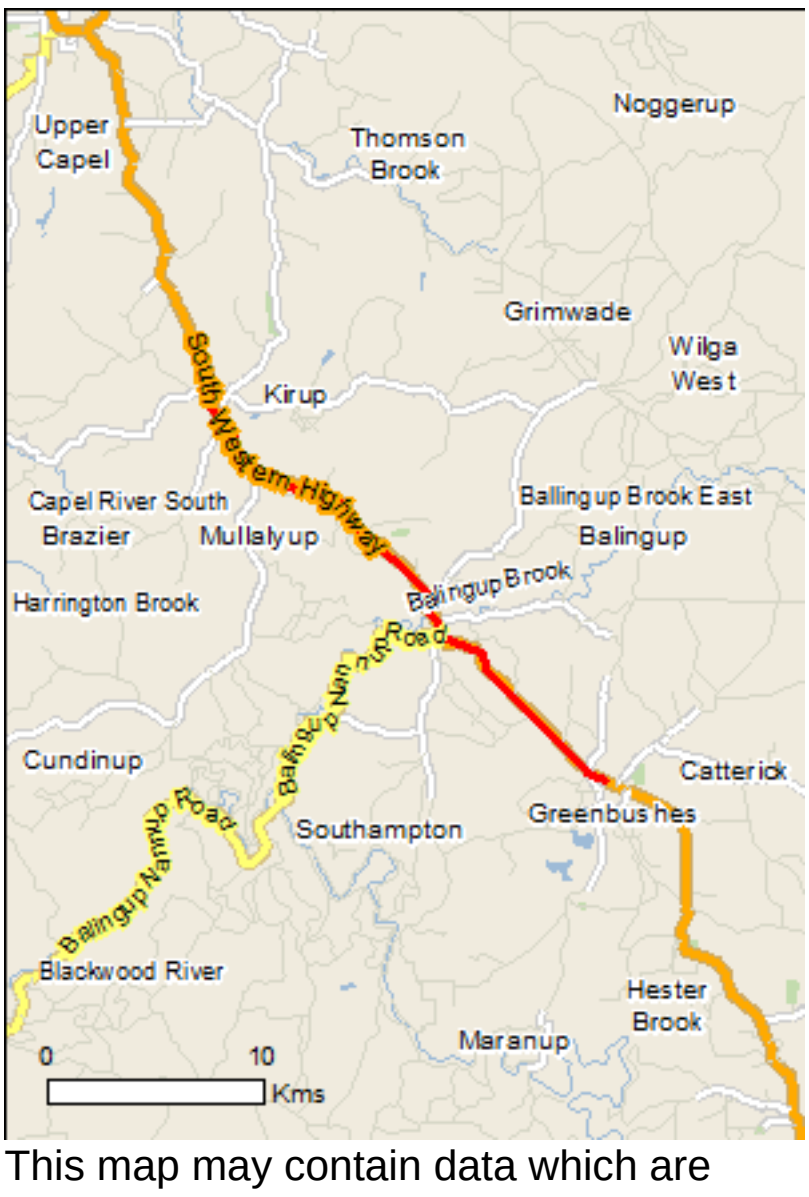

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Coordinates
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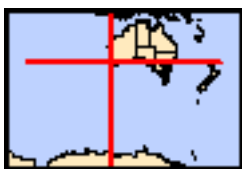

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	14
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

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

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

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

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

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	20
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii		
Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus latirostris		
Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Myrmecobius fasciatus		
Numbat [294]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat known to occur within area
Setonix brachyurus		
Quokka [229]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Caladenia harringtoniae		
Harrington's Spider-orchid, Pink Spider-orchid [56786]	Vulnerable	Species or species habitat likely to occur within area
Caladenia hoffmanii		
Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis keigheryi		
Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Unnamed WA20751	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding		Species or species

Name	Status	Type of Presence
Pine [20780]		habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-33.696605 115.889434,-33.703461 115.891838,-33.709458 115.891838,-33.719454 115.901107,-33.727164 115.903511,-33.732018 115.907974,-33.743438 115.946769,-33.754 115.955009,-33.766273 115.973549,-33.773979 115.981102,-33.780257 115.982818,-33.783396 115.986251,-33.788532 115.986595,-33.792242 115.998268,-33.793954 116.004104,-33.79966 116.006164,-33.8356 116.047363,-33.838166 116.055603

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact Us page.

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NatureMap
Mapping Western Australia's biodiversity

NatureMap Flora Species Report

Created By Guest user on 12/05/2017

Kingdom	Plantae
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Line'
Vertices	33° 42' 46" S,115° 53' 39" E 33° 43' 20" S,115° 54' 04" E 33° 43' 34" S,115° 54' 10" E 33° 43' 41" S,115° 54' 20" E 33° 43' 55" S,115° 54' 33" E 33° 43' 58" S,115° 55' 01" E 33° 44' 35" S,115° 56' 45" E 33° 45' 17" S,115° 57' 25" E 33° 45' 25" S,115° 57' 43" E 33° 46' 00" S,115° 58' 33" E 33° 46' 33" S,115° 58' 53" E 33° 46' 48" S,115° 58' 56" E 33° 47' 18" S,115° 59' 06" E 33° 47' 27" S,115° 59' 28" E 33° 47' 28" S,115° 59' 53" E 33° 47' 38" S,116° 00' 14" E 33° 47' 50" S,116° 00' 13" E 33° 48' 22" S,116° 00' 59" E 33° 48' 27" S,116° 01' 00" E 33° 49' 26" S,116° 02' 12" E 33° 50' 14" S,116° 03' 08" E
Group By	Family

Family	Species	Records
Alliaceae	1	1
Apiaceae	7	12
Araceae	1	1
Asparagaceae	13	15
Asteraceae	13	24
Boraginaceae	1	1
Boryaceae	2	2
Brassicaceae	2	2
Bryaceae	2	2
Campanulaceae	2	2
Caprifoliaceae	1	1
Centrolepidaceae	1	2
Cephaloziellaceae	2	3
Colchicaceae	2	2
Convolvulaceae	1	1
Cupressaceae	1	1
Cyperaceae	8	9
Dasypogonaceae	2	2
Dennstaedtiaceae	1	1
Dicranaceae	1	12
Dilleniaceae	5	10
Ditrichaceae	1	2
Droseraceae	2	3
Elaeocarpaceae	5	12
Ericaceae	9	17
Euphorbiaceae	1	2
Fabaceae	43	64
Frullaniaceae	1	2
Gentianaceae	2	2
Geraniaceae	1	2
Goodeniaceae	5	7
Haemodoraceae	6	10
Hemerocallidaceae	2	3
Hypericaceae	1	1
Iridaceae	9	17
Juncaceae	4	4
Juncaginaceae	1	1
Lamiaceae	2	6
Lentibulariaceae	1	1
Lindsaeaceae	1	1
Loganiaceae	2	2
Lophocoleaceae	1	1
Malvaceae	1	3
Myrtaceae	17	23
Olacaceae	1	2
Onagraceae	2	2
Orchidaceae	19	25
Oxalidaceae	2	2
Phyllanthaceae	2	2
Pinaceae	1	1
Pittosporaceae	3	4
Plantaginaceae	3	5
Poaceae	12	17
Podocarpaceae	1	11
Polygonaceae	2	2
Pottiaceae	2	6
Primulaceae	1	1
Proteaceae	14	21
Racopilaceae	1	1
Ranunculaceae	3	4
Restionaceae	6	9
Ricciaceae	1	1
Rosaceae	4	6
Rubiaceae	2	3
Rutaceae	2	2
Santalaceae	2	7
Sapindaceae	1	2

Scrophulariaceae	1	1
Sematophyllaceae	1	5
Solanaceae	2	2
Stylidiaceae	11	14
Thymelaeaceae	3	3
Xanthorrhoeaceae	2	2
Zamiaceae	1	2
TOTAL	**295**	**457**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Alliaceae					
1.	1378	*Allium triquetrum (Three-cornered Garlic)*	Y		
Apiaceae					
2.	6218	*Daucus glochidiatus (Australian Carrot)*			
3.	6246	*Pentapeltis silvatica (Southern Pentapeltis)*			
4.	6253	*Platysace filiformis*			
5.	6283	*Xanthosia atkinsoniana*			
6.	6284	*Xanthosia candida*			
7.	6285	*Xanthosia ciliata*			
8.	6289	*Xanthosia huegelii*			
Araceae					
9.	1049	*Zantedeschia aethiopica (Arum Lily)*	Y		
Asparagaceae					
10.	8779	*Asparagus asparagoides (Bridal Creeper)*	Y		
11.	1280	*Chamaescilla corymbosa (Blue Squill)*			
12.	1309	*Laxmannia squarrosa*			
13.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
14.	1225	*Lomandra drummondii*			
15.	1228	*Lomandra hermaphrodita*			
16.	1229	*Lomandra integra*			
17.	1234	*Lomandra nigricans*			
18.	1236	*Lomandra odora (Tiered Matrush)*			
19.	1239	*Lomandra preissii*			
20.	1243	*Lomandra sericea (Silky Mat Rush)*			
21.		*Lomandra sp.*			
22.	1338	*Thysanotus manglesianus (Fringed Lily)*			
Asteraceae					
23.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
24.	20074	*Conyza sumatrensis*	Y		
25.	12741	*Hyalosperma cotula*			
26.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
27.	18585	*Lagenophora huegelii*			
28.	8106	*Millotia tenuifolia (Soft Millotia)*			
29.	8203	*Senecio diaschides*			
30.	20663	*Senecio multicaulis subsp. multicaulis*			
31.	8223	*Sigesbeckia orientalis (Indian Weed)*	Y		
32.	14583	*Siloxerus multiflorus*			
33.	8227	*Silybum marianum (Variegated Thistle)*	Y		
34.	8248	*Tolpis barbata (Yellow Hawkweed)*	Y		
35.	29048	*Tolpis virgata*	Y		
Boraginaceae					
36.	6674	*Borago officinalis (Borage)*	Y		
Boryaceae					
37.	1272	*Borya scirpoidea*			
38.	1273	*Borya sphaerocephala (Pincushions)*			
Brassicaceae					
39.	3061	*Raphanus raphanistrum (Wild Radish)*	Y		
40.	3066	*Rorippa nasturtium-aquaticum (Watercress)*	Y		
Bryaceae					
41.	32426	*Rosulabryum campylothecium*			
42.	32427	*Rosulabryum capillare*			
Campanulaceae					
43.	9289	*Lobelia anceps (Angled Lobelia)*			
44.		*Wahlenbergia sp.*			
Caprifoliaceae					
45.	7365	*Lonicera japonica (Japanese Honeysuckle)*	Y		
Centrolepidaceae					
46.	1121	*Centrolepis aristata (Pointed Centrolepis)*			
Cephaloziellaceae					
47.		*Cephaloziella exiliflora*			
48.		*Cephaloziella hirta*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Colchicaceae					
49.	12770	*Burchardia congesta*			
50.	1385	*Burchardia multiflora (Dwarf Burchardia)*			
Convolvulaceae					
51.	6663	*Cuscuta epithymum (Lesser Dodder, Greater Dodder)*	Y		
Cupressaceae					
52.	93	*Callitris drummondii (Drummond's Cypress Pine)*			
Cyperaceae					
53.	747	*Baumea rubiginosa*			
54.	763	*Chorizandra enodis (Black Bristlerush)*			
55.	902	*Gahnia decomposita*			
56.	933	*Lepidosperma gladiatum (Coast Sword-sedge, Kerbin)*			
57.	944	*Lepidosperma scabrum*			
58.	976	*Schoenus breviculmis*			
59.	985	*Schoenus discifer*			
60.	35578	*Tetraria sp. Blackwood River (A.R. Annels 3043)*		P3	
Dasypogonaceae					
61.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
62.	1219	*Dasypogon hookeri (Pineapple Bush)*			
Dennstaedtiaceae					
63.	41651	*Pteridium esculentum subsp. esculentum*			
Dicranaceae					
64.	32338	*Campylopus introflexus*	Y		
Dilleniaceae					
65.	5109	*Hibbertia amplexicaulis*			
66.	5114	*Hibbertia commutata*			
67.	5125	*Hibbertia ferruginea*			
68.	45534	*Hibbertia hypericoides subsp. hypericoides*			
69.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
Ditrichaceae					
70.	32462	*Ceratodon purpureus subsp. convolutus*			
Droseraceae					
71.	13217	*Drosera erythrorhiza subsp. erythrorhiza*			
72.	3118	*Drosera pallida (Pale Rainbow)*			
Elaeocarpaceae					
73.	4526	*Tetratheca affinis*			
74.	4535	*Tetratheca hirsuta (Black Eyed Susan)*			
75.	4538	*Tetratheca parvifolia*		P3	
76.	4544	*Tetratheca setigera*			
77.	4548	*Tremandra stelligera*			
Ericaceae					
78.	6360	*Leucopogon australis (Spiked Beard-heath)*			
79.	6367	*Leucopogon capitellatus*			
80.	6396	*Leucopogon glabellus*			
81.	41260	*Leucopogon microcarpus*			
82.	40941	*Leucopogon obovatus subsp. revolutus*			
83.	6428	*Leucopogon pendulus*			
84.	6436	*Leucopogon propinquus*			
85.	6454	*Leucopogon verticillatus (Tassel Flower)*			
86.	31952	*Sphenotoma gracilis (Swamp Paper-heath)*			
Euphorbiaceae					
87.	4666	*Monotaxis occidentalis*			
Fabaceae					
88.	11377	*Acacia browniana var. obscura*			
89.	3331	*Acacia extensa (Wiry Wattle)*			
90.	3410	*Acacia lateriticola*			
91.	17958	*Acacia mearnsii*	Y		
92.	10955	*Acacia melanoxylon*	Y		
93.	3448	*Acacia mooreana*			
94.	15483	*Acacia pulchella var. pulchella*			
95.	3504	*Acacia pycnantha (Golden Wattle)*	Y		
96.	30034	*Acacia saligna subsp. pruinescens*			
97.	30032	*Acacia saligna subsp. saligna*			
98.	30036	*Acacia saligna subsp. stolonifera*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
99.	15487	*Acacia varia var. varia*			
100.	3713	*Bossiaea linophylla*			
101.	3714	*Bossiaea ornata (Broad Leaved Brown Pea)*			
102.	10861	*Callistachys lanceolata (Wonnich)*			
103.	18156	*Chamaecytisus palmensis (Tagasaste)*	Y		
104.	8971	*Chorizema cordatum*			
105.	3761	*Chorizema rhombeum*			
106.	3799	*Daviesia cordata (Bookleaf)*			
107.	15505	*Daviesia incrassata subsp. incrassata*			
108.	3891	*Gastrolobium bilobum (Heart Leaf Poison)*			
109.	3924	*Gastrolobium spinosum (Prickly Poison)*			
110.	18143	*Genista monspessulana*	Y		
111.	3948	*Gompholobium capitatum*			
112.	3954	*Gompholobium polymorphum*			
113.	3955	*Gompholobium preissii*			
114.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
115.	3964	*Hovea chorizemifolia (Holly-leaved Hovea)*			
116.	3968	*Hovea trisperma (Common Hovea)*			
117.	4036	*Kennedia carinata*			
118.	4037	*Kennedia coccinea (Coral Vine)*			
119.	4044	*Kennedia prostrata (Scarlet Runner)*			
120.	3669	*Labichea punctata (Lance-leaved Cassia)*			
121.	8564	*Lotus subbiflorus*	Y		
122.	4065	*Lupinus angustifolius (Narrowleaf Lupin)*	Y		
123.	4067	*Lupinus luteus (Yellow Lupin)*	Y		
124.	4090	*Mirbelia dilatata (Holly-leaved Mirbelia)*			
125.	3618	*Paraserianthes lophantha (Albizia)*			
126.	4177	*Pultenaea ochreata*			
127.	4207	*Sphaerolobium medium*			
128.	4208	*Sphaerolobium nudiflorum*			
129.		*Trifolium sp.*			
130.	4313	*Trifolium subterraneum (Subterranean Clover)*	Y		
Frullaniaceae					
131.		*Frullania probosciphora*			
Gentianaceae					
132.	6539	*Centaurium erythraea (Common Centaury)*	Y		
133.	6543	*Cicendia filiformis (Slender Cicendia)*	Y		
Geraniaceae					
134.	4341	*Geranium solanderi (Native Geranium)*			
Goodeniaceae					
135.	7420	*Dampiera alata (Winged-stem Dampiera)*			
136.	29362	*Goodenia coerulea*			
137.	7505	*Goodenia eatoniana*			
138.	7568	*Lechenaultia biloba (Blue Leschenaultia)*			
139.	7602	*Scaevola calliptera*			
Haemodoraceae					
140.	11931	*Anigozanthos bicolor subsp. decrescens*			
141.	1447	*Conostylis pusilla*			
142.	1453	*Conostylis serrulata*			
143.	1465	*Haemodorum discolor*			
144.	1468	*Haemodorum laxum*			
145.	1478	*Phlebocarya ciliata*			
Hemerocallidaceae					
146.	1296	*Johnsonia inconspicua*		P3	
147.	1297	*Johnsonia lupulina (Hooded Lily)*			
Hypericaceae					
148.	5182	*Hypericum perforatum (St John's Wort)*	Y		
Iridaceae					
149.	18279	*Babiana angustifolia*	Y		
150.	18392	*Freesia alba x leichtlinii*	Y		
151.	1534	*Ixia polystachya (Variable Ixia)*	Y		
152.	19179	*Moraea flaccida (One-leaf Cape Tulip)*	Y		
153.	1542	*Patersonia babianoides*			
154.	11550	*Patersonia umbrosa var. xanthina (Yellow Flags)*			
155.	1558	*Sparaxis bulbifera*	Y		
156.	1561	*Tritonia crocata*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
157.	38401	*Tritonia gladiolaris (Lined Tritonia)*	Y		
Juncaceae					
158.	8328	*Juncus amabilis*			
159.	1184	*Juncus holoschoenus (Jointleaf Rush)*			
160.	1195	*Juncus subsecundus (Finger Rush)*			
161.	1198	*Luzula meridionalis (Field Woodrush)*			
Juncaginaceae					
162.	40660	*Cycnogeton huegelii*			
Lamiaceae					
163.	38323	*Lavandula stoechas subsp. stoechas*	Y		
164.	6881	*Marrubium vulgare (Horehound)*	Y		
Lentibulariaceae					
165.	7157	*Utricularia violacea (Violet Bladderwort)*			
Lindsaeaceae					
166.	59	*Lindsaea linearis (Screw Fern)*			
Loganiaceae					
167.	46255	*Orianthera campanulata*			
168.	46316	*Orianthera serpyllifolia subsp. angustifolia*			
Lophocoleaceae					
169.		*Chiloscyphus semiteres var. semiteres*			
Malvaceae					
170.	5092	*Thomasia pauciflora (Few Flowered Thomasia)*			
Myrtaceae					
171.	17104	*Corymbia calophylla (Marri)*			
172.	5615	*Eucalyptus decipiens (Limestone Marlock, Moit)*			
173.	5628	*Eucalyptus drummondii (Drummond's Gum)*			
174.	13547	*Eucalyptus marginata subsp. marginata (Jarrah)*			
175.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
176.	18085	*Eucalyptus utilis*			
177.	5797	*Eucalyptus wandoo (Wandoo, Wondu)*			
178.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
179.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
180.	40780	*Melaleuca citrina*	Y		
181.	13273	*Melaleuca incana subsp. incana*			
182.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
183.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
184.	37683	*Melaleuca viminalis*		P2	
185.	13280	*Melaleuca viminea subsp. viminea*			
186.	20133	*Taxandria parviceps*			
187.	15618	*Verticordia plumosa var. plumosa*			
Olacaceae					
188.	2365	*Olax benthamiana*			
Onagraceae					
189.	6132	*Epilobium ciliatum*	Y		
190.	6133	*Epilobium hirtigerum (Hairy Willow Herb)*			
Orchidaceae					
191.	15335	*Caladenia brownii*			
192.	1580	*Caladenia cairnsiana (Zebra Orchid)*			
193.	1590	*Caladenia ferruginea (Rusty Spider Orchid)*			
194.	1597	*Caladenia infundibularis*			
195.	1603	*Caladenia longiclavata (Clubbed Spider Orchid)*			
196.	15377	*Caladenia reptans subsp. reptans*			
197.		*Caladenia sp.*			
198.	15380	*Caladenia splendens*			
199.	12945	*Corybas recurvus*			
200.	1627	*Cryptostylis ovata (Slipper Orchid)*			
201.	12944	*Diuris amplissima*			
202.	11156	*Drakaea livida*			
203.	15411	*Eriochilus dilatatus subsp. magnus*			
204.	1656	*Lyperanthus serratus (Rattle Beak Orchid)*			
205.	1668	*Prasophyllum brownii*			
206.	1698	*Pterostylis vittata (Banded Greenhood)*			
207.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			
208.	1705	*Thelymitra crinita (Blue Lady Orchid)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
209.	11053	*Thelymitra macrophylla*			
Oxalidaceae					
210.	30375	*Oxalis exilis*			
211.	4351	*Oxalis flava (Pinkbulb Soursob)*	Y		
Phyllanthaceae					
212.	4675	*Phyllanthus calycinus (False Boronia)*			
213.	4690	*Poranthera huegelii*			
Pinaceae					
214.	88	*Pinus radiata (Radiata Pine)*	Y		
Pittosporaceae					
215.	3157	*Billardiera floribunda (White-flowered Billardiera)*			
216.	25798	*Billardiera fusiformis (Australian Bluebell)*			
217.	28290	*Cheiranthera parviflora*			
Plantaginaceae					
218.	7068	*Kickxia spuria (Roundleaf Toadflax)*	Y		
219.	34759	*Plantago bellardii*	Y		
220.	7109	*Veronica calycina (Cup Speedwell)*			
Poaceae					
221.	185	*Aira cupaniana (Silvery Hairgrass)*	Y		
222.	194	*Amphipogon amphipogonoides*			
223.	250	*Bromus hordeaceus (Soft Brome)*	Y		
224.	277	*Cortaderia selloana (Pampas Grass)*	Y		
225.	299	*Deyeuxia quadriseta (Reed Bentgrass)*			
226.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
227.	528	*Paspalum distichum (Water Couch)*	Y		
228.	557	*Piptatherum miliaceum (Rice Millet)*	Y		
229.	40430	*Rytidosperma pilosum*			
230.	40427	*Rytidosperma setaceum*			
231.	667	*Tetrarrhena laevis (Forrest Ricegrass)*			
232.		*Vulpia sp.*			
Podocarpaceae					
233.	86	*Podocarpus drouynianus (Wild Plum, Kula)*			
Polygonaceae					
234.	13911	*Persicaria decipiens*			
235.	2429	*Rumex acetosella (Sorrel)*	Y		
Pottiaceae					
236.	32315	*Barbula calycina*			
237.	32445	*Tortula muralis*			
Primulaceae					
238.	6483	*Samolus junceus*			
Proteaceae					
239.	32580	*Banksia dallanneyi var. dallanneyi*			
240.	32577	*Banksia dallanneyi var. mellicula*			
241.	1819	*Banksia grandis (Bull Banksia, Pulgarla)*			
242.	32046	*Banksia squarrosa subsp. argillacea*		T	
243.	13085	*Grevillea centristigma*			
244.	2080	*Grevillea quercifolia (Oak-leaf Grevillea)*			
245.	2082	*Grevillea ripicola (Collie Grevillea)*		P4	
246.	2112	*Grevillea trifida*			
247.	2128	*Hakea amplexicaulis (Prickly Hakea)*			
248.	2175	*Hakea lissocarpha (Honey Bush)*			
249.	2191	*Hakea oleifolia (Dungyn)*			
250.	2203	*Hakea ruscifolia (Candle Hakea)*			
251.	2237	*Isopogon sphaerocephalus (Drumstick Isopogon)*			
252.	2267	*Persoonia longifolia (Snottygobble)*			
Racopilaceae					
253.	32480	*Racopilum cuspidigerum var. convolutaceum*			
Ranunculaceae					
254.	2929	*Clematis pubescens (Common Clematis)*			
255.	10911	*Ranunculus amphitrichus*			
256.	2932	*Ranunculus colonorum (Common Buttercup)*			
Restionaceae					
257.	17691	*Desmocladus fasciculatus*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
258.	1070	*Hypolaena exsulca*			
259.	1071	*Hypolaena fastigiata*			
260.	1078	*Leptocarpus coangustatus*			
261.	1090	*Lepyrodia muirii*			
262.	1092	*Loxocarya cinerea*			
Ricciaceae					
263.		*Riccia sp.*			
Rosaceae					
264.	10764	*Rosa chinensis x multiflora*	Y		
265.	3187	*Rosa rubiginosa (Sweet Briar)*	Y		
266.	20506	*Rubus anglocandicans*	Y		
267.	23990	*Rubus ulmifolius var. ulmifolius*	Y		
Rubiaceae					
268.	7348	*Opercularia hispidula (Hispid Stinkweed)*			
269.	7350	*Opercularia rubioides*		P3	
Rutaceae					
270.	4420	*Boronia fastigiata (Bushy Boronia)*			
271.	18529	*Philotheca spicata (Pepper and Salt)*			
Santalaceae					
272.	2342	*Leptomeria cunninghamii*			
273.	2355	*Leptomeria squarrulosa*			
Sapindaceae					
274.	4757	*Dodonaea ceratocarpa*			
Scrophulariaceae					
275.	7107	*Verbascum virgatum (Twiggy Mullein)*	Y		
Sematophyllaceae					
276.	32433	*Sematophyllum homomallum*			
Solanaceae					
277.	6964	*Datura stramonium (Common Thornapple)*	Y		
278.		*Solanum torvum*			
Stylidiaceae					
279.	7674	*Levenhookia preissii (Preiss's Stylewort)*			
280.	7676	*Levenhookia pusilla (Midget Stylewort)*			
281.	7678	*Stylidium adnatum (Common Beaked Triggerplant)*			
282.	7684	*Stylidium amoenum (Lovely Triggerplant)*			
283.	30278	*Stylidium androsaceum*			
284.	7702	*Stylidium ciliatum (Golden Triggerplant)*			
285.	7708	*Stylidium crassifolium (Thick-leaved Triggerplant)*			
286.	7745	*Stylidium junceum (Reed Triggerplant)*			
287.	7796	*Stylidium scandens (Climbing Triggerplant)*			
288.		*Stylidium sp.*			
289.	7799	*Stylidium spathulatum (Creamy Triggerplant)*			
Thymelaeaceae					
290.	5231	*Pimelea angustifolia (Narrow-leaved Pimelea)*			
291.	11533	*Pimelea imbricata var. imbricata*			
292.	11182	*Pimelea lehmanniana subsp. nervosa*			
Xanthorrhoeaceae					
293.	1253	*Xanthorrhoea gracilis (Graceful Grass Tree, Mimidi)*			
294.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
Zamiaceae					
295.	85	*Macrozamia riedlei (Zamia, Djiridji)*			

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5 - Priority 5

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NatureMap
Mapping Western Australia's biodiversity

NatureMap Fauna Species Report

Created By Guest user on 12/05/2017

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Line'
Vertices	33° 42' 46" S,115° 53' 45" E 33° 43' 20" S,115° 54' 04" E 33° 43' 32" S,115° 54' 11" E 33° 43' 57" S,115° 54' 33" E 33° 43' 57" S,115° 54' 55" E 33° 44' 32" S,115° 56' 41" E 33° 45' 17" S,115° 57' 25" E 33° 45' 22" S,115° 57' 45" E 33° 46' 11" S,115° 58' 42" E 33° 46' 52" S,115° 58' 59" E 33° 47' 17" S,115° 59' 04" E 33° 47' 28" S,115° 59' 48" E 33° 47' 34" S,116° 00' 04" E 33° 47' 40" S,116° 00' 12" E 33° 47' 52" S,116° 00' 12" E 33° 48' 28" S,116° 01' 02" E 33° 49' 59" S,116° 02' 38" E 33° 50' 18" S,116° 03' 19" E
Group By	Species Group

Species Group	Species	Records
Amphibian	6	22
Bird	107	1696
Fish	3	7
Invertebrate	15	15
Mammal	17	114
Reptile	9	34
TOTAL	**157**	**1888**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
4.	25404	*Geocrinia leai (Ticking Frog)*			
5.	25388	*Litoria moorei (Motorbike Frog)*			
6.	25421	*Neobatrachus albipes (White-footed Trilling Frog)*			
Bird					
7.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
8.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
9.	24262	*Acanthiza inornata (Western Thornbill)*			
10.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
11.	25536	*Accipiter fasciatus (Brown Goshawk)*			
12.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
13.	24301	*Aegotheles cristatus subsp. cristatus (Australian Owlet-nightjar)*			
14.	24312	*Anas gracilis (Grey Teal)*			
15.	24315	*Anas rhynchotis (Australasian Shoveler)*			
16.	24316	*Anas superciliosa (Pacific Black Duck)*			
17.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
18.	24561	*Anthochaera carunculata (Red Wattlebird)*			
19.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
20.	24285	*Aquila audax (Wedge-tailed Eagle)*			
21.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
22.	24341	*Ardea pacifica (White-necked Heron)*			
23.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
24.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
25.	24318	*Aythya australis (Hardhead)*			
26.		*Barnardius zonarius*			
27.	24319	*Biziura lobata (Musk Duck)*			
28.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
29.	24427	*Cacomantis flabelliformis subsp. flabelliformis (Fan-tailed Cuckoo)*			
30.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
31.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
32.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
33.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo (long-billed black-cockatoo), Baudin's Cockatoo)*		T	

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
34.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
35.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
36.	24432	*Chrysococcyx lucidus subsp. plagosus (Shining Bronze Cuckoo)*			
37.	24288	*Circus approximans (Swamp Harrier)*			
38.	24289	*Circus assimilis (Spotted Harrier)*			
39.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
40.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
41.	25592	*Corvus coronoides (Australian Raven)*			
42.	25595	*Cracticus tibicen (Australian Magpie)*			
43.	24322	*Cygnus atratus (Black Swan)*			
44.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
45.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
46.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
47.	24470	*Dromaius novaehollandiae (Emu)*			
48.		*Egretta novaehollandiae*			
49.		*Elanus axillaris*			
50.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
51.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
52.	24567	*Epthianura albifrons (White-fronted Chat)*			
53.	25621	*Falco berigora (Brown Falcon)*			
54.	24471	*Falco berigora subsp. berigora (Brown Falcon)*			
55.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
56.	25623	*Falco longipennis (Australian Hobby)*			
57.	24474	*Falco longipennis subsp. longipennis (Australian Hobby)*			
58.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
59.	25727	*Fulica atra (Eurasian Coot)*			
60.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
61.	25530	*Gerygone fusca (Western Gerygone)*			
62.	24443	*Grallina cyanoleuca (Magpie-lark)*			
63.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
64.	24295	*Haliastur sphenurus (Whistling Kite)*			
65.	24491	*Hirundo neoxena (Welcome Swallow)*			
66.	25661	*Lichmera indistincta (Brown Honeyeater)*			
67.		*Lophoictinia isura*			
68.	25650	*Malurus elegans (Red-winged Fairy-wren)*			
69.	25654	*Malurus splendens (Splendid Fairy-wren)*			
70.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
71.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
72.		*Microcarbo melanoleucos*			
73.	25610	*Myiagra inquieta (Restless Flycatcher)*			
74.	24738	*Neophema elegans (Elegant Parrot)*			
75.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
76.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
77.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
78.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
79.	25682	*Pardalotus striatus (Striated Pardalote)*			
80.	48061	*Petrochelidon nigricans (Tree Martin)*			
81.	48066	*Petroica boodang (Scarlet Robin)*			
82.	24659	*Petroica goodenovii (Red-capped Robin)*			
83.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
84.	24409	*Phaps chalcoptera (Common Bronzewing)*			
85.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
86.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
87.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
88.	25720	*Platycercus icterotis (Western Rosella)*			
89.	24745	*Platycercus icterotis subsp. icterotis (Western Rosella)*			
90.	24747	*Platycercus spurius (Red-capped Parrot)*			
91.	25703	*Podargus strigoides (Tawny Frogmouth)*			
92.	24679	*Podargus strigoides subsp. brachypterus (Tawny Frogmouth)*			
93.	25704	*Podiceps cristatus (Great Crested Grebe)*			
94.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
95.	30854	*Polytelis anthopeplus subsp. westralis (Regent Parrot)*			
96.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
97.	24771	*Porzana tabuensis (Spotless Crake)*			
98.		*Purpureicephalus spurius*			
99.	48096	*Rhipidura albiscapa (Grey Fantail)*			
100.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
101.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
102.	24645	*Stagonopleura oculata (Red-eared Firetail)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
103.	24329	*Stictonetta naevosa (Freckled Duck)*			
104.	25597	*Strepera versicolor (Grey Currawong)*			
105.	25752	*Sturnus vulgaris (Common Starling)*	Y		
106.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
107.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
108.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
109.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
110.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
111.	25764	*Tyto novaehollandiae (Masked Owl)*			
112.	24855	*Tyto novaehollandiae subsp. novaehollandiae (Masked Owl (southern subsp))*		P3	
113.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
Fish					
114.		*Edelia vittata*			
115.	34028	*Galaxias occidentalis (Western Minnow)*			
116.		*Nannoperca vittata*			
Invertebrate					
117.		*Aganippe rhaphiduca*			
118.		*Araneus cyphoxis*			
119.		*Araneus senicaudatus*			
120.		*Argiope protensa*			
121.		*Austracantha minax*			
122.		*Celaenia excavata*			
123.	33939	*Cherax cainii (Marron)*			
124.		*Cherax preissii*			
125.		*Cyclosa trilobata*			
126.		*Heurodes turritus*			
127.		*Latrodectus hasseltii*			
128.		*Longepi woodman*			
129.		*Missulena granulosa*			
130.		*Tasmanicosa leuckartii*			
131.		*Tetragnatha nitens*			
Mammal					
132.	24187	*Chalinolobus morio (Chocolate Wattled Bat)*			
133.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
134.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
135.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P4	
136.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P4	
137.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
138.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
139.	24223	*Mus musculus (House Mouse)*	Y		
140.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
141.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
142.	25508	*Phascogale tapoatafa (Brush-tailed Phascogale)*			
143.	24166	*Pseudocheirus occidentalis (Western Ringtail Possum)*		T	
144.	24243	*Rattus fuscipes (Western Bush Rat)*			
145.	24245	*Rattus rattus (Black Rat)*	Y		
146.	24111	*Sminthopsis gilberti (Gilbert's Dunnart)*			
147.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
148.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
Reptile					
149.	24990	*Aprasia pulchella (Granite Worm-lizard)*			
150.	24980	*Christinus marmoratus (Marbled Gecko)*			
151.	25096	*Egernia kingii (King's Skink)*			
152.	25117	*Hemiergis peronii subsp. peronii*			
153.	25118	*Hemiergis peronii subsp. tridactyla*			
154.	25192	*Morethia obscura*			
155.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
156.	25225	*Varanus rosenbergi (Heath Monitor)*			
157.	25526	*Varanus tristis (Racehorse Monitor)*			

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Appendix D – Flora Data

Flora species list

Quadrat and relevé data

Flora likelihood of occurrence assessment guidelines

Flora likelihood of occurrence assessment

Flora Species List – Greenbushes to Kirup Link

Family		*Taxon*	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Apiaceae									
		Platysace compressa		✓					
Asparagaceae									
	* W & DP	*Asparagus asparagoides*				✓	✓		
		Lomandra hermaphrodita		✓					
		Lomandra micrantha	✓		✓				
		Lomandra nigricans		✓					
		Lomandra preissii		✓					
		Lomandra purpurea	✓						
		Lomandra sericea		✓					
		Thysanotus manglesianus/patersonii			✓				
Asteraceae									
	*	*Conyza bonariensis*						✓	
	*	*Crepis capillaris*				✓	✓		
	*	*Hypochaeris glabra*	✓	✓	✓			✓	
		Lagenophora huegelii	✓						
	*	*Sonchus oleraceus*				✓		✓	
Boraginaceae									
		Burchardia congesta	✓						
Brassicaceae									
	*	*Brassica tournefortii*						✓	
Cyperaceae									
	*	*Cyprus congestus*						✓	
		Lepidosperma leptostachyum	✓						

Family		*Taxon*	VT01	VT02	VT03	VT04	VT05	VT06	VT07
		Lepidosperma sp.		✓					
		Tetraria octandra		✓					
Dasypogonaceae									
		Dasypogon bromeliifolius		✓					
Dennstaedtiaceae									
		Pteridium esculentum	✓	✓	✓			✓	✓
Dilleniaceae									
		Hibbertia amplexicaulis		✓	✓				
		Hibbertia hypericoides	✓	✓					
Droseraceae									
		Drosera sp.		✓					
Elaeocarpaceae									
		Platytheca galioides	✓						
Ericaceae									
		Leucopogon ?capitellatus			✓				
		Leucopogon propinquus		✓					
		Leucopogon verticillaris	✓		✓				
		Sphenotoma capitata	✓						
Fabaceae									
		Acacia alata	✓						
	*	*Acacia baileyana*				✓		✓	
		Acacia divergens		✓					
		Acacia extensa	✓	✓		✓			
	*	*Acacia longifolia*		✓					
		Acacia obovata							

Family		*Taxon*	VT01	VT02	VT03	VT04	VT05	VT06	VT07
		Acacia pulchella		✓		✓			
	*	*Acacia pycnantha*						✓	
		Acacia saligna						✓	
		Acacia stenoptera							
		Bossiaea linophylla			✓				
		Bossiaea ornata	✓	✓	✓				
		Hardenbergia comptoniana			✓				
		Hovea chorizemifolia	✓	✓					
		Jacksonia furcellata				✓			
		Kennedia prostrata			✓				✓
		Mirbelia dilatata	✓	✓					✓
Goodeniaceae									
		Dampiera linearis	✓						
		Scaevola calliptera		✓	✓				
Haemodoraceae									
		Haemodorum simplex			✓				✓
Hemerocallidaceae									
		Johnsonia lupulina	✓	✓					
Iridaceae									
	*	*Gladiolus caryophyllaceus*		✓					
		Patersonia occidentalis	✓	✓					
		Watsonia meriana var. *bulbillifera*	✓						✓
Juncaceae									
	*	*Juncus microcephalus*							
		Juncus pallidus				✓	✓		

Family		*Taxon*	VT01	VT02	VT03	VT04	VT05	VT06	VT07
Lamiaceae									
	*	*Mentha pulegium*					✓		
Malvaceae									
		Lasiopetalum floribunda	✓						
Myrtaceae									
		Agonis flexuosa						✓	
		Callistemon sp.						✓	
		Calothamnus sp.							✓
		Corymbia calophylla	✓	✓	✓	✓		✓	✓
		Eucalyptus marginata	✓	✓	✓	✓		✓	✓
		Eucalyptus rudis					✓	✓	
	*	*Eucalyptus* spp. (planted)						✓	
		Melaleuca sp. (sterile)		✓					
		Taxandria linearifolia						✓	
		Taxandria parviceps		✓					
Orchidaceae									
		Eriochilus dilatatus subsp. *multiflorus*			✓				
Orobanchaceae									
	*	*Orobanche minor*				✓			
Oxalidaceae									
	*	*Oxalis glabra*	✓		✓			✓	✓
Plantaginaceae									
	*	*Plantago lanceolata*				✓	✓		
Pinaceae									
	*	*Pinus pinaster*		✓				✓	✓

Family		*Taxon*	VT01	VT02	VT03	VT04	VT05	VT06	VT07
	*	*Pinus radiata*				✓			
Pittosporaceae									
		Billardiera heterophylla	✓			✓		✓	
Poaceae									
	*	*Avena* sp.				✓			
	*	*Bambusa textilis gracilis*						✓	
	*	*Briza maxima*	✓	✓	✓			✓	✓
	*	*Briza minor*	✓						
	*	*Cynodon dactylon*						✓	
	*	*Eragrostis curvula*						✓	✓
	*	*Poaceae* sp. (sterile)	✓	✓				✓	
Podocarpaceae									
		Podocarpus drouynianus	✓	✓					
Primulaceae									
	*	*Lysimachia arvensis*				✓	✓		
Proteaceae									
		Banksia dallanneyi		✓					✓
		Banksia grandis		✓	✓				
		Banksia nivea	✓						
		Hakea amplexicaulis	✓	✓					✓
		Hakea lissocarpha	✓						
		Hakea petiolaris						✓	
		Persoonia longifolia	✓		✓				✓
Ranunculaceae									
		Clematis linearifolia							✓

Family	*Taxon*	VT01	VT02	VT03	VT04	VT05	VT06	VT07
	Clematis pubescens			✓				
Restionaceae								
	Desmocladus fasciculatus		✓					✓
	Desmocladus flexuosus		✓					
	Hypolaena exsulca		✓					
	Leptocarpus scariosus	✓	✓					
Rhamnaceae								
	Trymalium odoratissimum subsp. *trifidum*							
Rubiaceae								
	Opercularia hispidula			✓				
	Opercularia vaginata			✓				
*W & DP	*Rubus ulmifolius*				✓	✓		
Solanaceae								
*	*Solanum nigrum*				✓		✓	
Thymelaeaceae								
	Pimelea suaveolens subsp. *suaveolens*	✓						
Violaceae								
	Hybanthus floribundus subsp. *floribundus*							
Xanthorrhoeaceae								
	Xanthorrhoea gracilis	✓	✓				✓	
	Xanthorrhoea preissii	✓	✓		✓		✓	✓
Zamiaceae								
	Macrozamia riedlei	✓	✓	✓			✓	✓

* - Denotes an introduced species

W - Weeds of National Significance (WONS)

DP - Declared Pests (BAM Act)

VEGETATION DATA SHEET:		Date: 16/05/2017	Site : Mullalyup Tank
Location:	Tank site, south of Cundinup Road		
MGA zone:	50	Easting: 399 580	Northing: 626 6755
Site type:	Quadrat 1	Dimensions: 10 m x 10 m	
Vegetation type: VT02			Observer: AB
Corymbia calophylla Eucalyptus marginata open forest *Banksia grandis* isolated trees *Taxandria parviceps Hibbertia hypericoides Podocarpus drouynianus* shrubland *Lomandra sericea Desmocladus fasciculatus* open herbland			Drainage: Good Landform: Plain Slope: Negligible Leaf litter: Plentiful
Condition: Very Good			Wood Litter: Plentiful
Disturbance: Weeds			Rocks: Laterite 6-20mm
Fire:	Old (> 5 yr)	Soil surface:	Humus/litter 80%
Fire intensity:	Minor, scars on some trees	Soil:	Loamy sand (orange/ brown)

Quadrat 1 Species List

Taxon	70-30%	30-10%	<10%	<2% N	<2% T <10	Ht (m)
Corymbia calophylla	✓					25
Eucalyptus marginata		✓				2
Banksia grandis			✓			3
Taxandria parviceps			✓			2
Acacia extensa				✓		1.5
Desmocladus flexuosus				✓		0.3

Taxon	70-30%	30-10%	<10%	<2% N	<2% T <10	Ht (m)
Hibbertia hypericoides				✓		1
Lomandra sericea				✓		0.5
Patersonia sp.				✓		1
Podocarpus drouynianus				✓		1
Xanthorrhoea gracilis				✓		1.5
Bossiaea ornata					✓	0.2
Desmocladus fasciculatus					✓	0.3
Drosera sp.					✓	cr
**Gladiolus caryophyllaceus*					✓	0.2
Hakea amplexicaulis					✓	1
Hovea chorizemifolia					✓	0.2
**Hypochaeris glabra*					✓	0.2
Johnsonia lupulina					✓	0.5
Lepidosperma sp.					✓	0.3
Leptocarpus scariosus					✓	0.5
Leucopogon propinquus					✓	0.4
Lomandra hermaphrodita					✓	0.3
Lomandra nigricans					✓	0.5
Macrozamia riedlei					✓	1
Myrtaceae sp. (sterile)					✓	1
Platysace compressa					✓	0.2
**Poaceae sp. (sterile)*					✓	0.2
Scaevola calliptera					✓	0.2
Tetraria/ Schoenus					✓	0.3
Acacia divergens						opp
**Acacia longifolia*						opp
Acacia pulchella						opp
Banksia dallanneyi						opp
**Briza maxima*						opp
Dasypogon bromeliifolius						opp
Hibbertia amplexicaulis						opp
Hypolaena exsulca						opp
Lomandra preissii						opp
Lomandra sericea						opp
Mirbelia dilatata						opp
**Pinus pinaster*						opp
Pteridium esculentum						opp
Xanthorrhoea preissii						opp

* denotes an introduced species
opp – opportunistic species

VEGETATION DATA SHEET:			Date: 17/05/2017	Site : South Alignment East
Location:	Cnr of Hay & Old Padbury Rd, North Greenbushes			
MGA zone:	50	Easting: 408 861	Northing:	625 7511
Site type:	Quadrat 2	Dimensions: 10 m x 10 m		
Vegetation type: VT03			Observer:	AB
Eucalyptus marginata Corymbia calophylla Banksia grandis open forest *Bossiaea linophylla* shrubland *Pteridium esculentum Lomandra sericea Desmocladus fasciculatus* open fernland/herbland.			Drainage:	Good
			Landform:	Plain
			Slope:	Negligible
			Leaf litter:	Plentiful
Condition: Very Good - Good			Wood Litter:	Plentiful
Disturbance: Weeds and gravel road nearby			Rocks:	Negligible
Fire:	Old (> 5 yr)	Soil surface:	Humus/litter 80%	
Fire intensity:	Minor, scars on some trees	Soil:	Loamy sand (orange/ brown)	

Quadrat 2 Species List

Taxon	70-30%	30-10%	<10%	<2% N	<2% T <10	Ht (m)
Corymbia calophylla	✓					25
Eucalyptus marginata		✓				2
Banksia grandis			✓			3
Taxandria parviceps			✓			2
Acacia extensa				✓		1.5
Desmocladus flexuosus				✓		0.3
Hibbertia hypericoides				✓		1

Taxon	70-30%	30-10%	<10%	<2% N	<2% T <10	Ht (m)
Lomandra sericea				✓		0.5
Patersonia sp.				✓		1
Podocarpus drouynianus				✓		1
Xanthorrhoea gracilis				✓		1.5
Bossiaea ornata					✓	0.2
Desmocladus fasciculatus					✓	0.3
Drosera sp.					✓	cr
**Gladiolus caryophyllaceus*					✓	0.2
Hakea amplexicaulis					✓	1
Hovea chorizemifolia					✓	0.2
**Hypochaeris glabra*					✓	0.2
Johnsonia lupulina					✓	0.5
Lepidosperma sp.					✓	0.3
Leptocarpus scariosus					✓	0.5
Leucopogon propinquus					✓	0.4
Lomandra hermaphrodita					✓	0.3
Lomandra nigricans					✓	0.5
Macrozamia riedlei					✓	1
Myrtaceae sp. (sterile)					✓	1
Platysace compressa					✓	0.2
**Poaceae* sp. (sterile)					✓	0.2
Scaevola calliptera					✓	0.2
Tetraria/ Schoenus					✓	0.3
Acacia divergens						opp
Acacia longifolia						opp
Acacia pulchella						opp
Banksia dallanneyi						opp
**Briza maxima*						opp
Dasypogon bromeliifolius						opp
Hibbertia amplexicaulis						opp
Hypolaena exsulca						opp
Lomandra preissii						opp
Lomandra sericea						opp
Mirbelia dilatata						opp
**Pinus pinaster*						opp
Pteridium esculentum						opp
Xanthorrhoea preissii						opp

* denotes an introduced species
opp – opportunistic species

VEGETATION DATA SHEET:		Date: 16/05/2017	Site : Kirup Dam Bypass
Location:	Near Castle Street towards Kirup Dam		
MGA zone:	50	Easting: 397 059	Northing: 626 8979
Site type:	Relevé 1	Dimensions: NA	
Vegetation type: VT01			Observer: AB
Eucalyptus marginata Corymbia calophylla open forest *Hibbertia hypericoides Hakea lissocarpha* shrubland *Patersonia occidentalis Lepidosperma leptostachyum* open herbland			Drainage: Good
			Landform: Mid-slope
			Slope: Moderate
			Leaf litter: Plentiful
Condition: Good - Degraded			Wood Litter: Plentiful
Disturbance: Weeds and a gravel road occupies most of the site (80 %)			Rocks: Coarse gravel
Fire:	Old (> 5 yr)	Soil surface:	Lateritic gravel
Fire intensity:	Minor, scars on some trees	Soil:	Loamy sand (orange/ brown)

Relevé 1 Species List

Taxon
Corymbia calophylla
Eucalyptus marginata
**Briza maxima*
**Briza minor*
Hakea lissocarpha
Hibbertia hypericoides

Taxon
**Hypochaeris glabra*
Lepidosperma leptostachyum
Leptocarpus scariosus
Mirbelia dilatata
Patersonia occidentalis
**Poaceae* sp. (sterile)
Pteridium esculentum
Xanthorrhoea gracilis
Acacia alata
Dampiera linearis
Hakea amplexicaulis
Hovea chorizemifolia
Johnsonia lupulina
Macrozamia riedlei
Persoonia longifolia
Platytheca galioides
Podocarpus drouynianus
Acacia extensa
Banksia nivea
Billardiera heterophylla
Bossiaea ornata
Burchardia congesta
Lagenophora huegelii
Lasiopetalum floribunda
Leucopogon verticillaris
Lomandra micrantha
Lomandra purpurea
**Oxalis glabra*
Pimelea suaveolens subsp. *suaveolens*
Sphenotoma capitata
**Watsonia meriana* var. *bulbillifera*
Xanthorrhoea preissii

* denotes an introduced species
opp – opportunistic species

VEGETATION DATA SHEET:			Date: 17/05/2017	Site : South Alignment West
Location:	Old Padbury Road			
MGA zone:	50	Easting:	408 132	Northing: 625 8021
Site type:	Relevé 2	Dimensions:	NA	
Vegetation type: VT04				Observer: AB
*Eucalyptus marginata Corymbia calophylla *Pinus radiata* open forest *Xanthorrhoea preissii* isolated shrubs **Rubus ulmifolius* shrubland				Drainage: Good
				Landform: Mid-slope
				Slope: Undulating
				Leaf litter: Plentiful
Condition: Degraded				Wood Litter: Plentiful
Disturbance: Dominated by Declared Weeds and WONS				Rocks: Coarse gravel
Fire:	Old (> 5 yr)	Soil surface:	Lateritic gravel	
Fire intensity:	Minor, scars on some trees	Soil:	Loamy sand (orange/ brown)	

Relevé 2 Species List

Taxon
**Acacia baileyana*
Acacia extensa
Acacia pulchella
**Asparagus asparagoides* (WON & DP)
**Avena* sp.
Billardiera heterophylla
**Briza maxima*

Taxon
Corymbia calophylla
**Crepis capillaris*
Eucalyptus marginata
Eucalyptus rudis
Jacksonia furcellata
Juncus pallidus
**Lysimachia arvensis*
**Mentha pulegium*
**Orobanche minor*
**Oxalis glabra*
**Pinus radiata*
**Plantago lanceolata*
**Rubus ulmifolius* (WONS & DP)
**Solanum nigrum*
Xanthorrhoea preissii

* denotes an introduced species
opp – opportunistic species

VEGETATION DATA SHEET:			Date: 17/05/2017	Site : South Alignment West	
Location:	Old Padbury Road				
MGA zone:	50	Easting:	407 895	Northing:	625 8191
Site type:	Relevé 3	Dimensions:	NA		
Vegetation type: VT05				Observer:	AB
Eucalyptus marginata Corymbia calophylla Banksia grandis open forest *Bossiaea linophylla* shrubland *Pteridium esculentum Lomandra sericea Desmocladus fasciculatus* open fernland/herbland.				Drainage:	Good
				Landform:	Drainage depression
				Slope:	NA
				Leaf litter:	Plentiful
Condition: Degraded				Wood Litter:	Plentiful
Disturbance: Dominated by Declared Weeds and WONS				Rocks:	Coarse gravel
Fire:	Old (> 5 yr)		Soil surface:	Lateritic gravel	
Fire intensity:	Minor, scars on some trees		Soil:	Loamy sand (orange/ brown)	

Relevé 3 Species List

Taxon
**Asparagus asparagoides* (WONS & DP)
Corymbia calophylla
**Crepis capillaris*
Eucalyptus rudis
Juncus pallidus
**Lysimachia arvensis*
**Mentha pulegium*
**Orobanche minor*

Taxon
**Oxalis glabra*
**Plantago lanceolata*
**Rubus ulmifolius* (WONS & DP)
**Solanum nigrum*
Xanthorrhoea preissii

* denotes an introduced species

VEGETATION DATA SHEET:		Date:	17/05/2017	Site :	New Cirilo Road Option
Location:	South West Highway, Mullalyup				
MGA zone:	50	Easting:	401 946	Northing:	626 6014
Site type:	Relevé 4	Dimensions:	NA		
Vegetation type: VT06				Observer:	AB
*Eucalyptus marginata Corymbia calophylla *Pinus radiata* open forest *Xanthorrhoea preissii* isolated shrubs **Rubus ulmifolius* shrubland				Drainage:	Good
				Landform:	Plain
				Slope:	Negligible
				Leaf litter:	Plentiful
Condition: Degraded				Wood Litter:	Plentiful
Disturbance: Weeds, Fire and gravel tracks				Rocks:	Coarse gravel
Fire:	Recent (<1 yr)	Soil surface:	Lateritic gravel		
Fire intensity:	Minor, scars on most trees	Soil:	Loamy sand (orange/ brown)		

Relevé 4 Species List

Taxon
Banksia dallanneyi
**Brassica tournefortii*
**Briza maxima*
**Calothamnus* sp.
Clematis linearifolia
Conyza bonariensis
Corymbia calophylla

Taxon
**Eragrostis curvula*
Eucalyptus marginata
Haemodorum simplex
Hakea amplexicaulis
**Hypochaeris glabra*
Kennedia prostrata
Macrozamia riedlei
Mirbelia dilatata
**Oxalis glabra*
Persoonia longifolia
**Pinus pinaster*
**Poaceae* sp. (sterile)
Pteridium esculentum
**Solanum nigrum*
**Sonchus oleraceus*
**Watsonia meriana* var. *bulbillifera*
Xanthorrhoea gracilis
Xanthorrhoea preissii

* denotes an introduced species

VEGETATION DATA SHEET:			Date: 17/05/2017	Site : New Cirilo Road Option	
Location:	South West Highway, Mullalyup				
MGA zone:	50	Easting:	402 622	Northing:	626 5444
Site type:	Relevé 5	Dimensions:	NA		
Vegetation type: VT07				Observer:	AB
Eucalyptus rudis open woodland *Xanthorrhoea preissii* isolated shrubs **Rubus ulmifolius* shrubland.				Drainage:	Good
				Landform:	Plain
				Slope:	Negligible
				Leaf litter:	Plentiful
Condition: Degraded to Completely Degraded/Cleared				Wood Litter:	Plentiful
Disturbance: Weeds, gravel tracks, infrastructure				Rocks:	Coarse gravel
Fire:	Old (>5 yr)		Soil surface:	Lateritic gravel	
Fire intensity:	No damage		Soil:	Loamy sand (orange/ brown)	

Relevé 5 Species List

Taxon
**Acacia baileyana*
**Acacia pycnantha*
Acacia saligna
Agonis flexuosa
**Bambusa textilis gracilis*
Billardiera heterophylla
**Brassica tournefortii*
**Briza maxima*

Taxon
**Callistemon* sp.
**Conyza bonariensis*
Corymbia calophylla
**Cynodon dactylon*
**Cyprus congestus*
Desmocladus fasciculatus
**Eragrostis curvula*
Eucalyptus marginata
Eucalyptus rudis
**Eucalyptus* spp.(unidentified)
Hakea amplexicaulis
Hakea petiolaris
**Hypochaeris glabra*
Kennedia prostrata
Macrozamia riedlei
Mirbelia dilatata
**Oxalis glabra*
Persoonia longifolia
**Pinus pinaster*
**Poaceae* sp. (sterile)
Pteridium esculentum
**Solanum nigrum*
**Sonchus oleraceus*
Taxandria linearifolia
Xanthorrhoea gracilis
Xanthorrhoea preissii

* denotes an introduced species

Flora likelihood of occurrence assessment guidelines

Likelihood of occurrence	Guideline
Known	Species recorded within study area from field survey results.
Likely	Species previously recorded within 2 km and large areas of suitable habitat occur in the study area.
Possible	Species previously recorded within 2 km and areas of suitable habitat occur/may occur in the study area.
Unlikely	Species previously recorded within 2 km, but suitable habitat does not occur in the study area.
Highly unlikely	Species not previously recorded within 2 km, suitable habitat does not occur in the study area and/or the study area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Source information - desktop searches

PMST – DotE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within the study area

NM – DBCA NatureMap (accessed May 2017)

Flora likelihood of occurrence assessment for conservation significant flora

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–, DotE 2017)	Likelihood of Occurrence	Source
		WC Act	EPBC Act			
Proteaceae	*Banksia squarrosa subsp. argillacea*	T		Erect, open, non-lignotuberous shrub, 1.2-4 m high. Flowers yellow, Jun to Nov. White/grey sand, gravelly clay or loam. Winter-wet flats, clay flats	Unlikely – there is no suitable habitat present in the survey area and the closest known record is ~ 3.5 km away.	NM
Orchidaceae	*Caladenia harringtoniae*	T	Vu	Tuberous, perennial, herb, 0.2-0.4 m high. Flowers. pink, Oct to Nov. Sandy loam. Winter-wet flats, margins of lakes, creeklines, granite outcrops	Unlikely – there is no suitable habitat present in the survey area and the closest known record is ~ 5 km away	PMST
Orchidaceae	*Caladenia hoffmanii*	T	En	Tuberous, perennial, herb, 0.13-0.3 m high. Flowers green & yellow & red, Aug to Oct. Clay, loam, laterite, granite. Rocky outcrops and	Highly Unlikely – there is no suitable habitat present in the survey area and the closest known record is >100 km away.	PMST

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–, DotE 2017)	Likelihood of Occurrence	Source
		WC Act	EPBC Act			
				hillsides, ridges, swamps and gullies		
Orchidaceae	*Caladenia huegelii*	T	En	Tuberous, perennial, herb, 0.25-0.6 m high. Flowers green & cream & red, Sep to Oct. Grey or brown sand, clay loam	Unlikely – there is no suitable habitat present in the survey area and the closest known record is ~ 30 km away.	PMST
Orchidaceae	*Diuris micrantha*	T	Vu	Tuberous, perennial, herb, 0.3-0.6 m high. Flowers yellow & brown, Sep to Oct. Brown loamy clay. Winter-wet swamps, in shallow water	Highly Unlikely – there is no suitable habitat present in the survey area and the closest known record is > 60 km away.	PMST
Orchidaceae	*Eleocharis keigheryi*	T	Vu	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Flowers green, Aug to Nov. Clay, sandy loam. Emergent in freshwater: creeks, claypans	Highly Unlikely – there is no suitable habitat present in the survey area and the closest known record is > 30 km away.	PMST
Myrtaceae	*Melaleuca viminalis*	P2		Slender erect shrub, with weeping branches. 1-4 m high Flowers red, Nov-May. Sandy clay	Unlikely – there is no suitable habitat present in the survey area and the closest known record is ~ 3.5 km away.	NM
Hemerocallidaceae	*Johnsonia inconspicua*	P3		Rhizomatous, tufted perennial, grass-like or herb, 0.1-0.3 m high, to 0.2 m wide. Flowers green-white/pink, Oct to Nov. White-grey or black sand. Low dunes, winter-wet flats	Unlikely – there is no suitable habitat present in the survey area and the closest known record is ~ 2.5 km away.	NM
Rubiaceae	*Opercularia rubioides*	P3		Perennial, herb or shrub, 0.04-0.45 m high. Flowers green-cream-white, Sep to Nov. White/grey sand, gravelly sandy clay, sandy loam. Floodplains, stony hills, flat plains	Unlikely – there is no suitable habitat present in the survey area and the closest known record is ~ 4 km away.	NM
Cyperaceae	*Tetraria* sp. Blackwood River (A.R. Annels 3043)	P3		Sedge up to 40 cm high which grows in wetlands and on the edges of creeklines.	Likely – limited habitat is available but the species is cryptic and the closest known record is ~ 50 m away.	NM

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–, DotE 2017)	Likelihood of Occurrence	Source
		WC Act	EPBC Act			
Elaeocarpaceae	*Tetratheca parvifolia*	P3		Small shrub, 0.2-0.3 m high. Flowers pink, Oct. Gravelly soil	Possibly – suitable habitat was found within the survey area. The closest known record is ~ 5 km away.	NM
Proteaceae	*Grevillea ripicola*	P4		Spreading, much-branched, non-lignotuberous shrub, 0.6-2(-3) m high, to 4 m wide. Flowers red/red-orange, Jan or Mar to Apr or Nov to Dec. Sandy clay, clay or gravelly loam. Swampy flats, granite outcrops, along watercourses	Unlikely – there is no suitable habitat present in the survey area and the closest known record is ~ 3.5 km away.	NM

Appendix E - Fauna data

Fauna species list

Fauna likelihood of occurrence assessment guidelines

Fauna likelihood of occurrence assessment

Fauna species list

Scientific Name	Common Name	Status (State/Federal)
Amphibians		
Crinia georgiana	Quacking frog	
Crinia signifera	Clicking froglet	
Geocrinia leai	Ticking frog	
Heleioporus eyrei	Moaning frog	
Birds		
Acanthiza inornata	Western Thornbill	
Anthochaera carunculata	Red Wattlebird	
Barnardius zonarius	Twenty-eight Parrot	
Cacomantis pallidus	Pallid Cuckoo	
Calyptorhynchus banksii subsp. *naso*	Forest Red-tailed Black-Cockatoo	Vu, Vu
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	En, Vu
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	En, En
Colluricincla harmonica	Grey Shrike-thrush	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	
Corvus coronoides	Australian Raven	
Cracticus tibicen	Australian Magpie	
Dacelo novaeguineae	Laughing Kookaburra	*
Daphoenositta chrysoptera	Varied Sittella	
Dromaius novaehollandiae	Emu	
Eolophus roseicapillus	Galah	
Gerygone fusca	Western Gerygone	
Grallina cyanoleuca	Magpie-lark	
Lichenostomus virescens	Singing Honeyeater	
Lichmera indistincta	Brown Honeyeater	
Malurus splendens	Splendid Fairy-wren	
Myiagra inquieta	Restless Flycatcher	
Pachycephala rufiventris	Rufous Whistler	
Pardalotus striatus	Striated Pardalote	
Petroica boodang	Scarlet Robin	
Phylidonyris niger	White-cheeked Honeyeater	
Phylidonyris novaehollandiae	New Holland Honeyeater	
Platycercus icterotis subsp. *icterotis*	Western Rosella	
Polytelis anthopeplus	Regent Parrot	
Purpureicephalus spurius	Red-capped Parrot	
Rhipidura albiscapa	Grey Fantail	
Rhipidura leucophrys	Willie Wagtail	
Smicrornis brevirostris	Weebill	
Trichoglossus haematodus	Rainbow Lorikeet	*
Mammals		

Scientific Name	Common Name	Status (State/Federal)
Bos taurus	European Cattle	*
Canis lupus subsp. *familiaris*	Domestic Dog	*
Felis catus	Cat	*
Macropus fuliginosus	Western Grey Kangaroo	
Mus musculus	House Mouse	*
Oryctolagus cuniculus	Rabbit	*
Rattus fuscipes	Bush Rat	
Trichosurus vulpecula	Common Brushtail Possum	
Vulpes vulpes	Fox	*

*introduced species

See Appendix B for conservation codes

Parameters of fauna likelihood of occurrence assessment

Assessment outcome	Description
Likely	Species are **likely** to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area. OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 5 km of the survey area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. • The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR Those species that have a known distribution overlapping with the survey area however: • There is limited habitat in the survey area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). • The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the survey area include: • Those species that have no suitable habitat within the survey area. • Those species that have become locally extinct, or are not known to have ever been present in the region of the survey area.

Source information - desktop searches

PMST – DotEE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within the survey area

DBCA – DBCA 2017. WA Government, Department of Parks and Wildlife Threatened and Priority fauna rankings (current as of 6 January 2017) - *Wildlife Conservation Act 1950*

NM – DBCA NatureMap (accessed May2017)

Fauna likelihood of occurrence assessment

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
Birds							
Calyptorhynchus latirostris (Carnaby's Black Cockatoo)	En	En	X	X	X	This species mainly occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland dominated by *Hakea*, *Banksia* and *Grevillea* species. The species also occurs in forests containing Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) or Karri (*E. diversicolor*). Breeding usually occurs in the western Wheatbelt region of WA, with flocks moving to the higher rainfall coastal area to forage after the breeding season. Feeds on the seeds of a variety of native plants, including *Allocasuarina*, *Banksia*, *Eucalyptus*, *Grevillea* and *Hakea*, and some introduced plants (DSEWPaC, 2012).	**Known** Several flocks were observed feeding in and flying over the survey area. The habitat within the survey area is suitable for foraging and contains potential breeding trees.
Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)	Vu	Vu	X	X	X	Forest Red-tailed Black Cockatoo typically occurs in dense Jarrah (*Eucalyptus marginata*), Karri (*E. diversicolor*) and Marri (*Corymbia calophylla*) forests, however the species also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt, Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DSEWPaC, 2012). Habitats also tend to have an understorey of *Banksia spp., Persoonia spp., Allocasuarina* spp. The Forest red-tailed Black Cockatoo generally nests in hollows in live or dead trees of Marri, Karri, Wandoo, Bullich, Blackbutt, Tuart and Jarrah (DSEWPaC 2012).	**Known** One flock was observed loafing in the survey area and there was numerous evidence of fresh and old foraging on Marri nuts. The habitat within the survey area is suitable for foraging and contains potential breeding trees.

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
Calyptorhynchus baudinii (Baudin's Cockatoo)	Vu	En	X	X	X	Baudin's Black Cockatoo occurs in high-rainfall areas, usually at sites that are heavily forested and dominated by Marri (*Corymbia calophylla*) and Eucalyptus species, especially Karri (*E. diversicolor*) and Jarrah (*E. marginata*). The species also occurs in woodlands of Wandoo (*E. wandoo*), Blackbutt (*E. patens*), Flooded Gum (*E. rudis*), and Yate (*E. cornuta*). Baudin's Black Cockatoo breeds in the Jarrah, Marri and Karri forests of the deep south-west in areas averaging more than 750 mm of rainfall annually. The range of the species extends from Albany to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Boyup Brook. Preferred roosts are in areas with a dense canopy close to permanent water sources that provide the birds with protection from weather conditions (DSEWPaC, 2012).	**Known** Several individuals were observed in the survey area. The habitat within the survey area is suitable for foraging and contains potential breeding trees.
Falco peregrinus (Peregrine Falcon)		S	X			The Peregrine Falcon is seen occasionally anywhere in the south-west of WA. It is found everywhere from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions. The species nests primarily on ledges of cliffs, shallow tree hollows, and ledges of building in cities (Morcombe, 2004).	**Likely – irregular visitor** The woodland within the survey area is suitable for foraging for the Peregrine Falcon.
Merops ornatus (Rainbow Bee-eater)		IA	X		X	The Rainbow Bee-eater is found throughout the state except in desert regions, particularly in open forests and woodlands, with sandy, loamy soil, but also sandridges, sandpits, riverbanks, mangroves, rainforest shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. They also inhabit sand dune systems in coastal areas and at inland sites that are in close proximity to water (Morcombe 2004; Pizzey and Knight 2012). They dig out nests	**Likely – seasonal visitor** There is suitable habitat and recent records located within the survey area. The species is a seasonal spring breeding migrant in south-western Australia.

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
						in open areas where there is relatively soft but firm sands, either on flat ground or in the side of a sandy bank (Nevill 2013).	
Ninox connivens subsp. *connivens* (Barking Owl Southern subsp.)		P2	X		X	The southwest subspecies of the Barking Owl is found in the deep south-west region and is very scarce (Nevill 2013). Barking Owls are found in open woodlands and the edges of forests, often adjacent to farmland. They are less likely to use the interior of forested habitat. They are usually found in habitats that are dominated by eucalyptus species, particularly Marri. They prefer woodlands and forests with a high density of large trees and particularly sites with hollows that are used by the owls as well as their prey. Habitat preference is strongly biased towards areas that provide a high density of large trees greater than 60 cm diameter and a high density of hollow trees of a range of sizes, including large hollows greater than 15 cm diameter which are suitable nesting places. Roost sites are often located near waterways or wetlands.	**Likely – occasional visitor** The woodland habitat in the survey area is considered to be moderate value to the barking owl due to the low density of large hollow-bearing trees. The nearest record is located approximately 31 km from the survey area.
Oxyura australis (Blue-billed Duck)		P4			X	The blue-billed Duck is a small Australian almost entirely aquatic duck, with both the male and female growing to a length of 40 cm. The male has a slate-blue bill which changes to bright-blue during the breeding season. The Blue-billed Duck is endemic to Australia's temperate regions, ranging from the south west of WA, extending to southern Queensland, through New South Wales and Victoria, to Tasmania. The species is readily seen on freshwater lakes and billabongs where deep fresh water is present (Morcombe 2004).	**Unlikely** There is no suitable habitat within the survey area for the Blue-billed Duck, although there are nearby areas where the species may occur. The nearest record is located within 1 km of the survey area.
Tyto novaehollandiae subsp. *novaehollandiae*		P3	X		X	The Masked Owl is found across a range of habitats from wet sclerophyll forest, dry sclerophyll forest, non-eucalypt dominated forest, scrub and	**Likely**

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
(Masked Owl southern subsp.)						cleared land with remnant old growth trees. There are however several aspects of habitat preference which appear to be common: the Masked Owl requires large hollows in old growth eucalypts for nesting; it often favours areas with dense understorey or ecotones comprising dense and sparse ground cover, they are often recorded foraging within 100-300 m of the boundary of two vegetation types (Bell & Mooney, 2002).	The woodland habitat in the survey area is considered to be moderate value to the barking owl due to the low density of large hollow-bearing trees (limited nesting habitat). There is a recent NatureMap record located within the survey area.
Mammals							
Falsistrellus mackenziei (Western False Pipistrelle)		P4			X	The Western False Pipistrelle occurs in wet sclerophyll forest dominated by Karri (Eucalyptus diversicolor), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) dry sclerophyll forests. The species is restricted to areas in or adjacent to stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*Corymbia. calophylla*), Sheoak (*Casuarina huegeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (Churchill 2008; McKenzie and Start 1999).	**Likely** There is suitable woodland habitat for this species in the survey area and the nearest record is located approximately 12 km away.
Dasyurus geoffroii (Western Quoll, Chuditch)	Vu	Vu	X	X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, *Eucalyptus marginata*), dry woodland and mallee shrublands. In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Most diurnal resting sites in sclerophyll forest consist of hollow logs or earth burrows (Van Dyke & Strahan, 2008). The species can travel large distances, has a large home range	**Likely** There is suitable woodland habitat for this species in the survey area and there is a recent NatureMap record located within the survey area.

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
						and is sparsely populated through a large portion of its range.	
Phascogale tapoatafa subsp. *tapoatafa* (Southern Brush-tailed Phascogale)		Vu				Found in dry, open sclerophyll forests and woodlands with a generally sparse ground-storey, which contain suitable nesting resources such as tree hollows, rotted stumps and tree cavities. Records are less common in high rainfall areas in both the north and south of WA (DEC 2012). This species is one of the most arboreal dasyurids and seldom feed on the ground. Foraging success is greatest on mature trees, large logs and dead standing trees with rough bark. An individual can use more than 40 nests in a single year, including hollow trees, rotted stumps, house ceilings and bird nests (Van Dyck and Strahan 2008).	**Likely** There is suitable woodland habitat for this species in the survey area and the nearest record is located approximately 5 km away.
Pseudocheirus occidentalis (Western Ringtail Possum)	Vu	Cr	X	X	X	Ideal habitat for the Western Ringtail Possum comprises long unburnt mature remnants of peppermint (*Agonis flexuosa*) woodlands with high canopy continuity; others comprise of jarrah (Eucalyptus marginata)/marri (*Corymbia calophylla*) forests and woodlands with adequate hollows, coastal heath, myrtaceous heaths and shrublands, Bullich (*E. megacarpa*) dominated riparian zones and karri forests. Populations are associated with swamps, water courses or floodplains, and at topographic low points which provide cooler, often more fertile conditions. Their current distribution is patchy and largely restricted to the moister south-western corner of WA, especially in the Australind/Eaton area to Waychinicup National Park. The Upper Warren area east of Manjimup is the only place the possum survives in the absence of coastal peppermint. Persistence in translocation sites has only been at Karakamia Sanctuary, Perup	**Unlikely** There is some suitable woodland habitat (e.g. hollow-bearing trees) for this species in the survey area and the nearest records are located within 5 km (1997 and 2014). The survey area was thoroughly searched for dreys (nests) and scats however no evidence of Western Ringtail Possum was observed during the survey. Previous records of Western Ringtail Possums are sparsely scattered in the local region. The Western Ringtail Possum may potentially occur in native vegetation surrounding the survey area however the population density is likely to be very low.

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
						Sanctuary and Yalgorup National Park (DBCA 2014; TSSC 2013; Van Dyck and Strahan 2008).	
Setonix brachyurus (Quokka)	Vu	Vu		X	X	The Quokka prefer dense forests and thickets, streamside vegetation, heaths and shrublands of *Agonis linearifolia*-dominated swamps in the Jarrah (*Eucalyptus marginata*) forest. The northern extent of the current distribution on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, to southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 millimetres or more (Van Dyck and Strahan, 2008).	**Unlikely** There is no suitable habitat within the survey area for the Quokka, due to the absence of areas with dense understorey vegetation The nearest record is located approximately 6 km away.
Myrmecobius fasciatus (Numbat)	Vu	En	X	X	X	Current Numbat populations occupy several different habitat types: upland Jarrah forest, open eucalypt woodland, banksia woodland and tall closed shrubland. The only remaining original subpopulations are at Dryandra Woodland and the Upper Warren area (including Tone Perup Nature Reserve, Greater Kingston National Park and adjoining State Forest). In WA there are nine translocation sites, including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (see DBCA 2015 for complete list and details). At Dryandra, numbats inhabit brown mallet (*Eucalyptus astringens*) plantations. Habitats usually have an abundance of termites in the soil, and hollow logs, tree hollows, burrows and branches for shelter (DotEE 2017; Van Dyck and Strahan 2008).	**Unlikely** There are no remaining populations of the Numbat in the Donnybrook to Bridgetown region.

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
Hydromys chrysogaster (Water Rat)		P4	X		X	The Water Rat lives in the vicinity of permanent bodies of fresh, brackish, or marine water, lakes and farm dams, and on sheltered coastal beaches, mangroves and offshore islands. In the south-west of WA they have been shown to prefer areas with riparian vegetation, better water quality and a degree of habitat complexity. Woody debris, rock ledges and wetland islands are likely to be important areas for feeding and refuge (DEC 2012). It is an occasional vagrant to temporary waters. Water Rat's dens are made at the end of tunnels in banks and occasionally in logs (Van Dyck and Strahan 2008).	**Unlikely** There is no suitable habitat within the survey area.
Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)		P4	X		X	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan, 2008).	**Likely** There is suitable woodland habitat within the survey area and the species was previously recorded (Astron Environmental Services 2013). The Quenda would typically prefer areas with a dense understorey, such as the riparian vegetation in the Southern Alignment.
Macropus irma (Western Brush Wallaby)		P4	X		X	The Western Brush Wallaby is a grazer found primarily in open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest. This species was once very common in the south-west of WA but has undergone a reduction in range and a significant decline in abundance in its current habitat. (Van Dyke & Strahan, 2008).	**Likely** There is suitable woodland habitat for this species in the survey area and there is a recent NatureMap record located within the survey area.

Species Name	Status		Desktop Search			Description and habitat requirements	Likelihood
	EPBC Act Status	WA Status	NM	PMST	DBCA – South West		
Reptiles							
Ctenotus delli (Dell's Skink)		P4			X	The Perth Slider is locally restricted to the Swan Coastal Plain south of the Swan River, including Rottnest and Garden Islands, where it inhabits coastal dunes, *Banksia*/eucalypt woodlands and suburban gardens. There are also isolated populations on the mid-west coast at Woodleigh Station and in Busselton (Wilson and Swan 2013).	**Unlikely** The survey area is outside the known distribution of the Dell's Skink. The nearest NatureMap record to the survey area is an error in the database.

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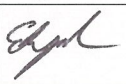
6135763-12616/https://projects.ghd.com/oc/WesternAustralia/cs02767greenbushesto/Delivery/Documents/6135763-REP-B_Flora_Fauna_Report.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	A Benkovic L Zimmermann	A Napier E Lynch		D Farrar		16/08/17

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Memorandum

15 August 2017

To	Water Corporation		
Copy to			
From	Erin Lynch	Tel	+61 8 6222 8316
Subject	Additional Survey Area - Black Cockatoo Trees	Job no.	6135763

1 Introduction

1.1 Project background

The Water Corporation proposes to construct new infrastructure to improve the supply of water to the towns of Balingup, Mullalyup and Kirup, as a component of the broader Warren Blackwood Water Supply Scheme. This will potentially involve clearing of vegetation and fauna habitat for the construction and installation of this infrastructure.

A previous Spring Flora and Fauna Survey Report was prepared by Astron Environmental Services in 2013 covering the majority of the project area (Astron 2013), however since that time, the location of some of the components of the project have changed. As a result, a further survey of the areas not previously covered was required to identify the key ecological values. This survey was conducted by GHD in May 2017 (GHD 2017). It has since been identified that some segments along the original survey area had not been thoroughly surveyed for Black Cockatoo habitat trees.

GHD was commissioned by the Water Corporation to undertake a targeted Black Cockatoo Tree survey for segments along the proposed alignment not previously surveyed by GHD. The purpose of the survey was to ensure potential Black Cockatoo habitat trees have been identified within the survey boundary and recorded. The results of this assessment will be used to assess the ecological impact of the project, assist with the project design (refining the disturbance footprint) and inform the environmental approvals process.

The limitations and assumptions outlined in the GHD biological assessment report (GHD 2017) also apply to this memorandum.

1.2 Survey area

The survey areas are located within the Shires of Donnybrook – Balingup and Bridgetown – Greenbushes, between the towns of Mullalyup and Greenbushes (Figure 1). The combined length of the survey areas is approximately 4.6 km with a width of approximately 12 m.

2 Survey methodology

Two GHD ecologists, Erin Lynch and Angela Benkovic undertook a targeted Black Cockatoo tree survey within the survey areas on the 8-9 August 2017. The tree survey was conducted in accordance with the EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) *Calyptorhynchus latirostris*, Baudin's Cockatoo (Vulnerable) *Calyptorhynchus*

baudinii, and Forest Red-tailed Black Cockatoo (Vulnerable) *Calyptorhynchus banksii naso*, (Department of Sustainability, Environment, Water, Populations, and Communities (DSEWPaC 2012).

The assessment included the identification, description and recording of:

- Potential and actual breeding habitat (relevant tree species with a DBH of >500 mm for Jarrah, Marri and Flooded Gum (*Eucalyptus rudis*) or DBH of >300 mm for Wandoo or Salmon Gum
- Existing tree hollows and any evidence of use by Black Cockatoos (a suitable nesting hollow currently able to support breeding was defined as a tree hollow with an entrance diameter greater than 100-150 mm which would allow entry of a Black Cockatoo)
- The diameter at breast height (DBH) of trees with existing hollows
- Potential night roosting habitat and foraging evidence.

3 Results – Black Cockatoo Trees

The Black Cockatoo tree survey identified 222 potential breeding trees of suitable DBH (Jarrah and Marri >500 mm) from within or immediately adjacent to the survey area (Figure 1). Trees of this size are considered to have nesting potential now, or will develop hollows within 100 years. Of the 222 trees, 36 were identified with potentially suitable hollows for Black Cockatoo nesting (with a hollow diameter greater than 100-150 mm, to allow entry of Black Cockatoo).

The size of a hollow is an estimate as the assessment was undertaken from ground level, there is the potential for the actual hollow size to be greater than 100 mm. In addition there may be more hollows present which could not be identified from ground level. None of the trees recorded showed signs of breeding or roosting by Black Cockatoos. There was however old and fresh foraging evidence on Marri nuts (Forest Red-tailed Black Cockatoo) observed along the alignment.

4 References

Astron Environmental Services 2013, *Greenbushes to Kirup Pipeline Route Vegetation, Flora and Fauna Assessment*, unpublished report prepared for Water Corporation, October 2013.

DSEWPaC 2012, *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species: Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest red-tailed Black Cockatoo*, Canberra, Department of Sustainability, Environment, Water, Population and Communities.

GHD 2017, *Greenbushes to Kirup Link Biological Assessment*, unpublished report prepared for Water Corporation, August 2017.

Regards

pp

Erin Lynch
Ecologist

LEGEND

Black Cockatoo Habitat

- Marri (*Corymbia calophylla*) – no hollows
- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Marri (*Corymbia calophylla*) – hollows
- Local Road
- Additional Survey Area

Paper Size A4

0 25 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

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Water Corporation
Greenbushes to Kirup Link EIA and Approvals
Additional Survey Area

Job Number 61-35763-01
Revision A
Date 16 Aug 2017

Black Cockatoo Observations

Figure 1

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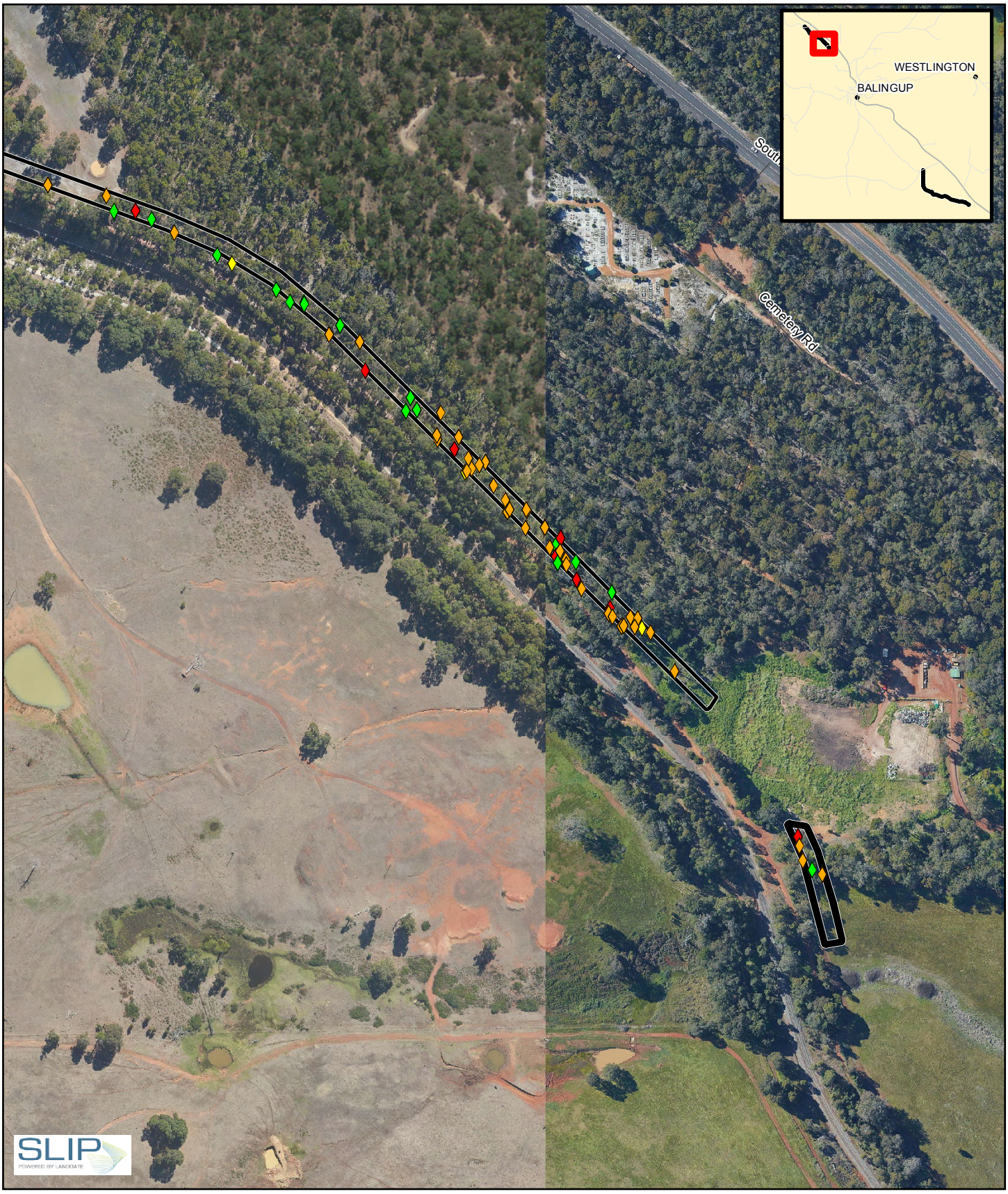
Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson



LEGEND

Black Cockatoo Habitat

- Marri (*Corymbia calophylla*) – no hollows
- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Marri (*Corymbia calophylla*) – hollows
- Local Road
- Additional Survey Area

Paper Size A4

0 25 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Water Corporation
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Additional Survey Area

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Black Cockatoo Observations

Figure 1

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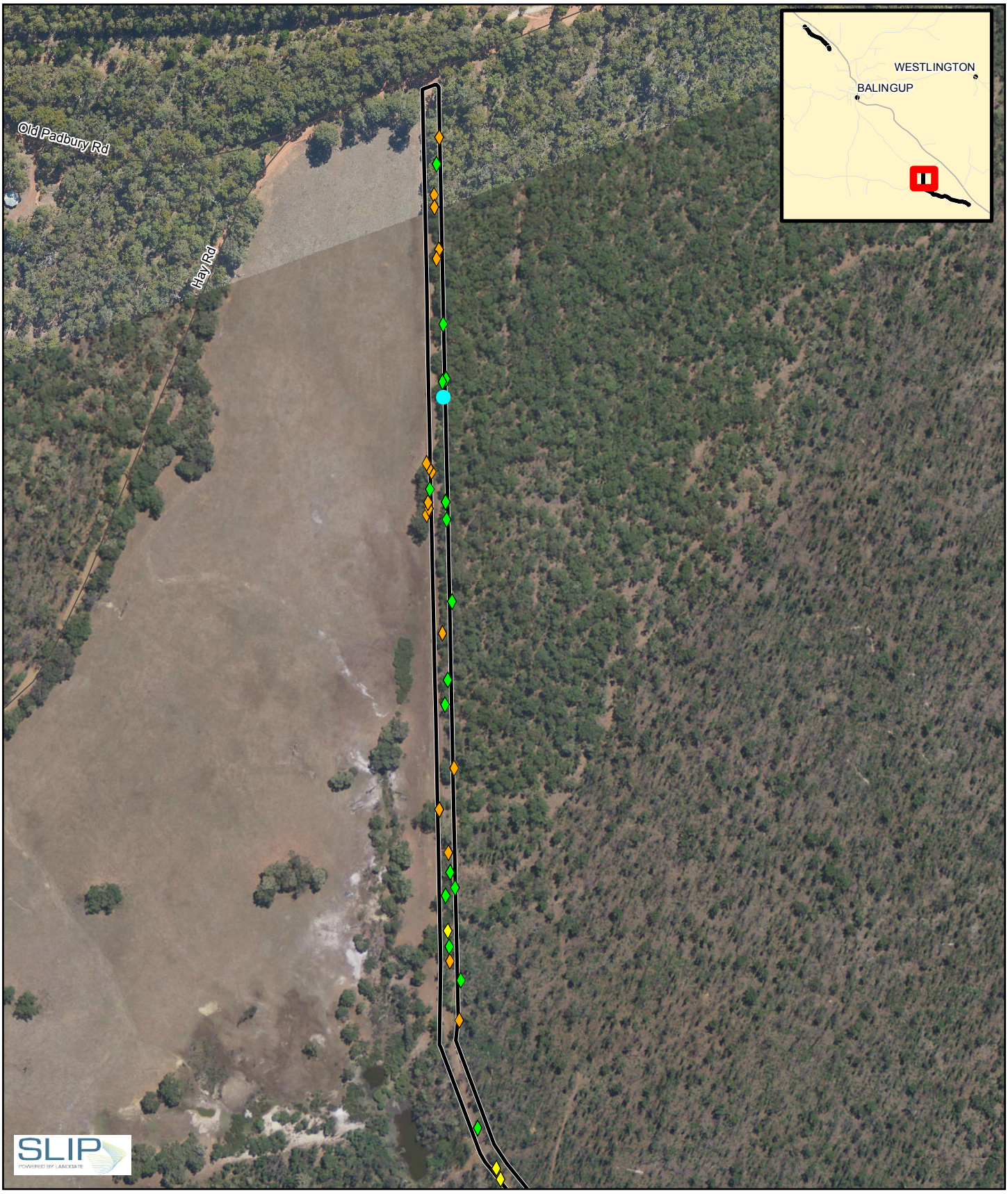
Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson



LEGEND

Black Cockatoo Habitat

- Marri (*Corymbia calophylla*) – no hollows
- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Local Road
- Additional Survey Area

Paper Size A4

0 25 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Water Corporation
Greenbushes to Kirup Link EIA and Approvals
Additional Survey Area

Job Number 61-35763-01
Revision A
Date 16 Aug 2017

Black Cockatoo Observations

Figure 1

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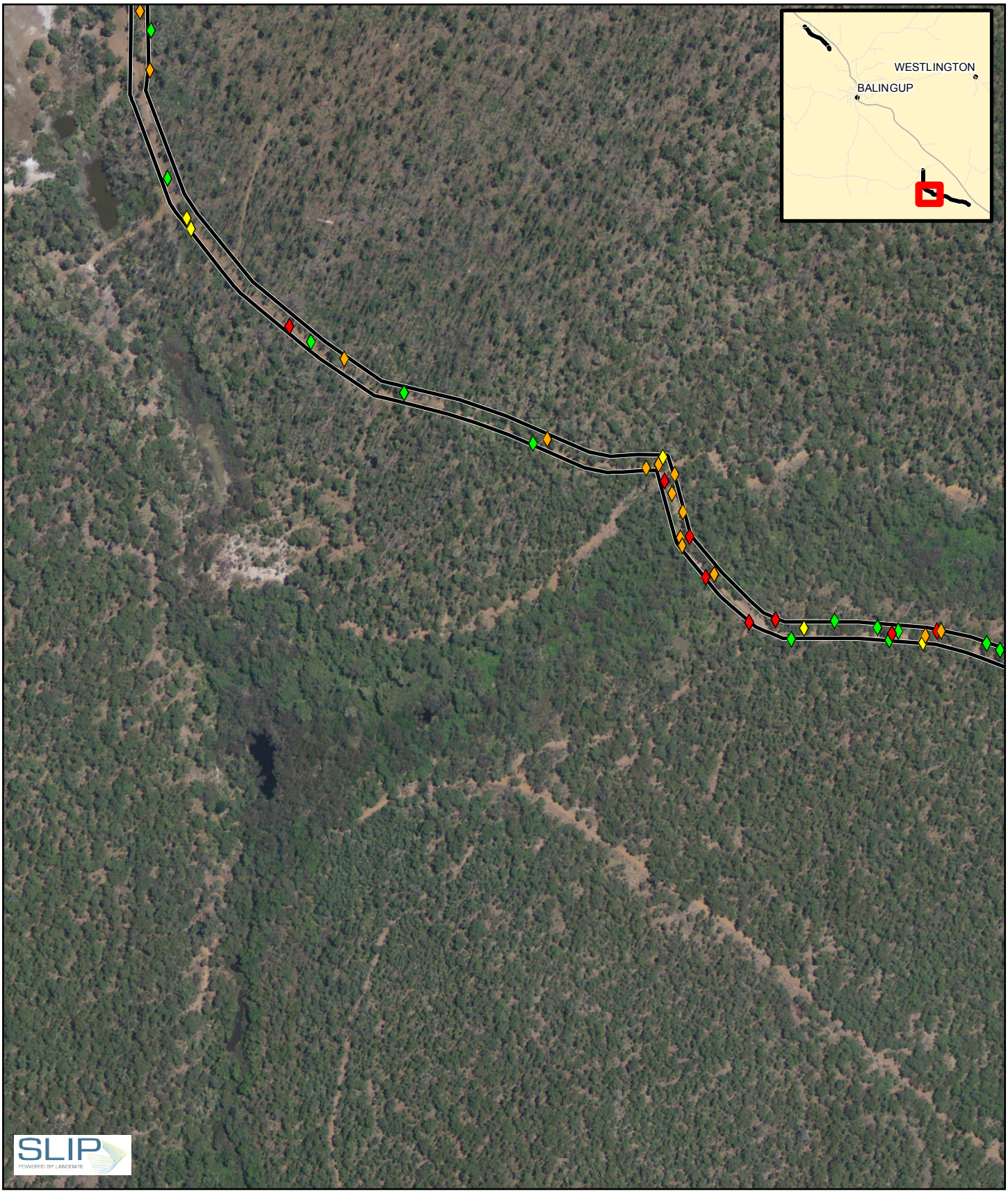
Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson



LEGEND

Black Cockatoo Habitat

- Marri (*Corymbia calophylla*) – no hollows
- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Marri (*Corymbia calophylla*) – hollows
- Additional Survey Area

Paper Size A4

0 25 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

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Greenbushes to Kirup Link EIA and Approvals
Additional Survey Area

Job Number 61-35763-01
Revision A
Date 16 Aug 2017

Black Cockatoo Observations

Figure 1

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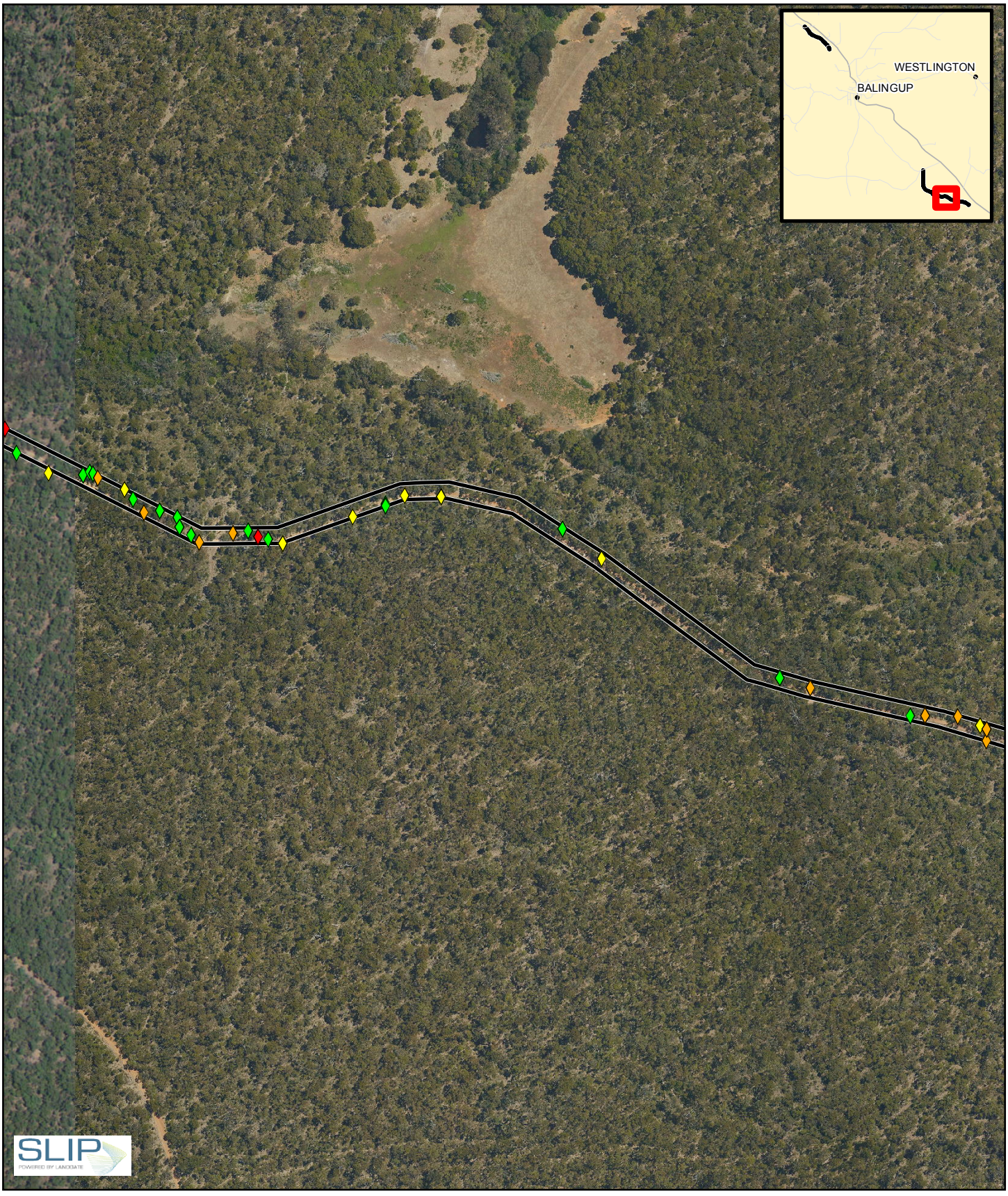
999 Hay Street, Perth WA 6000 Australia **T** 61 8 6222 8555 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data source: Landgate: Virtual Mosaic, Roads - 20170525; Water Corporation: Survey Area - 20170511; GHD: Black Cockatoo Habitat, Fauna Observations, Sample Locations - 20170525, Created by:krawlinson



LEGEND

Black Cockatoo Habitat

- Marri (*Corymbia calophylla*) – no hollows
- Jarrah (*Eucalyptus marginata*) – no hollows
- Jarrah (*Eucalyptus marginata*) – hollows
- Marri (*Corymbia calophylla*) – hollows
- Additional Survey Area

Paper Size A4

0 25 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

WATER CORPORATION

Water Corporation
Greenbushes to Kirup Link EIA and Approvals
Additional Survey Area

Job Number 61-35763-01
Revision A
Date 16 Aug 2017

Black Cockatoo Observations

Figure 1

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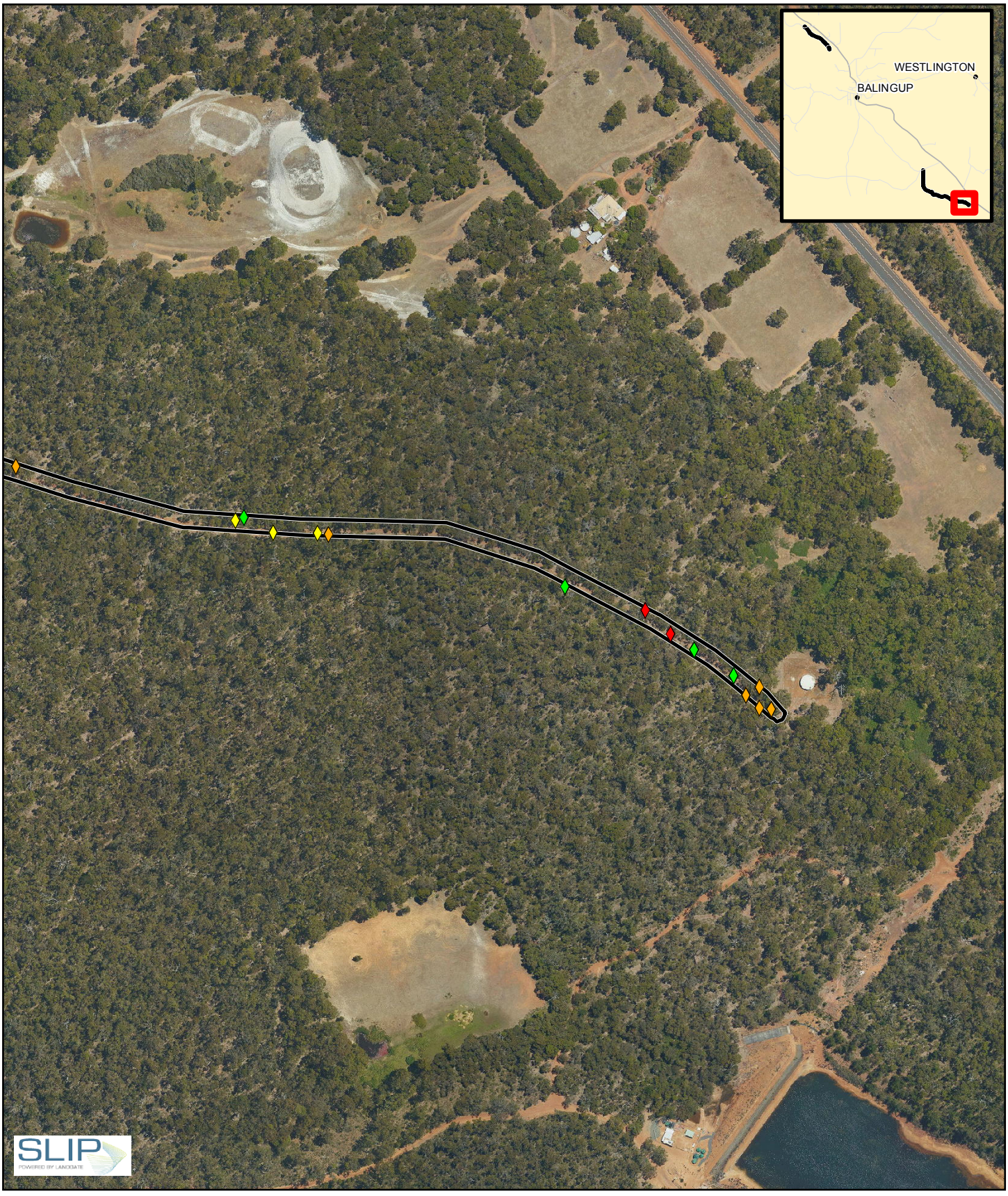

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