

Burroloo Well Nature Reserve (R42)
Environmental Assessment
2022



Prepared for: Department of Biodiversity, Conservation and Attractions
(DBCA)
Perth Hills District
District Nature Conservation Program

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EXECUTIVE SUMMARY

This report has been prepared by Del Botanics on behalf of Department of Biodiversity, Conservation and Attractions (DBCA) to review remnant flora, fauna and vegetation within Burroloo Well Nature Reserve (R42). A site survey was undertaken on 9th November 2022. The site is approximately 57 kilometres north of the Perth central area, in the Shire of Chittering.

Burroloo Well Nature Reserve (R42) consists of approximately 10.0 hectares of Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) woodland, Wandoo (*Eucalyptus wandoo*) woodland and a low lying dampland. The purpose of this reserve is to conserve the flora and fauna.

The vegetation within Burroloo Well Nature Reserve (R42) ranges from “Degraded” to “Very Good” condition with a number of invasive weeds recorded. During the site visits, vegetation communities were broadly mapped and described by recording the dominant tree species and other upper-level flora species. The vegetation described on site can be categorised into three broad vegetation communities.

Burroloo Well Nature Reserve (R42) is a conservation reserve for the protection of flora and fauna. The reserve is currently in predominantly good condition and provides a valuable habitat for fauna with diverse habitats and an array of flora species.

STATEMENT OF LIMITATIONS

This environmental report has been prepared in accordance with the scope of services set out in the original quotation. In preparing the report, Del Botanics has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Del Botanics has not verified the accuracy or completeness of the data to the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Del Botanics will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed.

In accordance with the scope of services, Del Botanics has have relied on publically available data and information supplied by DBCA and have conducted environmental field monitoring in the preparation of the report. The nature and extent of monitoring conducted is described in the report. Within the limitations imposed by the scope of services, the monitoring and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care. No other warranty, express or implied, is made.

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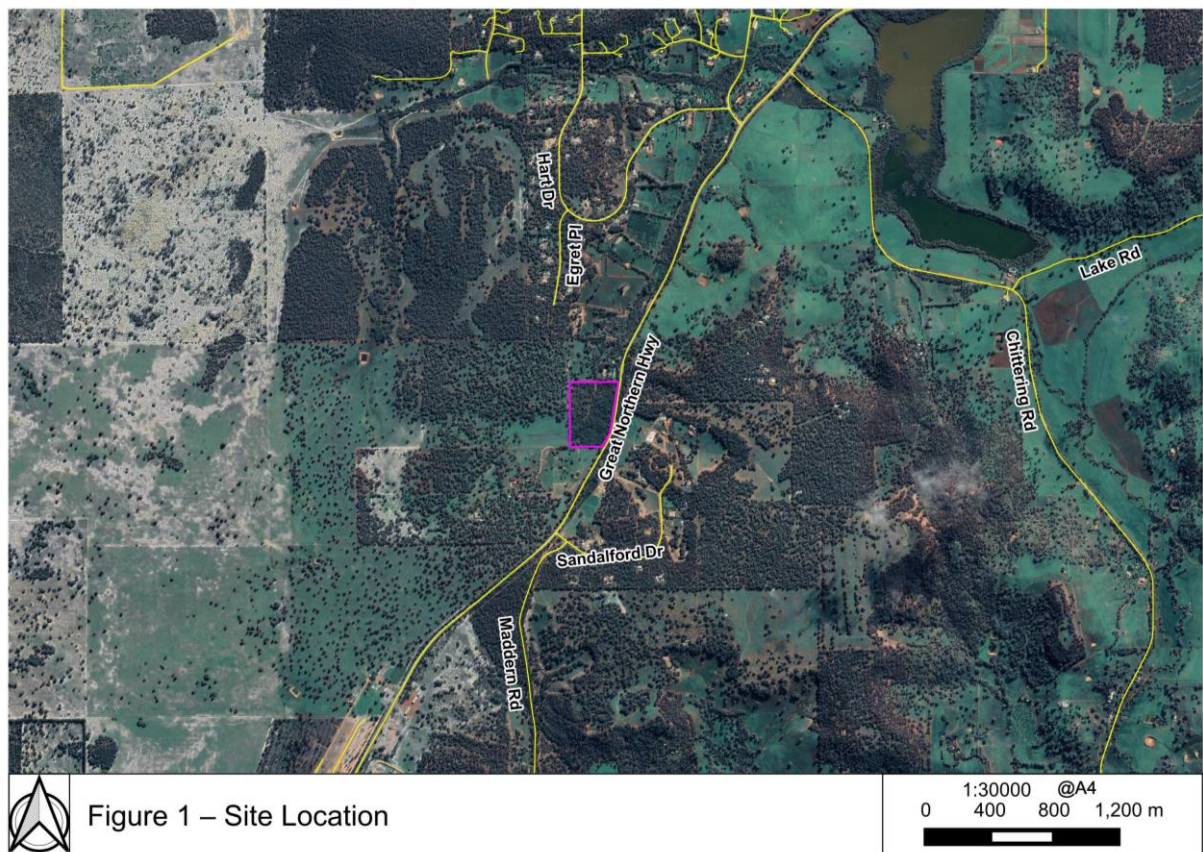
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1. INTRODUCTION

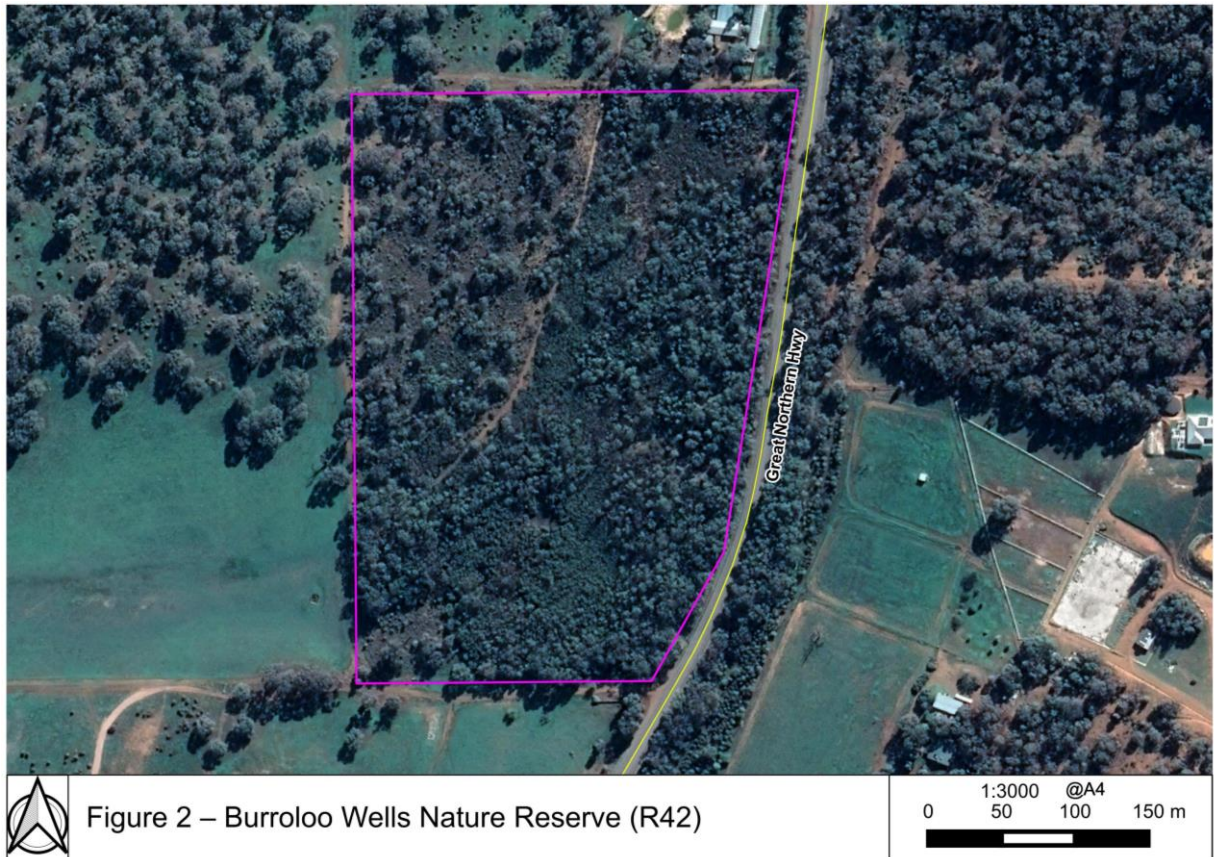
1.1 BURROLOO WELL NATURE RESERVE (R42)

This report has been prepared by Del Botanics on behalf of Department of Biodiversity, Conservation and Attractions (DBCA) to review remnant flora, fauna and vegetation at Burroloo Well Nature Reserve (R42). A site survey was undertaken on 9th November 2022. The site is approximately 57 kilometres north of the Perth central area, in the Shire of Chittering. The location of the site is shown on **Figure 1** below.



The Shire of Chittering covers an area of approximately 1,200 square kilometres, along the northeastern fringe of the Perth metropolitan area. The Shire has a unique landscape of large areas of untouched bushland, state forest, wetlands, and industrial and commercial estates.

Burroloo Well Nature Reserve (R42) is approximately 7.0 km north of the Chittering town site and is shown on **Figure 2** below. The purpose of this reserve is for the conservation of flora and fauna. Burroloo Well Nature Reserve (R42) consists of approximately 10 hectares of Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) Woodland with a small pocket of Wandoo (*Eucalyptus wandoo*) in the northern section of the reserve and a dampland running through the center of the reserve in a north south direction.



1.2 HISTORY

The Shire of Chittering was first established as the Chittering Brook Road District on 10 January 1896, it was renamed the Chittering Road District on 7 February that year. On 1 July 1961, it became a Shire following the enactment of the Local Government Act 1960, which reformed all remaining road districts into Shires. The local economy is based on broad-acre farming, orchards, small rural and semi-rural lifestyle residential properties. There is limited industry, being extractive industry operations (gravel, clay and sand), the state livestock yards (WAMIA), mineral sands processing (Tronox), tourist attractions, viticulture and wineries and other small businesses.



Photo 1: Burroloo Well Nature Reserve (R42)

2. EXISTING ENVIRONMENT

2.1 SOILS AND LANDFORMS

2.1.1 Landforms

Burroloo Well Nature Reserve occurs on the uplands of the Darling Plateau. The Darling Scarp is the steep rise in topography from the eastern edge of the Swan Coastal Plain up to the hills. The terms Darling Scarp and Darling Plateau go together as official physiographic divisions, the Scarp being restricted to the relatively steep western termination of the Plateau (the local surface expression of the Darling Fault), while the Plateau extends well to the east. The scarp extends for almost 1000 km, from east of Shark Bay, in the State's northwest, to Point D'Entrecasteaux on the south coast. Rapid erosion of the rocks along the scarp prior to the Cretaceous period has caused the scarp to retreat 1–3 km inland of the actual line of the fault. The Darling Scarp is a major and ancient geological discontinuity separating

the Archaean Yilgarn Craton in the east from the younger Pinjarra Orogen and overlying Phanerozoic Perth Basin to the west (Gozzard, 2007).

The Darling Plateau uplands consist of a mosaic of open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla*, with some admixtures with *Eucalyptus laeliae* in the north (subhumid zone), with occasional *Eucalyptus marginata* subsp. *elegantella* (mainly in subhumid zone) and *Corymbia haematoxylon* in the south (humid zone) on deeper soils adjacent to outcrops, woodland of *Eucalyptus wandoo* (subhumid and semiarid zones), low woodland of *Allocasuarina huegeliana* on shallow soils over granite outcrops, closed heath of Myrtaceae-Proteaceae species and lithic complex on or near granite outcrops in all climate zones (DataWA, 2023).

2.1.2 Soils

The soils which occur within Burroloo Well Nature Reserve are part of the Gabbla 1x phase (253Ga). These soils occur on very gently to moderately sloping valleys (<10-15%) and consist of alluvial and colluvial soils. The soils are yellow with some red, duplex soils that are often finely layered and highly prone to salinity (DataWA, 2023).

2.2 VEGETATION

The survey area lies in the Drummond Botanical Subdistrict within the Southwest Botanical Province as described by Beard (1990). Flora composition has been described by Beard (1990) as predominantly consisting of Banksia low woodlands on leached sands with Melaleuca swamps where ill drained and woodlands of Eucalyptus spp. on less leached soils. This area has been described by Beard (1990) as the Northern Jarrah Forrest Botanical District.

The updated mapping system IBRA (Interim Biogeographic Regionalisation for Australia) was developed in 1993-94 and is endorsed by all levels of government as a key tool for identifying land for conservation under Australia's Strategy for the National Reserve System 2009-2030.

The nationally agreed regionalisation was published in Thackway and Cresswell (1995), An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves.

The latest version, IBRA7, classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. The IBRA description of vegetation for this area is best categorised as Jarrah Forest.

The southwest of Western Australia has been divided into districts, known as Natural Resource Zones, which are determined by their vegetation type, drainage/catchment system and rainfall. The Shire of Chittering is part of the Northern Jarrah Forrest Vegetation Zone. (Cresswell, 1995)

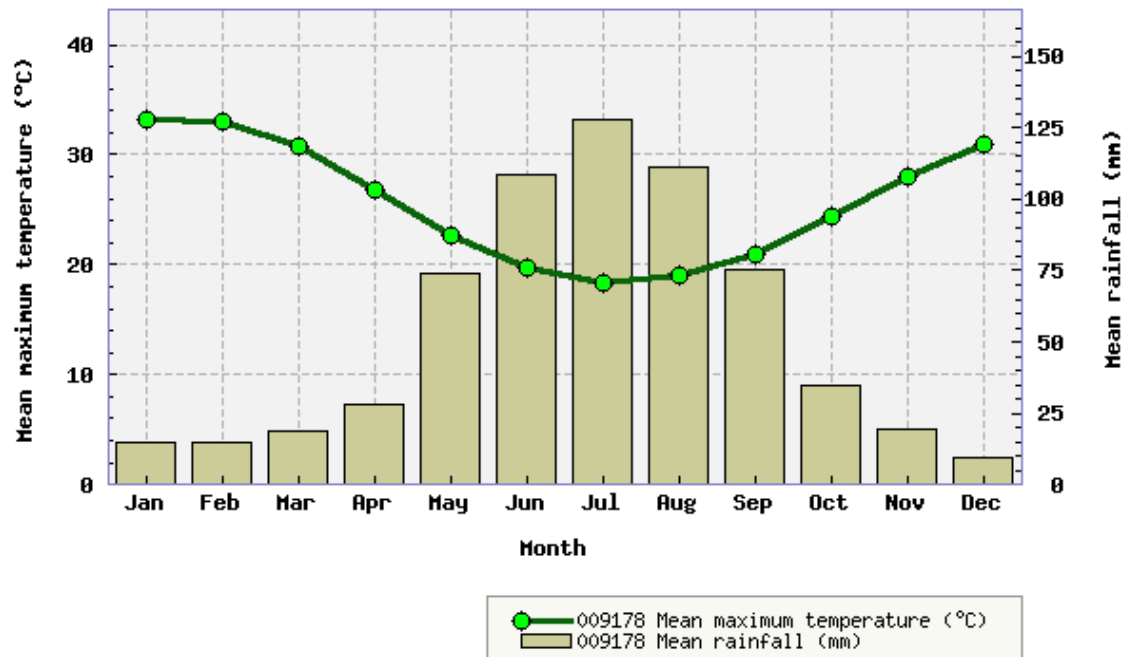
Vegetation complexes are based on the pattern of vegetation at a regional scale as they reflect the underlying key determining factors of landforms, soils and climate. The Perth and Peel Regions are spread over two IBRA regions, the Swan Coastal Plain and Jarrah Forest. The Jarrah Forest IBRA region can be divided into two sub-regions, the Northern Jarrah Forest, and the Southern Jarrah Forest. The Perth and Peel Region extends only to the Northern Jarrah Forest IBRA sub-region. Burroloo Well NR falls within the Northern Jarrah Forest sub region (Havel, 2000).

2.3 CLIMATE

The Shire's climate consists of a warm Mediterranean climate with hot dry summers and mild wet winters. The Shire of Chittering's closest weather station is at the Gingin Aero site no. 9178, which is approximately 20.4km from the survey area. The average rainfall per annum recorded from 1996 to 2022 is 620mm. The average maximum temperatures range from 33.2°C in January and 18.4°C in July, while average minimum temperatures range from 17.1°C in February to 6.5°C in July.

The survey was undertaken in November 2022, which followed a few months of significant rainfall, hence why there was a lot of water still visible and a number of flora species in flower. It was noted that 2022 overall had a decrease in rainfall from 2021 by 232.20mm (BoM, 2023).

Location: 009178 GINGIN AERO



Australian Government
Bureau of Meteorology

Created on Mon 16 Jan 2023 14:28 PM AEDT

Graph 1: Shire of Chittering annual weather data

3. FLORA, FAUNA AND VEGETATION

3.1 FLORA

The site is dominated by Jarrah (*Eucalyptus marginata*) Marri (*Corymbia calophylla*) woodland with occurrences of Wandoo woodland in the north east and a dampland in the low-lying areas. There is low species diversity across the site with high densities of weed species along the fence line boundaries adjoining private properties and in the degraded areas.

A species list is available in **Appendix A**, this provides a list of dominant flora species identified during the field survey.

3.1.1 Threatened flora

A search of the Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database identified six Threatened (T), seven Priority 4 (P4), thirteen Priority 3 (P3), eleven Priority 2 (P2), and three Priority 1 (P1) species within a 10 km radius, that are likely to occur within the area. These species are listed in **Table 1** below.

Table 1: NatureMap listed flora species

Taxon	Conservation Status	WA Ranking
<i>Acacia anarthros</i>	3	
<i>Acacia anomala</i>	T	
<i>Acacia cummingiana</i>	3	
<i>Acacia drummondii</i> subsp. <i>affinis</i>	3	
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	3	
<i>Acacia pulchella</i> var. <i>reflexa acuminata bracteole variant</i>	3	
<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i>	3	
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	4	
<i>Calothamnus pachystachyus</i>	4	
<i>Caustis gigas</i>	2	
<i>Chamelaucium lullfitzii</i>	T	VU
<i>Cyanicula ixioides</i> subsp. <i>candida</i>	2	
<i>Darwinia</i> sp. Bindoon	1	
<i>Eryngium pinnatifidum</i> subsp. <i>umbraphilum</i>	2	
<i>Eucalyptus exilis</i>	4	
<i>Gastrolobium crispatum</i>	1	
<i>Gastrolobium nudum</i>	2	
<i>Grevillea corrugata</i>	T	VU
<i>Halgania corymbosa</i>	3	
<i>Hibbertia glomerata</i> subsp. <i>ginginensis</i>	2	
<i>Hibbertia miniata</i>	4	
<i>Hypocalymma sylvestre</i>	T	EN

<i>Hypolaena robusta</i>	4	
<i>Lasiopetalum caroliae</i>	3	
<i>Millotia tenuifolia</i> var. <i>laevis</i>	2	
<i>Netrostylis</i> sp. Chandala	2	
<i>Oxymyrrhine coronata</i>	4	
<i>Persoonia rudis</i>	3	
<i>Poranthera moorokatta</i>	2	
<i>Ptychosema pusillum</i>	T	VU
<i>Schoenus griffinianus</i>	4	
<i>Senecio gilbertii</i>	1	
<i>Stylidium longitubum</i>	4	
<i>Stylidium squamellosum</i>	2	
<i>Styphelia allittii</i>	3	
<i>Tetratheca pilifera</i>	3	
<i>Thelymitra stellata</i>	T	EN
<i>Thelymitra variegata</i>	2	
<i>Thysanotus</i> sp. Badgingarra	2	
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	4	
<i>Verticordia rutilastra</i>	3	
<i>Verticordia serrata</i> var. <i>linearis</i>	3	

A search of the Department of Agriculture, Water and the Environment (DAWE) Protected Matters database identified twenty-seven flora species of significance within a 10 km radius, which are likely to occur within the area. Six flora species have been listed as Vulnerable, nineteen species are listed as Endangered and two are listed as Critically Endangered. These species are listed in **Table 2** below.

Table 2: DAWE Protected Matters listed flora species

Genus /Species	Common Name	Priority
<i>Acacia anomala</i>	Grass Wattle, Chittering Grass Wattle	Vulnerable
<i>Andersonia gracilis</i>	Slender Andersonia	Endangered
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	Dwarf Green Kangaroo Paw	Vulnerable
<i>Banksia mimica</i>	Summer Honeypot	Endangered
<i>Caleana dixonii</i>	Sandplain Duck Orchid	Endangered (listed as <i>Paracaleana dixonii</i>)
<i>Chamelaucium lullfitzii</i>	Gingin Wax	Endangered (listed as <i>Chamelaucium</i> sp. Gingin (N.G.Marchant 6))
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	One-headed Smokebush	Endangered
<i>Darwinia carnea</i>	Mogumber Bell, Narrogin Bell	Endangered
<i>Darwinia foetida</i>	Muchea Bell	Critically Endangered
<i>Diplolaena andrewsii</i>		Endangered
<i>Diuris drummondii</i>	Tall Donkey Orchid	Vulnerable
<i>Diuris purdiei</i>	Purdie's Donkey-orchid	Endangered

<i>Drakaea elastica</i>	Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid	Endangered
<i>Eleocharis keigheryi</i>	Keighery's Eleocharis	Vulnerable
<i>Eucalyptus leprophloia</i>	Scaly Butt Mallee, Scaly-butt Mallee	Endangered
<i>Goodenia arthrotricha</i>		Endangered
<i>Grevillea corrugata</i>		Endangered
<i>Grevillea curviloba</i> subsp. <i>curviloba</i>	Curved-leaf Grevillea	Endangered
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Narrow curved-leaf Grevillea	Endangered
<i>Grevillea flexuosa</i>	Zig Zag Grevillea	Vulnerable
<i>Hypocalymma sylvestre</i>		Endangered
<i>Macarthuria keigheryi</i>	Keighery's Macarthuria	Endangered
<i>Melaleuca sciotostyla</i>	Wongan Melaleuca	Endangered
<i>Ptychosema pusillum</i>	Dwarf Pea	Vulnerable
<i>Synaphea</i> sp. Fairbridge Farm	Selena's Synaphea	Critically Endangered
<i>Thelymitra dedmaniarum</i>	Cinnamon Sun Orchid	Endangered
<i>Thelymitra stellata</i>	Star Sun-orchid	Endangered

3.1.2 Weeds

Invasive plants are widespread in fragmented landscapes that have been highly modified, and where nutrient enrichment of soils and frequent disturbance encourages the establishment of weeds over native vegetation. Established weeds compete with native plants, affecting their recruitment and survival, therefore reducing the habitat quality for native fauna.

Grassy weeds can also increase the flammability of the vegetation, increasing fire frequency and intensity. Once established, weeds become a long-term and potentially costly management issue.

Weed densities are low on average across the site, however there are areas of high weed densities, in particular grass weeds along the boundary and *Watsonia* in the dampland. There was one area recorded with Cape Tulip, this area is shown on **Figure 4**. DBCA historic records indicated that large areas of the site were previously infested with *Watsonia*, Cape Tulip and Lupins, however the weed densities have reduced over time with weed control and only small areas of *Watsonia* and Cape Tulip were recorded during the site visit.

Weeds are dominant along the edges of the reserve, adjacent to roads and private properties and scattered throughout the reserve. Weed control may be applied to the areas along the boundary fence lines and roads, however due to weed infestations occurring on neighbouring properties weeds may continue to be an issue. It is important to minimise the encroachment of weeds into bushland areas. Most of the dominant weeds are grasses. Dense weed locations were recorded and are shown on **Figure's 4 & 5**.



Photo 2: Weeds adjacent to the reserve on neighbouring private properties

3.2 FAUNA

This reserve is an important stepping stone of native vegetation in this landscape as most of the natural bushland has been cleared. The site has a variety of fauna habitats available with large trees containing hollows, a natural stream, fallen logs and dense understorey for ground dwelling fauna. During the survey a number of bird species were observed, as well as scats from Emu's and Kangaroo's. There was evidence of Black Cockatoo foraging within the reserve. A species list is available in **Appendix B**, this provides a list of fauna species identified during the field survey.

3.2.1 *Threatened Fauna.*

A search of the Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database identified twenty priority species within a 10 km radius, which are likely to occur within the area. Of these, two are listed as MI (Migratory), three are listed as Vulnerable (VU), two are listed as Endangered (EN), one is listed as Priority 2 (P2) one is listed as Priority 3 (P3) and three as Priority 4 (P4) species. The list is provided in **Table 3** below.

Table 3: NatureMap listed fauna species

Taxon	Common Name	WA Status	EPBC Status
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	MI	MI
<i>Calyptorhynchus banksii naso</i>	Forest red-tailed black cockatoo	VU	VU
<i>Calyptorhynchus latirostris</i>	Carnaby's cockatoo	EN	EN
<i>Calyptorhynchus sp. 'white-tailed black cockatoo'</i>	White-tailed black cockatoo	EN	EN
<i>Dasyurus geoffroii</i>	Chuditch, western quoll	VU	VU
<i>Idiosoma mccllementsorum</i>	Julimar shield-backed trapdoor spider	P2	
<i>Idiosoma sigillatum</i>	Swan Coastal Plain shield-backed trapdoor spider	P3	
<i>Isoodon fusciventer</i>	Quenda, southwestern brown bandicoot	P4	
<i>Notamacropus irma</i>	Western brush wallaby	P4	
<i>Oxyura australis</i>	Blue-billed duck	P4	
<i>Tringa nebularia</i>	Common greenshank	MI	MI
<i>Westralunio carteri</i>	Carter's freshwater mussel	VU	VU

A search of the Department of Agriculture, Water and the Environment (DAWE) Protected Matters database identified ten fauna species of significance likely to occur within a 10km radius of the reserve. Two fauna species are listed as Critically Endangered, three species are listed as Endangered and five species are listed as Vulnerable. These species are listed in **Table 4** below.

Table 4: DAWE Protected Matters listed fauna species

Genus /Species	Common Name	Priority
<i>Calidris ferruginea</i>	Curlew Sandpiper	Critically Endangered
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo, Karrak	Vulnerable
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable
<i>Numenius madagascariensis</i>	Eastern Curlew, Far Eastern Curlew	Critically Endangered
<i>Rostratula australis</i>	Australian Painted Snipe	Endangered
<i>Zanda latirostris</i>	Carnaby's Black Cockatoo, Short-billed Black-cockatoo	Endangered (listed as <i>Calyptorhynchus latirostris</i>)
<i>Galaxiella nigrostriata</i>	Blackstriped Dwarf Galaxias, Black-stripe Minnow	Endangered
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	Vulnerable
<i>Macroderma gigas</i>	Ghost Bat	Vulnerable
<i>Westralunio carteri</i>	Carter's Freshwater Mussel, Freshwater Mussel	Vulnerable

3.2.2 Feral Animals

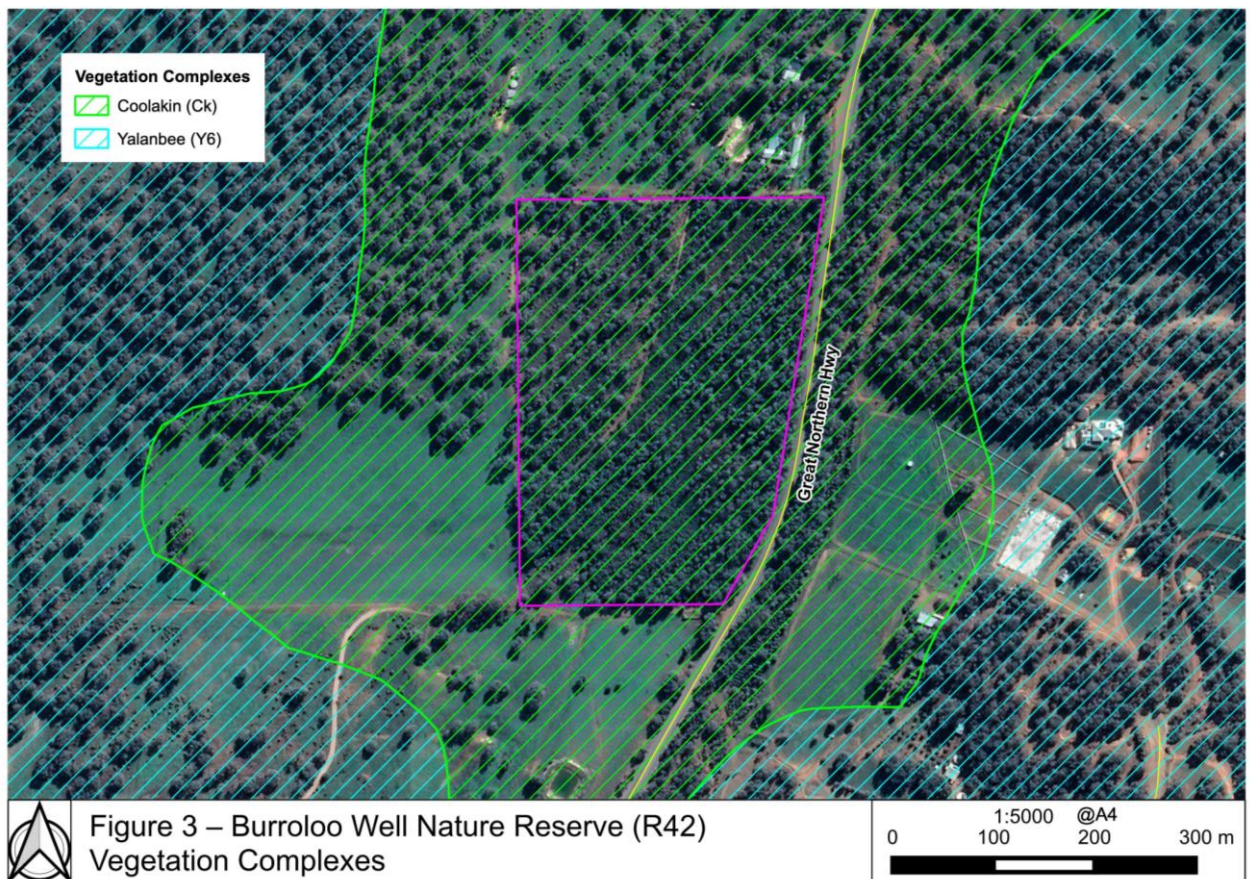
Several species of invasive animals have established in the region, which have impacted upon native vegetation and fauna. Feral cats (*Felis catus*) and the European Fox (*Vulpes vulpes*) are key predators that prey upon ground-dwelling native fauna. The European Rabbit (*Oryctolagus cuniculus*) causes direct loss of plant species, and indirect loss of native plant and animal species through changes to soil structure and nutrient dynamics by their digging, burrowing and grazing activities. There was evidence of rabbits occurring in this reserve.

3.3 VEGETATION

Burroloo Well Nature Reserve (R42) is in Very Good condition with only 17% of the site in less than good condition. The vegetation is dominated by Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*), with pockets of Wandoo (*Eucalyptus wandoo*) and a variety of native understorey species. The low-lying areas are dominated by wetlands species.

3.3.1 Vegetation Complexes

There are 18 vegetation complexes represented within the Jarrah Forest portions of the Perth and Peel Scheme Regions. The vegetation complexes shown on **Figure 3** provides the vegetation distribution coverage of pre-1750 south west forest region of Western Australia. This mapping was undertaken by Mattiske and Havel (1998) as part of the biodiversity assessment for the comprehensive regional assessment for the south west forest region. One local vegetation complex occurs within Burroloo Well Nature Reserve. The description of the vegetation is provided below and is shown on **Figure 3**:



3.3.2 Vegetation complexes found within Burroloo Well Nature Reserve (R42)

Coolakin (Ck)

Coolakin Vegetation Complex consists of woodland of *Eucalyptus wandoo* with mixtures of *Eucalyptus patens*, *Eucalyptus marginata* subsp. *thalassica* and *Corymbia calophylla* on the valley slopes in arid and perarid zones.

3.3.3 Burroloo Well Nature Reserve Local Vegetation Communities

During the site visit, vegetation communities were broadly mapped and described by recording the dominant flora species. The vegetation described on site can be categorised into three broad vegetation communities. These communities are described in **Table 5** and shown on **Figure 4**.

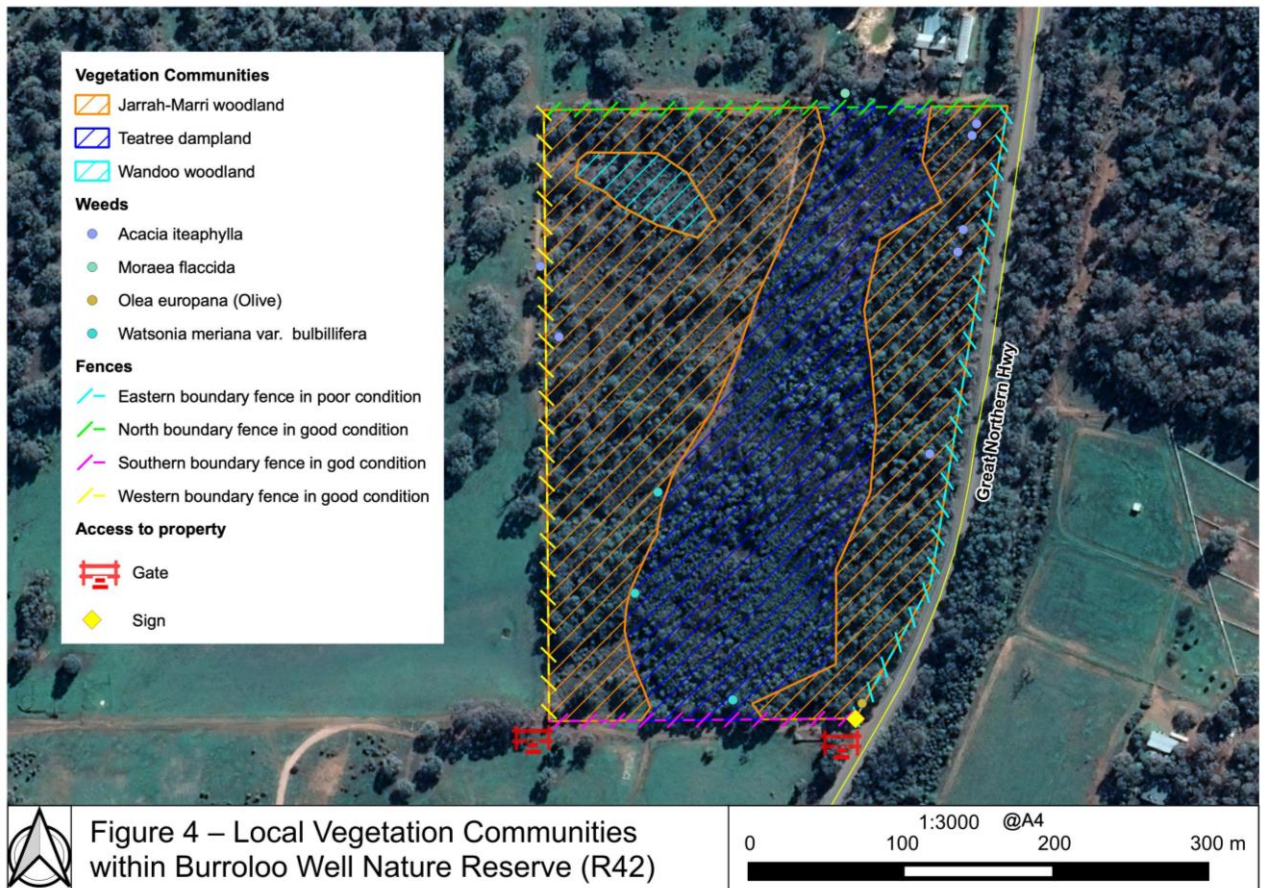


Table 5: Local Vegetation Communities

Community Description	
Vegetation Community 1 – Jarrah – Marri Woodland	
1	Open forest of <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> over low woodland of <i>Banksia grandis</i> over shrubland of <i>Xanthorrhoea preissii</i> , <i>Banksia nivea</i> , <i>Bossiaea eriocarpa</i> and <i>Hibbertia hypericoides</i> over herbland of <i>Anigozanthos manglesii</i> and <i>Haemodorum</i> sp.
Community Description	
Vegetation Community 2 – Wandoo Woodland	
2	Open woodland of <i>Eucalyptus wandoo</i> over shrubland of <i>Lechenaultia biloba</i> and <i>Hibbertia ovata</i> over herbland of <i>Chamaescilla corymbosa</i> , <i>Corynotheca micrantha</i> , <i>Dianella revoluta</i> and <i>Tricoryne elatior</i>
Community Description	
Vegetation Community 3 – Teatree Dampland	
3	Tall shrubland of <i>Acacia saligna</i> over open shrubland of <i>Leptospermum erubescens</i> and <i>Hypocalymma angustifolium</i> over sedgeland of <i>Lepidosperma</i> spp. and <i>Chorizandra enodis</i>



Photo 3: Jarrah- Marri Woodland



Photo 4: Wandoo Woodland



Photo 5: Dampland

3.3.4 *Threatened Ecological Communities*

The EPBC Act provides for the strong protection of TEC's, which are listed under section 181 of the Act and are described as 'Critically Endangered', 'Endangered' or 'Vulnerable' under section 182. Schedules of protected TEC's maintained pursuant to the EPBC Act are based on the same Floristic Community Type's (FCT's) as adopted by DBCA, however not all TEC's listed by the DBCA are scheduled under the EPBC Act.

A Department of Agriculture, Water and the Environment (DAWE) Protected Matters report indicated there are two known Threatened Ecological Communities (TEC's) likely to occur in the area, which are listed below in **Table 6**.

Table 6: DAWE listed Threatened Ecological Communities

Name	Status	Type of Presence
Tuart (<i>Eucalyptus gomphocephala</i>) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community may occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

The vegetation recorded onsite does not contain the dominant flora species which characterise these ecological communities. The site therefore does not contain the two listed TEC's.

3.3.5 *Vegetation Condition*

Many bushland remnants have been historically subject to ongoing degradation and are especially susceptible to disturbances arising as a result of indirect impacts from surrounding developments and human activity. Degradation is caused by a wide range of factors, including isolation and edge effects, weed invasion, plant diseases, changes in fire frequency and behaviour, landscape fragmentation, illegal firewood cutting, rubbish/refuse dumping, off-road motorbikes and 4WD's, increased predation on native fauna by feral animals, decrease in species richness and general modification of ecological function. These issues can affect the biodiversity and ecological viability of areas of remnant vegetation and should be continuously assessed.

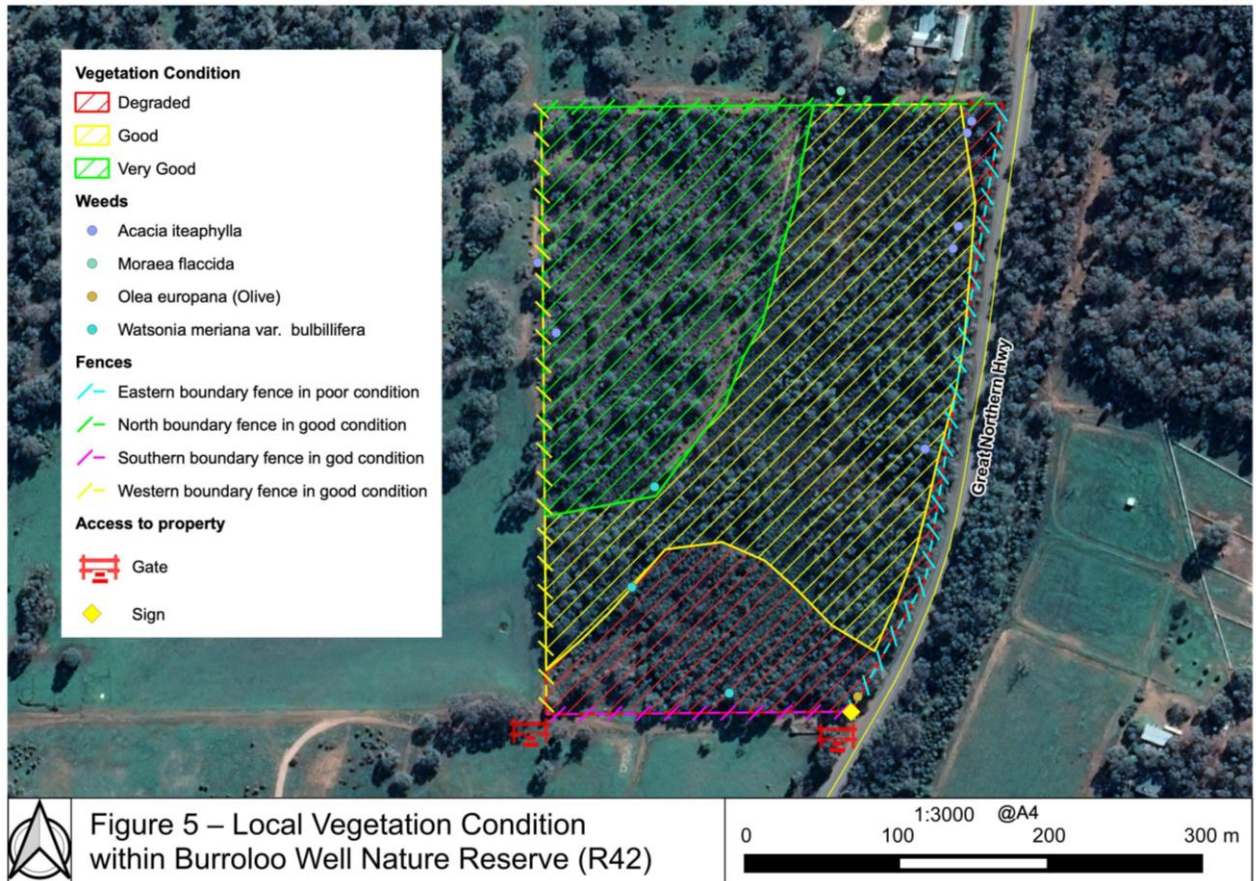
The vegetation condition was rated according to the Vegetation Condition Scale used in the Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). The definitions are described in **Table 7** below.

In general, the vegetation condition ranged from “Degraded” to “Very Good” with 83% of the vegetation recorded within the reserve in good or better condition. Vegetation condition mapping is provided on **Figure 5**.

Table 7: Vegetation Condition Scale (Technical Guidance – *Flora and Vegetation Surveys for Environmental Impact Assessment* (2016)).

Vegetation Condition	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or 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.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement
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	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds,

	grazing.	or occasional vehicle tracks
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.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds
Poor		Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds
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.	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the 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 and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e., areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs



4. ACCESS, FIRE BREAKS, SIGNAGE AND ILLEGAL ACTIVITY

4.1 ACCESS AND FIREBREAK CONDITION

Burroloo Well Nature Reserve is accessible from one gate off Great Northern Highway on the south eastern boundary. The rest of the reserve is fenced. The adjoining neighbour to the west of the reserve has access to their property via an external gate located in the south west corner of the reserve. This gate is only accessible through the reserve from the gate on Great Northern Highway. Neither gate is locked.

There are well defined firebreaks around the west, north and south of the reserve, the eastern boundary requires work. There are private properties joining the west, north and south boundaries. The eastern boundary adjoins Great Northern Highway.

There is an access track through the middle of the reserve running in a north-south direction, along the dampland. There are no other firebreaks through any of the sections of the reserve. Maintenance of the firebreaks will be required to ensure the entire site is accessible. The eastern boundary requires work to define and clear the firebreak.

Apart from the firebreaks, there are no obvious additional tracks. There are no signs of vehicle use or rubbish dumping. There is rubbish on the eastern boundary, which appears to have blown in from the

adjacent highway. There is some evidence of historic logging scattered throughout the reserve and localised disturbances, which may be attributed to historic gravel extraction.

There is a water pipeline into the dampland area, which appears to be coming from an adjacent property. DBCA records noted in 2007 that water is extracted for use on an adjacent property. Infrastructure is still present.



Photo 6: Fire break along the southern boundary of the Reserve



Photo 7: Fire break along the eastern boundary of the Reserve

4.2 FENCING

Overall, the boundary fences appear to be in good condition. Ongoing maintenance is important to protect the bushland from stock and access, as the reserve is bounded by private properties to the north, south and west and Great Northern Highway to the east. Fencing along the eastern boundary requires attention.



Photo 8: Fencing along the western boundary of the Reserve



Photo 9: Fencing along the northern boundary of the Reserve

4.3 SIGNAGE

During the site visit, one nature reserve sign was observed. The sign is located at the entrance of the site on Great Northern Highway. The reserve sign location is shown on **Figures 4 & 5**.



Photo 10: Burroloo Well Nature Reserve signage

4.4 ILLEGAL ACTIVITY

No signs of motorbikes or 4WD's access was observed. There appears to be limited activity in this area.

5. FIRE

Prior to European settlement, fires occurred through lightning strikes and Indigenous burning of the landscape. Indigenous burning practices had been adopted for up to 60 000 years and likely comprised a mosaic of frequent, small-scale fires. Since European settlement, fires still occur through lightning strikes. However, they now also originate from prescribed burning operations (including escapes from planned fires), arson or accidental ignition due to a range of sources. The nature and impacts of fire are influenced by other threats in the landscape. Fragmentation into small remnants and the surrounding modified land use can affect the intensity and impact of fires across a patch. The type of understorey may promote or suppress fire spread. Frequency of fire is one important consideration in addition to fire intensity and season. Too frequent fires may eliminate sensitive species. For example: obligate seeder species that require fire to stimulate seed germination may die out if recurring fires kill plants before they

have a chance to mature and develop new seeds; and fauna may decline due to the loss of food and shelter resources after frequent fires.

It is important to develop appropriate fire management with the use of mosaic burning to maintain the diversity of habitats for flora and fauna. The eastern side of the reserve appears to have been burnt within the last 5 years as there is a high number of juvenile *Acacia saligna* and new growth of *Eucalyptus* spp. There is also a higher density of grass weeds within this area. The fire break around the perimeter of the reserve requires maintenance, the eastern boundary, adjacent to Great Northern Highway requires the most attention.

Fire provides a great opportunity to undertake weed control. Fire can promote the establishment of weeds, which can be followed up with herbicide or other weed management practices. Incorporating weed management where burning has occurred is essential to prevent further spread. It is important to control regenerating weeds before they set seed, as this will minimise future weed densities and prevent them dropping new seed into burnt areas.

6. CONCLUSION AND RECOMMENDATIONS

Burroloo Well Nature Reserve is a conservation reserve for the protection of flora and fauna. The reserve is an important bushland reserve as it contains vegetation in good condition, which provides valuable habitat for flora and fauna species. The seasonal water source and dampland vegetation within the reserve provides a valuable habitat for fauna.



Photo 11: Burroloo Well Nature Reserve

Based on the results of this assessment, Del Botanicus proposes the following reserve management recommendations:

- Implement a weed management plan with communication provided to adjacent landholders, to encourage control of priority weeds on adjacent properties and ensure a coordinated approach
- Undertake fire break maintenance;
- Undertake a Detailed Flora and Vegetation Survey;
- Undertake a targeted Declared Rare Flora Search for the species listed below in **Table 8**. These species have been selected as a result of a background search of the site; however, the search should not be limited to these species but should also include any Threatened and Priority flora found within the reserve.
- Undertake a Targeted Fauna Search for the species listed below in **Table 9**. These species have been selected as a result of a background search of the site; however, the search should not be limited to these species but should also include any Threatened and Priority fauna found within the reserve.

Table 8: Targeted Flora Search Species List

Taxon	Common Name
<i>Acacia anarthros</i>	
<i>Acacia anomala</i>	Grass Wattle, Chittering Grass Wattle
<i>Acacia cummingiana</i>	
<i>Acacia drummondii</i> subsp. <i>affinis</i>	
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	
<i>Acacia pulchella</i> var. <i>reflexa acuminata bracteole</i> variant	
<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i>	
<i>Andersonia gracilis</i>	Slender Andersonia
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	Golden Catpaw
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	Dwarf Green Kangaroo Paw
<i>Banksia mimica</i>	Summer Honeypot
<i>Caleana dixonii</i>	Sandplain Duck Orchid
<i>Calothamnus pachystachyus</i>	
<i>Caustis gigas</i>	Giant Twigrush
<i>Chamelaucium lullfitzii</i>	Gingin Wax
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	One-headed Smokebush
<i>Cyanicula ixioides</i> subsp. <i>candida</i>	
<i>Darwinia carnea</i>	Mogumber Bell, Narrogin Bell
<i>Darwinia foetida</i>	Muchea Bell
<i>Darwinia</i> sp. Bindoon	
<i>Diplolaena andrewsii</i>	
<i>Diuris drummondii</i>	Tall Donkey Orchid
<i>Diuris purdiei</i>	Purdie's Donkey-orchid
<i>Drakaea elastica</i>	Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid
<i>Eleocharis keigheryi</i>	Keighery's Eleocharis
<i>Eryngium pinnatifidum</i> subsp. <i>umbraphilum</i>	
<i>Eucalyptus exilis</i>	Boyagin Mallee
<i>Eucalyptus leprophloia</i>	Scaly Butt Mallee, Scaly-butt Mallee
<i>Gastrolobium crispatum</i>	
<i>Gastrolobium nudum</i>	
<i>Goodenia arthrotricha</i>	
<i>Grevillea corrugata</i>	
<i>Grevillea curviloba</i> subsp. <i>curviloba</i>	Curved-leaf Grevillea
<i>Grevillea flexuosa</i>	Zig Zag Grevillea
<i>Halgania corymbosa</i>	
<i>Hibbertia glomerata</i> subsp. <i>ginginensis</i>	
<i>Hibbertia miniata</i>	Orange Hibbertia
<i>Hypocalymma sylvestre</i>	
<i>Hypolaena robusta</i>	
<i>Lasiopetalum caroliae</i>	

<i>Macarthuria keigheryi</i>	Keighery's Macarthuria
<i>Melaleuca sciotostyla</i>	Wongan Melaleuca
<i>Millotia tenuifolia</i> var. <i>laevis</i>	
<i>Netrostylis</i> sp. Chandala	
<i>Oxymyrrhine coronata</i>	
<i>Persoonia rudis</i>	
<i>Poranthera moorokatta</i>	
<i>Ptychosema pusillum</i>	Dwarf Pea
<i>Schoenus griffinianus</i>	
<i>Senecio gilbertii</i>	
<i>Stylidium longitubum</i>	Jumping Jacks
<i>Stylidium squamellosum</i>	
<i>Styphelia allittii</i>	
<i>Synaphea</i> sp. Fairbridge Farm	Selena's Synaphea
<i>Tetratheca pilifera</i>	
<i>Thelymitra dedmaniarum</i>	Cinnamon Sun Orchid
<i>Thelymitra stellata</i>	Star Sun-orchid
<i>Thelymitra variegata</i>	Queen of Sheba
<i>Thysanotus</i> sp. Badgingarra	
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	
<i>Verticordia rutilastra</i>	
<i>Verticordia serrata</i> var. <i>linearis</i>	

Table 9: Targeted Fauna Search Species List

Taxon	Common Name
<i>Calidris acuminata</i>	sharp-tailed sandpiper
<i>Calidris ferruginea</i>	Curlew Sandpiper
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo, Karrak
<i>Calyptorhynchus latirostris</i>	Carnaby's cockatoo
<i>Calyptorhynchus</i> sp. 'white-tailed black cockatoo'	White-tailed black cockatoo
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll
<i>Galaxiella nigrostriata</i>	Blackstriped Dwarf Galaxias, Black-stripe Minnow
<i>Idiosoma mclelementsorum</i>	Julimar shield-backed trapdoor spider
<i>Idiosoma sigillatum</i>	Swan Coastal Plain shield-backed trapdoor spider
<i>Isodon fusciventer</i>	Quenda, southwestern brown bandicoot
<i>Leipoa ocellata</i>	Malleefowl
<i>Macroderma gigas</i>	Ghost Bat
<i>Notamacropus irma</i>	Western brush wallaby
<i>Numenius madagascariensis</i>	Eastern Curlew, Far Eastern Curlew
<i>Oxyura australis</i>	Blue-billed duck
<i>Rostratula australis</i>	Australian Painted Snipe
<i>Tringa nebularia</i>	Common greenshank
<i>Westralunio carteri</i>	Carter's freshwater mussel

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APPENDIX A
FLORA SPECIES RECORDED

Appendix A: Flora species recorded at Burroloo Well Nature Reserve (R42) November 2022.

Family	Genus /Species
Amaranthaceae	<i>Ptilotus manglesii</i> <i>Ptilotus polystachyus</i> <i>Ptilotus</i> sp (White)
Apiaceae	<i>Xanthosia huegelii</i>
Asparagaceae	<i>Thysanotus patersonii</i>
Asteraceae	* <i>Taraxacum khatoonae</i> * <i>Ursinia anthemoides</i> <i>Waitzia</i> sp <i>Waitzia nitida</i>
Campanulaceae	* <i>Wahlenbergia capensis</i>
Casuarinaceae	<i>Casuarina obesa</i>
Celastraceae	<i>Tripterococcus brunonis</i>
Cyperaceae	<i>Chorizandra enodis</i> <i>Lepidosperma</i> sp <i>Morelotia octandra</i>
Dasypogonaceae	<i>Dasypogon</i> sp
Dilleniaceae	<i>Hibbertia ?cunninghamii</i> <i>Hibbertia hypericoides</i> <i>Hibbertia ovata</i>
Elaeocarpaceae	<i>Tetratheca hirsuta</i>
Fabaceae	* <i>Acacia iteaphylla</i> * <i>Chamaecytisus palmensis</i> * <i>Trifolium</i> sp <i>Acacia pulchella</i> <i>Acacia saligna</i> <i>Bossiaea eriocarpa</i> <i>Daviesia horrida</i> <i>Jacksonia sternbergiana</i> <i>Kennedia prostrata</i> <i>Labichea punctata</i> <i>Viminaria juncea</i>
Geraniaceae	* <i>Pelargonium</i> sp
Goodeniaceae	<i>Damperia alata</i> <i>Goodenia ?fasciculata</i> <i>Lechenaultia biloba</i>
Haemodoraceae	<i>Anigozanthos manglesii</i> <i>Haemodorum</i> sp
Hemerocallidaceae	<i>Chamaescilla corymbosa</i> <i>Corynotheca micrantha</i> <i>Dianella revoluta</i> <i>Tricoryne elatior</i>
Iridaceae	* <i>Moraea flaccida</i> * <i>Oxalis pes-caprae</i> * <i>Romulea rosea</i> * <i>Watsonia meriana</i> var. <i>bulbillifera</i> <i>Patersonia occidentalis</i>
Juncaceae	<i>Juncus pallidus</i>

Myrtaceae	<i>Babingtonia camphorosmae</i>
	<i>Corymbia calophylla</i>
	<i>Eucalyptus marginata</i>
	<i>Eucalyptus wandoo</i>
	<i>Hypocalymma angustifolium</i>
	<i>Leptospermum erubescens</i>
	<i>Leptospermum erubescens</i>
	<i>Melaleuca preissiana</i>
Phyllanthaceae	<i>Lysiandra calycina</i>
Pinaceae	* <i>Pinus</i> sp
Poaceae	* <i>Aira caryophyllea</i>
	* <i>Avena barbata</i>
	* <i>Briza maxima</i>
	* <i>Bromus diandrus</i>
	* <i>Ehrharta calycina</i>
	* <i>Eragrostis curvula</i>
	* <i>Lagurus ovatus</i>
	* <i>Lolium rigidum</i>
	* <i>Poa</i> sp
	<i>Acanthocarpus ? canaliculatus</i>
	<i>Austrostipa nitida</i>
	<i>Neurachne alopecuroidea</i>
	<i>Tetrarrhena laevis</i>
	<i>Tetrarrhena laevis</i>
Polygalaceae	<i>Comesperma vagatum</i>
Primulaceae	* <i>Lysimachia arvensis</i>
Proteaceae	<i>Adenanthos cygnorum</i>
	<i>Adenanthos cygnorum</i> subsp. <i>Chamaephyton</i> (P3)
	<i>Banksia nivea</i>
	<i>Banksia squarrosa</i>
	<i>Grevillea manglesii</i>
	<i>Hakea prostrata</i>
	<i>Petrophile biloba</i>
	<i>Synaphea</i> sp
Restionaceae	<i>Loxocarya flexuosa</i>
Thymelaeaceae	<i>Pimelea</i> sp (white)
Xanthorroheaceae	<i>Xanthorrhoea gracilis</i>
	<i>Xanthorrhoea preissii</i>

APPENDIX B
FAUNA SPECIES RECORDED

Appendix B: Fauna species recorded at Burroloo Well Nature Reserve (R42) November 2022

Family	Genus/Species
Cacatuidae	<i>Calyptorhynchus banksii</i>
	<i>Calyptorhynchus latirostris</i>
	<i>Eolophus roseicapilla</i>
	<i>Dromaius novaehollandiae</i>
Corvidae	<i>Gymnorhina tibicen</i>
	<i>Corvus orru</i>
Macropodidae	<i>Macropus fuliginosus</i>
Psittaculidae	<i>Barnardius zonarius</i>
Rhipiduridae	<i>Rhipidura albiscapa</i>
	<i>Rhipidura leucophrys</i>
	<i>Rhipidura sp.</i>