



City of Melville

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# Eastern Reserves Strategic Management Plan

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2022-2027



## Executive Summary

The Eastern Reserves include George Welby Park, Tom Firth Park and Ron Carroll Reserve, and are located in the suburbs of Bateman and Bull Creek. This strategic management plan updates the previous *Eastern Reserve Strategic Management Plan 2015-2021*.

Assets in terms of flora, fauna, ecological communities and fauna habitat were recorded during the 2021 survey.

A total of four vegetation types were identified during the 2021 survey:

- *Banksia* Open Woodland
- *Melaleuca preissiana* and *Banksia* spp. Open Woodland
- *Banksia* and Marri Woodland
- *Melaleuca preissiana* Open Woodland.

A total of 191 flora species were recorded throughout the Eastern Reserves; 61.8% of these are native flora species. No threatened or priority species or 'at-risk' (Woodgis, 2019) species were recorded during the 2021 survey. No threatened or priority ecological communities were recorded in the Eastern Reserves. Results of the survey show decline in the number of habitat trees was observed since the previous management plan. This result is not representative of the conditions of the site due to a change in the survey boundaries which was reduced for George Welby Park.

The Eastern Reserves provided habitats for a range of fauna species; surveys found:

- six mammal species, three introduced and one priority
- 13 bird species
- three reptile species, all native species
- 17 invertebrates.

Of these, eight species were classified as 'at-risk' by the City, these include:

- Quenda (*Isodon fusciventer*)
- Gould's Wattled Bat (*Chalinolobus gouldii*)
- Chocolate Wattled Bat (*Chalinolobus morio*)
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)
- Red-tailed Black Cockatoo (*Calyptorhynchus banksii*)
- New Holland Honeyeater (*Phylidonyris novaehollandiae*)
- Pacific Black Duck (*Anas superciliosa*)
- Burton's Legless Lizard (*Lialis burtonis*).

Several threats are present within the Eastern Reserves, these include:

- physical disturbances e.g., vehicle tracks, fire, dumping of rubbish, informal paths
- unplanned fires
- a total of 66 weeds, Bridal Creeper (*\*Asparagus asparagoides*) classified as a declared pest and a weed of national significance
- presence of habitat loss (bare ground and weed cover)
- a total of seven feral fauna species
- potential presence of dieback in reserves.

Management strategies have been developed for 2022-2027 including Key Performance Indicators for the Eastern Reserves. The main priorities for management include:

- undertake weed control of Very High and High impact weeds
- revegetate areas proposed in Figure 9 to 11 to enhance vegetation condition and reduce habitat loss
- continue to monitor and report any increase in threats in the reserves and undertake management in accordance with the NAAMP



- continue to monitor assets for decline in health or damage and repair or manage in accordance with the NAAMP.

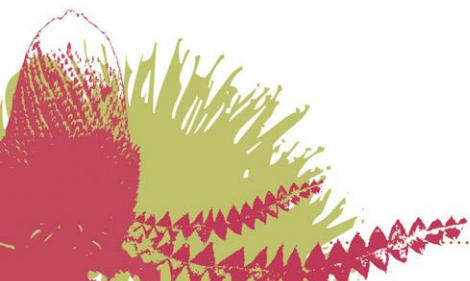




## Acknowledgements

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- Kellie Fowler, Environmental Officer (City of Melville)





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# 1 Introduction

The City of Melville (the City) commissioned Natural Area Consulting Management Services (Natural Area) to update the Management Plan for the Eastern Reserves (George Welby Park, Tom Firth Park, and Ron Carroll Reserve), in accordance with the City's Natural Areas Asset Management Plan (NAAMP 2019). Natural Area carried out flora, vegetation, and fauna surveys within George Welby Park, Tom Firth Park and Ron Carroll Reserve to provide updated flora and fauna inventory lists outlined in the NAAMP, to ensure the management strategy addresses local and current conditions. Management strategies outlined in this management plan should be considered in conjunction with the City's Natural Areas Asset Management Plan (NAAMP 2019).

## 1.1 Background

George Welby Park is in the suburb of Bateman within the City of Melville and is approximately 15.2 km south of Perth's Central Business District (CBD). George Welby Park is also known to the City as Lot 2986 and covers an area of approximately 2 ha (Figure 1).

Tom Firth Park is in the suburb of Bateman within the City of Melville and is approximately 14.6 km south of Perth's CBD. Tom Firth Park is also known to the City as Lot 3681 and covers an area of approximately 0.56 ha (Figure 1).

Ron Carroll Reserve is in the suburb of Bull Creek within the City of Melville and is approximately 13.6 km south of Perth's CBD. Ron Carroll Reserve is also known to the City as Lot 2425 and covers an area of approximately 5.58 ha (Figure 1).

The management plan for the reserves highlights site-specific threats and assets while outlining strategies to manage them accordingly. This management plan updates the Eastern Reserves Strategic Management Plan 2015-2020 (Woodgis, 2015) and provides a new five-year management plan for 2022-2027.

## 1.2 Objectives

The objective of this plan is to provide flexible management strategies for site specific risks in accordance with the City's NAAMP, with the primary aim being to maintain and enhance the various ecological functions and values associated within the Eastern Reserves. In order to achieve this, the following actions were required:

- identification of threatening processes outlined within the NAAMP that occur within the bushland areas
- identification of assets
- identification of site-specific threatening processes over time
- provide clear reserve management key performance indicators and recommendations to reduce negative impacts associated with the various threatening processes
- provide a plan to improve degraded areas within the reserve and maintain areas.







**Figure 1:**  
Site Location  
Eastern Reserves

Client: City of Melville  
Date: 16/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94

0 250 500 m





### 1.3 Scope

Natural Area carried out the following works:

- basic flora survey to record at-risk species, form species lists and determine vegetation types and condition
- weed mapping of all weed species as either point infestation or density
- detailed fauna survey including funnel and Elliot trapping over a 5 day period, installation of camera traps and night stalks
- mapping locations of existing tracks and paths within reserves
- mapping locations of disturbance activities and infrastructure
- mapping locations of habitat trees
- assess key threatening processes within the reserve
- provide management recommendations for the Eastern Reserves.

### 1.4 Land Tenure and Zoning

The area covered by the Eastern Reserves are:

- George Welby Park, approximately 2 ha
- Tom Firth Park, approximately 0.56 ha
- Ron Carroll Reserve, approximately 5.58 ha.

All reserves are open to the public with no restricted access or fences preventing unauthorised access. All reserves are zoned Public Open Space, with George Welby Park adjacent to parkland/sporting fields.



## 2 Assets

### 2.1 Reserve Ratings

The City of Melville's NAAMP (2019) developed a framework considering factors such as species presence, vegetation types and community value in order to assign an overall rating of between 1 (highest) to 5 (lowest) for the City's numerous reserves. This allows the prioritisation and management of higher rated reserves in order to maintain their value. The following reserve ratings are recorded for the Eastern Reserves:

- George Welby Park – 3 (previously 2)
- Ron Carroll Reserve - 3 (previously 2)
- Tom Firth Park – 4 (previously 3).

#### 2.1.1 Bush Forever

Bush Forever Sites are bushland and wetland areas deemed to be regionally significant within the Swan Coastal Plain and required protection in Perth's Bushland Project (Government of Western Australia, 2000).

No Bush Forever sites are located within the three Eastern Reserves, with the two closest sites approximately 380 m to the north-east of Ron Carroll Reserve and approximately 809 m to the west of the Tom Firth.

#### 2.1.2 Ecological Linkages

Ecological Linkages provide a place for fauna to hide and forage for food while moving between natural bushland areas, this increases the size of available fauna habitat and the genetic diversity of species in the site, this is also the same for flora species. Due to the increase in land clearing and the fragmentation of the landscape ecological linkages are important and need to be protected so they can continue to provide links between remnant bushland areas (WALGA, 2009).

None of the Eastern Reserves were identified as a very high or high ecological value linkage by City of Melville NAAMP (2019). The Eastern Reserves do provide local linkages between the bushland reserves within the City of Melville. The three reserves which comprise the Eastern Reserves are separated by a major barrier, the Kwinana Freeway. Ron Carroll is an isolated reserve which is surrounded by houses and roads, although would provide a local linkage for birds and insect pollinator species. Tom Firth Park and George Welby Park are linked locally though the vegetated freeway corridor which would allow for the movement of small mammals, reptiles, birds and insect pollinators.

### 2.2 Site Assets

This section discusses the environmental, heritage and social assets of the Eastern Reserves.

#### 2.2.1 Ecological Communities

##### 2.2.1.1 Vegetation Complex

The Eastern Reserves are situated within the Bassendean Complex Central and South (Department of Primary Industry and Regional Development (DPIRD, 2022). This complex is described as being woodlands of Jarrah-Sheoak-Banksia on sand dunes to low lying woodland of *Melaleuca* spp., sedgelands on low-lying depressions and swamps. The dominant species include *Banksia attenuata*, *Banksia grandis*, *Banksia menziesii*, *Banksia ilicifolia*, *Banksia littoralis*, *Melaleuca preissiana*, *Kunzea vestita*, *Hypocalymma angustifolium*, *Adenanthos obovatus*, and *Verticordia* spp. (Hedde, Lonergan and Havel, 1980). The pre-European extent of this vegetation type complex remaining is:





- 26.87% within the Swan Coastal Plain (Government of Western Australia, 2019)
- 7.82% within the City of Melville local government area (Government of Western Australia, 2019).

### 2.2.1.2 Vegetation Types

Ecological communities are assemblages of flora and fauna in particular landscapes. They are commonly described based on the dominant flora structure and assemblages present and provide habitat to specific fauna species. In this strategic management plan ecological communities are described based on the flora structure and cover present within each of the reserves.

The Protected Matters Search Tool (PMST) indicated the potential for three Threatened Ecological Communities (TEC) to occur within 5 km of the Eastern Reserves. The three potential TECs which are likely to occur within the area include:

- Banksia Woodlands of the Swan Coastal Plain (Endangered)
- Subtropical and Temperate Coastal Saltmarsh (Vulnerable)
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain (Critically Endangered).

A total of four vegetation types were identified by Natural Area during the 2021 survey; these are listed in Table 1, Figure 2-4. Vegetation types for the Tom Firth Park remains unchanged from the previous management plan. Ron Carroll Reserve and George Welby Park has varied slightly from the survey completed in 2015 with some vegetation types amalgamated. These changes in vegetation type classification are due to the difference in judgement of assessor in the field, or due to other species having matured and become dominant. The overarching vegetation classification and vegetation associations remain consistent with the previous survey although different species dominance is represented.

None of the reserves recorded vegetation types and flora species consistent with the key diagnostic characteristics of the critically endangered Tuart Woodlands and Forests of the Swan Coastal Plain or vulnerable Subtropical and Temperate Coastal Saltmarsh, identified as potentially present. The patch size and vegetation condition requirements for Banksia Woodlands of the Swan Coastal Plain does not meet the minimum threshold levels (minimum requirement of 2 ha in Good condition) for the reserves to qualify as a Banksia Woodland TEC. All of the Banksia vegetation types within the three reserves is less than 2 ha in size.



Table 1: Vegetation types present in Eastern Reserves

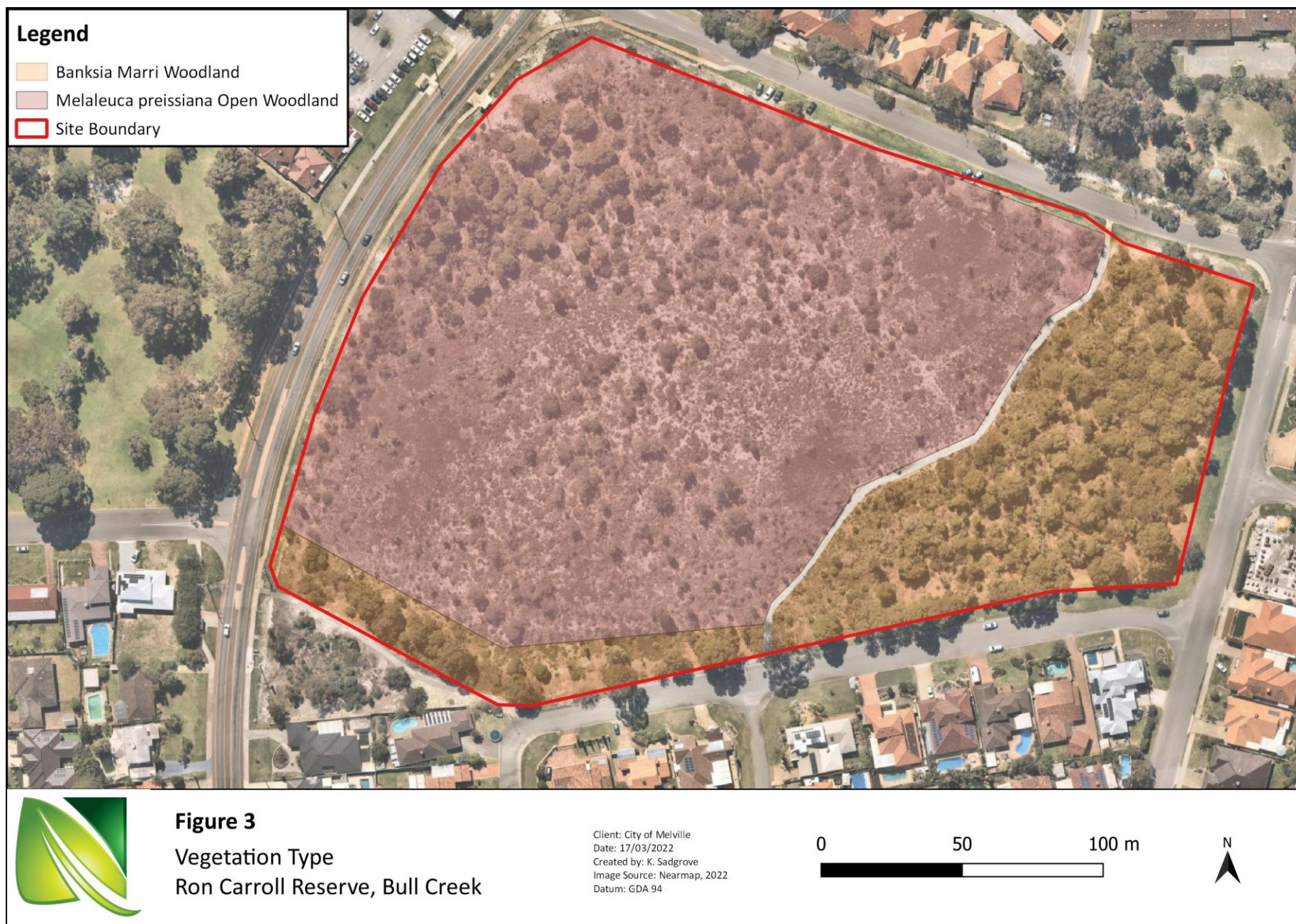
Vegetation Type	
Woodgis Environmental Assessment and Management (Woodgis 2015)	Natural Area (2021)
Tom Firth Park	
<i>Banksia attenuata</i> / <i>Banksia menziesii</i> Woodland	Banksia Open Woodland
George Welby Park	
<i>Banksia attenuata</i> / <i>Banksia menziesii</i> Woodland	<i>Melaleuca preissiana</i> and <i>Banksia</i> spp. Open Woodland
<i>Melaleuca preissiana</i> Woodland	
Ron Carroll Reserve	
<i>Banksia attenuata</i> / <i>Banksia menziesii</i> Woodland	Banksia and Marri Woodland
<i>Melaleuca preissiana</i> Woodland	<i>Melaleuca preissiana</i> Open Woodland
Mixed herbland	
<i>Melaleuca thymoides</i> Shrubland	



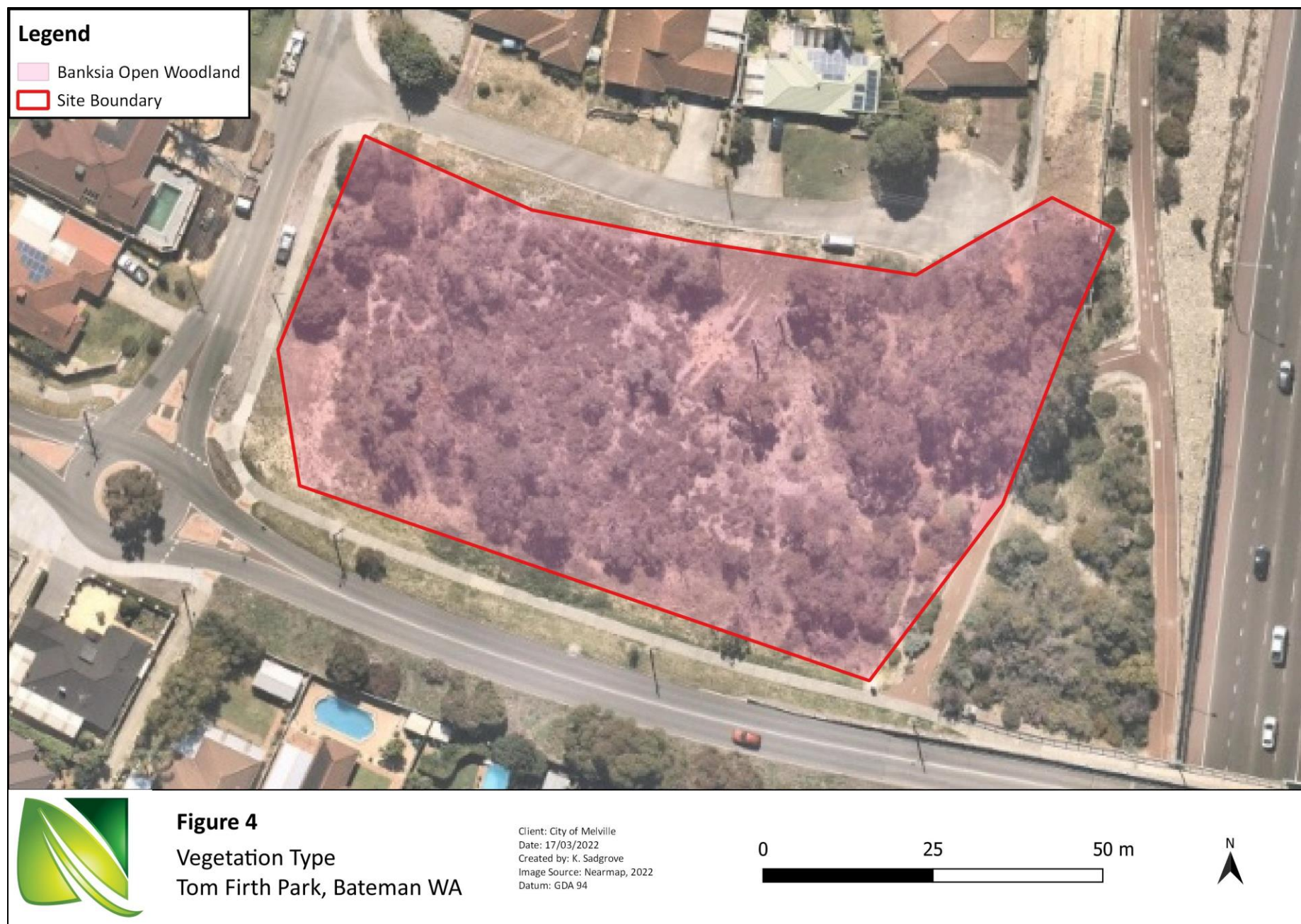












### 2.2.2 Fauna Habitat

The Eastern Reserves serves as important habitat source at a local level and as an ecological linkage to surrounding areas, particularly for mobile species such as bats and birds. Habitat present provides a refuge for native fauna, in particular food sources and potential roosting/nesting sites for threatened black cockatoos.

Evidence of recent feeding by black cockatoos was observed at George Welby Park at four locations, which is an indicator of the species use of the Eastern Reserves. The Eastern Reserves occur with areas which are classified as:

- Carnaby's Cockatoo Unconfirmed Breeding Areas within the Swan Coastal plain and Jarrah Forest IBRA Regions (DBCA 2022a)
- Black Cockatoo Roosting Sites Buffered (DBCA 064 2022c)
- Carnaby's Cockatoo Unconfirmed Roost Sites Buffered 6 km (DBCA 053 2022b).

Surveys conducted during spring 2021 by Natural Area confirmed that all three sites contained suitable feeding sources for threatened black cockatoos, including *Banksia* species and *Corymbia calophylla* (Marri). Evidence of feeding was observed at Ron Carroll Reserve and George Welby Park (Figure 5).

Large native trees with a diameter at breast height (DBH) greater than 500 mm provide important habitat for birds and bats. The larger trees are more likely to contain large hollows suitable for black cockatoos to nest in, they also provide roosting and foraging opportunities. Tree hollows with a DBH greater than 500 mm were mapped across the Eastern Reserves, with any observations of fauna recorded including nests, hollows and feral beehives (Table 2, Figure 6 to 8). Large hollows with a suitable entry angle, sufficiently wide entrance ( $\geq 10$  cm) and hollow depth may provide potential breeding habitat for black cockatoos. No nesting or roosting activities were observed during the 2021 surveys. Trees containing smaller hollows provide nesting opportunities for other smaller birds and have the potential to become suitable hollows for black cockatoos in the future. Results of the survey show decline in the number of habitat trees was observed since the previous management plan. This result is not representative of the conditions of the site due to a change in the survey boundaries which was reduced for George Welby Park.

Large habitat trees which are not locally endemic to the region such as *E. camaldulensis* can provide habitat values within a small reserve which can include roosting locations, provide shade and shelter. Succession planting should be considered prior to removal of potential habitat trees.







Evidence of feeding by black cockatoos



Examples of potential habitat trees

**Figure 5:** Evidence of cockatoo feeding with the reserves and potential habitat trees

**Table 2:** Habitat Trees with DBH > 500 mm in Eastern Reserves

Species	Alive	Dead	Total
<b>Tom Firth Park</b>			
<i>Eucalyptus camaldulensis</i>	1	0	1
<b>George Welby Park</b>			
<i>Eucalyptus grandis</i>	1	0	1
<i>Eucalyptus marginata</i>	0	2	2
<b>Ron Carroll Reserve</b>			
<i>Corymbia calophylla</i>	1	0	1

Species	Alive	Dead	Total
<i>Melaleuca preissiana</i>	2	0	2
<i>Melaleuca raphiophylla</i>	1	0	1
<i>Melaleuca sp.</i>	0	1	1
<b>Total</b>	<b>6</b>	<b>3</b>	<b>9</b>

Fauna habitat site indices for habitat trees is show in Table 3 and are recorded in trees per hectare for easier comparison between reserves within the City of Melville.

**Table 3: Fauna Habitat Sites Indices**

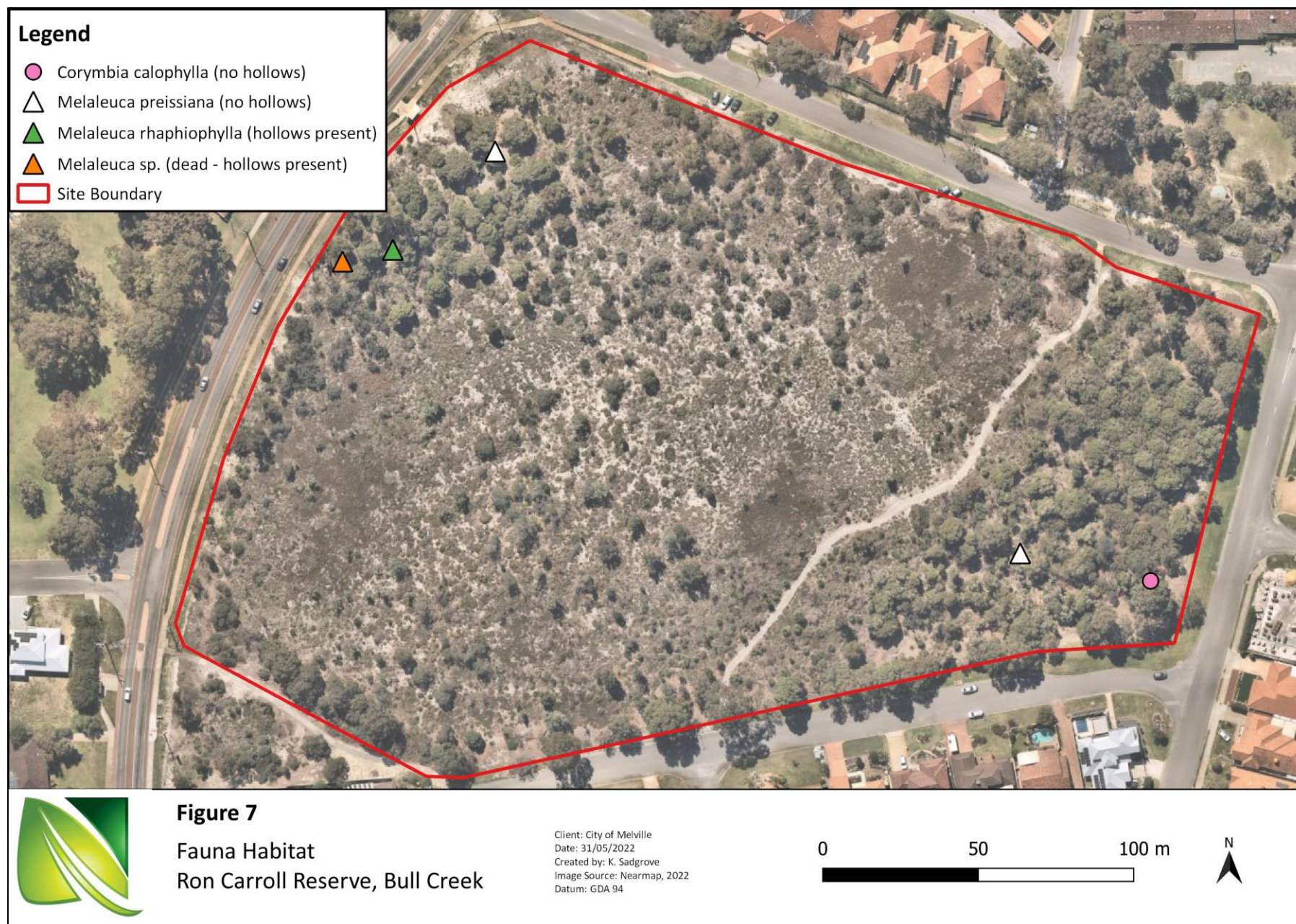
Values	Habitat Sites	Trees/Hectare 2005	Trees/Hectare 2014	Trees/Hectare 2021	Assets 2014-2021
<b>Medium Very Large Trees</b>	Live Native tree	No Data	6	<1	Decreased
	Dead tree		<1	<1	Maintained















**Figure 8**  
Fauna Habitat  
Tom Firth Park, Bateman

Client: City of Melbourne  
Date: 31/05/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94





### 2.2.3 Wetlands

Wetlands are areas that experience permanent, seasonal or intermittent waterlogging or inundation by water (DBCA, 2018). No wetlands are identified as occurring within the Eastern Reserves (DBCA, 2022). Two wetlands occur within close proximity to the Eastern Reserves with the closest located 160 m to the west of Tom Firth Park and is classified as a Resource Enhancement Wetland and the other is a Multiple Use Wetland located 185 m to the north-west of Ron Carroll Reserve (DBCA, 2022).

The Perth Ground Water Map from the Department of Water and Environmental Regulation (2022) identifies the depth to groundwater ranging from:

- Ron Carroll Reserve – 4 m to 6 m to the water table
- Tom Firth Park – 5 m to 8 m to the water table
- George Welby Park – 3 m to 5 m to the water table.

### 2.2.4 Heritage

No Aboriginal Heritage sites occur within the three Eastern Reserves as identified using the Aboriginal Heritage Inquiry System (DPLH 2022). Other heritage places within close proximity to the sites include Piney Lakes (number 21469) located 850 m east of Tom Firth and George Welby this is a place of modified tree, mythological camp, includes artefacts and is a woman's place (DPLH 2022). The other is 400 m north of Ron Carroll Reserve (number 4355) and may contain artefacts of significance (DPLH, 2022).

The Eastern Reserves contain no heritage sites listed on the:

- City of Melville Heritage Register (City of Melville 2019b)
- Australia's National Heritage List (Department of Agriculture, Water and the Environment 2022)
- Heritage Council search system, inHerit (Government of Western Australia 2022).

### 2.2.5 Community Interest

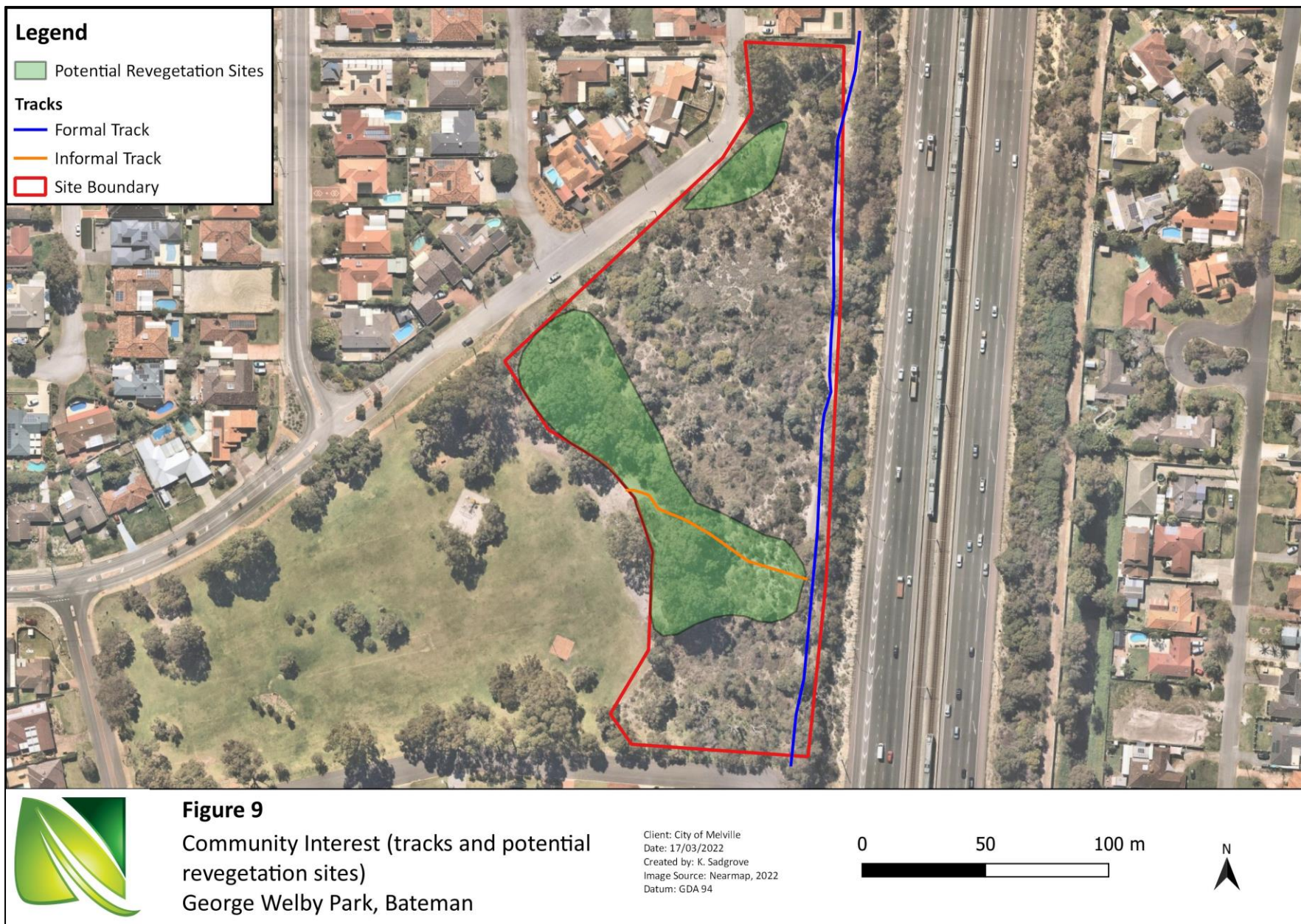
Two friends' groups operate within the Eastern Reserves, Friends of Tom Firth Park and Friends of George Welby Park. These friends' groups are actively seeking members to join regeneration activities within the reserves. Engaging the community in decision-making processes and on-ground field work helps to raise awareness and increase knowledge on local environmental related issues. Community groups and schools can also provide an invaluable resource to help with on-going revegetation efforts and monitoring.

Potential sites for revegetation have been identified within the Eastern Reserves due to the high level of bare ground, a lack of native understorey species and weed species present (Figure 9 to 11). It is recommended to ensure that regular maintenance occurs following revegetation installation with the removal of tree guards and bags once plants have established. Sizes of the proposed revegetation areas are shown in Table 4. Formal and informal tracks were present within the reserves which are shown in Figure 9 to 11.

**Table 4: Eastern Reserves proposed revegetation**

Location	Area (m2)
George Welby Park	5,943.8
Ron Carroll Reserve	12,331.53
Tom Firth Park	3,475.2

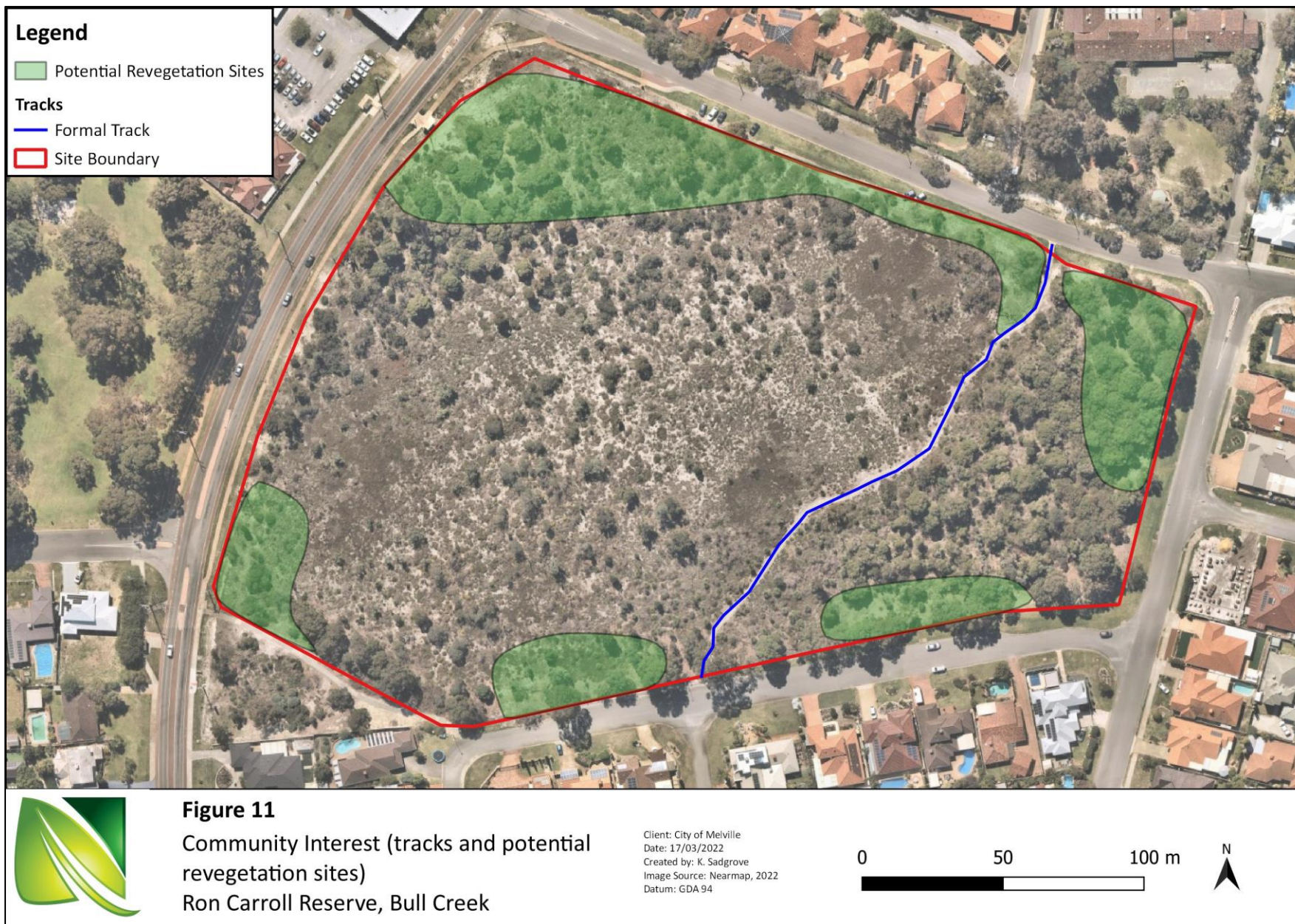












## 2.2.6 Reference Sites

Reference sites present within the Eastern Reserves include the fauna trapping locations as set out during the fauna survey by Natural Area in 2021, locations of these are shown in Appendix 1.

Trapping sites consisted of:

- Four trail cameras, two within George Welby Park and two at Ron Carroll Reserve
- Elliot traps
- trap lines consisting of funnel traps and fly-wire.

## 2.3 Species

Native flora, fauna and weed species were identified during the 2021 survey of the Eastern Reserves. Native flora and fauna are described in 2.3.1 and 2.3.2 with introduced species described within the Threats sections 3.3 and 3.5. Examples of flora species observed is shown in Figure 12.

### 2.3.1 Native Flora

A combined total of 191 species from 52 families were recorded in the Eastern Reserves during the 2021 survey, 88 species in George Welby, 83 species in Tom Firth and 155 species in Ron Carroll. Of the species recorded, 118 (61.8%) are native, 66 (34.5%) are introduced (weeds) and seven (3.6%) are planted species which are not endemic to the region. No threatened or priority species were recorded during the 2021 survey. The families Myrtaceae (myrtles) and Asteraceae (daisies) were the most species rich with both families recorded 23 different species.

Using the City of Melville's 'At-Risk' species list, no species on this list were recorded during the 2021 survey. Plant indices is shown in Table 5, examples of the flora species observed are shown in Figure 12, with a complete flora list in Appendix 3.

**Table 5: Plant Indices (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)**

Values	Plants	Status 2005 <sup>a</sup>	Status 2014 <sup>a</sup>	Status 2021	Assets 2014-2021	Comments
High Population at north/south edge of the natural distribution Well-represented in Melville reserves	<i>Melaleuca thymoides</i>	Assumed Present	50 shrubs RC 1 shrub GW	Present RC and GW	Confirmed present Maintained	These species are no longer on the 'at risk' register.
	<i>Beaufortia elegans</i>	Assumed Present	Appears Present Moderate Numbers	Absent	Not Maintained	
Low Well-represented in Melville reserves, but in low abundance in Eastern Reserves	<i>Banksia attenuata</i> Slender Banksia	Assumed Present	2 trees GW 9 trees RC 17 trees TF	Present in TF	1 species maintained and 2 species have a reduced presence.	
	<i>Banksia illicifolia</i> Holly-leaved Banksia		3 trees GW 11 trees RC 2 trees TF	Present in GW and RC		
	<i>Banksia menziesii</i> Firewood Banksia		11 trees GW 110 trees RC 31 trees TF	Present all reserves		

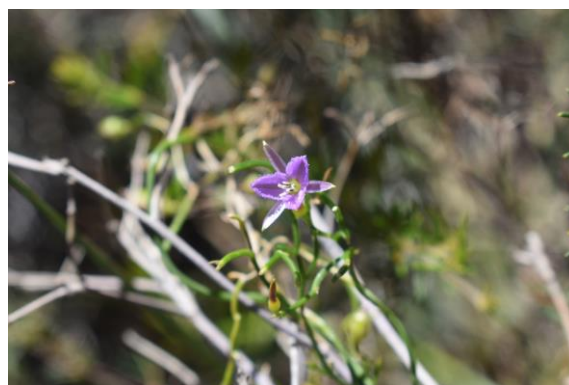
Source: Woodgis (2015)<sup>a</sup>







*Burchardia congesta*



*Thysanotus patersonii* (Fringed Lily)



*Dampiera linearis* (Common Dampiera)



*Caladenia flava* subsp. *flava*



*Jacksonia sternbergiana* (Stinkwood)



*Eremaea pauciflora*

**Figure 12:** Examples of native flora observed within the Eastern Reserves

### 2.3.2 Native Fauna

The Eastern Reserves provides a variety of habitats for an array of different fauna species with the potential for movement between Tom Firth and George Welby Park due to being connected through a vegetated corridor along the Kwinana Freeway. The fauna survey was conducted via trapping, night stalks and motion activated cameras between 19<sup>th</sup> and 22<sup>nd</sup>, with night stalk occurring on the 14<sup>th</sup> of October 2021. No trapping was conducted in Tom Firth due to the size and degraded state of the site, with no suitable location to hide the traps away from public interference, instead an active search was conducted on 20<sup>th</sup> October.

A total of 40 species from four species groups were observed across the Eastern Reserves, with 20% of species being introduced species (Table 6). Examples of species observed are shown in Figure 13 with a complete species list in Appendix 4.





**Table 6:** Native Fauna species found within the Eastern Reserves

Species Group	Eastern Reserves			
	George Welby	Ron Carroll	Tom Firth	Overall
Mammals	3	3	0	6
Birds	6	9	4	19
Reptiles	1	1	2	4
Invertebrates	9	8	2	19
<b>Total</b>	<b>18</b>	<b>20</b>	<b>8</b>	<b>46</b>





Bobtail  
(*Tiliqua rugosa rugosa*)



Crab Spider  
(*Stephanopis* sp.)



Quenda  
(*Isoodon fusciventer*)



Galah (nesting in hollows)  
(*Eolophus roseicapilla*)



Willie Wagtail  
(*Rhipidura leucophrys*)



Australian Magpie  
(*Gymnorhina tibicen*)

**Figure 13: Examples of fauna observed within Eastern Reserves**



### 2.3.2.1 Mammals

Of the six mammals observed in the Eastern Reserves, three were introduced species, the Domestic Dog (\**Canis lupus familiaris*), Cat (\**Felis catus*), and House Mouse (\**Mus musculus*). One 'at risk' species, Quenda (*Isoodon fusciventer*) which was recorded in George Welby via trapping and motion activated trail cameras. This species is also a Priority 4 under the *Biodiversity Conservation Act 2016* (WA). The one 'at risk' mammal species listed by the City is shown in Table 7 and their presence or absence is compared against fauna studies for previous management plans.

**Table 7: Mammal Indices (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)**

Values	Mammals	Status 2005	Status 2014	Status 2021	Assets
Very High	<i>Isoodon fusciventer</i> (Quenda)	-	-	Confirmed Present -GW (New record)	Assumed Maintained

### 2.2.1.2 Bats

Two species the *Chalinolobus gouldii* (Gould's Wattled Bat) and *Chalinolobus morio* (Chocolate Wattled Bat) were recorded through Echo Meter audio recordings during the 2021 survey. Both species are on the City's 'at risk' list with the bat indices provided in Table 8.

**Table 8: Bat Indices (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)**

Values	Bats	Status 2005	Status 2014	Status 2021	Assets
Medium	<i>Chalinolobus gouldii</i> (Gould's Wattled Bat)	-	Confirmed present	Confirmed present – GW, RC	Maintained
	<i>Chalinolobus morio</i> (Chocolate Wattled Bat)	-	-	Confirmed present - RC	Maintained
Low	<i>Vespadelus regulus</i> (Southern Forest Bat)	Assumed Present	Confirmed Present Eastern Reserves	Assumed Present	Assumed Unchanged

### 2.2.1.3 Birds

A total of 13 bird species were recorded during the 2021 survey of which three species are listed on the 'at risk' list, Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Red-tailed Black Cockatoo (*Calyptorhynchus banksii*), Pacific Black Duck (*Anas superciliosa*) and New Holland Honeyeater (*Phylidonyris novaehollandiae*). A total list of observed species is provided in Appendix 4.

Two conservation significant species was observed within the Eastern Reserves Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) which are listed as endangered under the *EPBC Act 1999* (Cwlth) and threatened under the *Biodiversity Conservation Act 2016* (WA). Birds that are classified as 'at risk' by the City are categorised by value in Table 9 and their presence or absence compared against fauna in previous management plans.





**Table 9: Bird Indices (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)**

Values	Birds	Status 2005	Status 2014	Status 2021	Assets 2015-2022
High	<i>Calyptorhynchus latirostris</i> (Carnaby's Black Cockatoo)	-	-	Present (new record)	Assumed maintained
	<i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)	-	-	Present (new record)	Assumed maintained
Low	<i>Anthochaera lunulata</i> Western Wattlebird				
	<i>Hirundo nigricans</i> Tree Martin		Confirmed		
	<i>Pardalotus striatus</i> Striated Pardalote	Assumed Present	Present Eastern Reserves	Assumed present	Assumed unchanged
	<i>Phylidonyris novaehollandiae</i> New Holland Honeyeater				
	<i>Purpureicephalus spurius</i> Red-capped Parrot				
	<i>Anas superciliosa</i> (Pacific Black Duck)	-	-	Present (new record)	Assumed maintained

### 2.2.1.4 Reptiles and Amphibians

No amphibians were recorded at the Eastern Reserves during the 2021 survey with three reptile species recorded (Appendix 4). No 'at risk' species were recorded during these surveys. Reptile species recorded during surveys are compared against fauna studies for previous management plans in Table 10.

**Table 10: Reptile Indices (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)**

Values	Reptiles	Status 2005	Status 2014	Status 2022	Assets
Low	<i>Lialis burtonis</i> Burton's Legless Lizard	Assumed Present in George Welby Park	Confirmed Present in George Welby Park (360 Environmental, 2014)	Assumed present in GW and RC	Assumed unchanged, suitable habitat.
	<i>Tiliqua rugosa rugosa</i> Bobtail	Assumed Present in Ron Carroll Reserve	Confirmed Present in Ron Carroll Reserve (Waters, 2015)	Present in RC, GW	Maintained in RC, increased presence in GW.
	<i>Cryptoblepharus buehnerii</i> (Buchanan's Snake-eyed Skink)	-	-	Present in TF	Assumed unchanged
	<i>Hemiergis quadrilineata</i> (Two-toed Earless Skink)	-	-	Present in TF	Assumed unchanged

### 2.2.1.5 Invertebrates

Invertebrates observed within the Eastern Reserves are listed in Appendix 4. A total of 17 was observed during the 2021 survey, of which three species are introduced. No 'at risk' species were identified as occurring with the Eastern Reserves.

## 3 Threats

Threats present within the eastern reserves include:

- physical disturbance
- fire
- weed species
- habitat loss
- feral animals
- disease and pathogens
- stormwater
- reticulation
- acid sulphate soils
- climate change.

### 3.1 Physical Disturbance

Physical disturbance relates to anthropogenic influences such as informal tracks, trampling of vegetation, dumping of rubbish and garden waste, removal of vegetation, unauthorised vehicle access and geocaching. Examples of the physical disturbance observed within the Eastern Reserves is shown in Figure 14 and locations are provided in Appendix 2, the disturbances present are assessed in Table 11.

Physical disturbances noted during the 2021 surveys across the reserves include:

- domestic rubbish
- dumped construction waste
- bushland management waste (Dieback injectors)
- unauthorised vehicle access
- trampling and the creation of informal tracks.

Dumped construction rubbish was noted to the east of the path which dissects Ron Carrol Reserve (-32.053037, 115.859468). The rubbish consists of concrete kerbing as shown in Figure 14. Other disturbances noted to occur within the Eastern Reserves include theft of Grass Trees (*Xanthorrhoea* sp.) which constitutes illegal clearing and can have negative impacts to the reserve such as loss of habitat species and potential for pathogen introduction.







Household rubbish



Rubbish dumping/Construction Waste (Ron Carroll Reserve)



Vehicle Tracks (Tom Firth Park)

**Figure 14:** Examples of physical disturbance within the Eastern Reserves

**Table 11:** Physical Disturbance Indices (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)

Impacts	Physical Disturbance	Disturbances 1995-2004	Disturbances 2005-2014	Disturbances 2021	Threats
<b>High</b> Potential to substantially change ecosystem structure, composition or function	Clearing for utilities	No Data	Minimal (but pruning beneath power lines can occur in George Welby Park)	No occurrences	Contained (low frequency of occurrence)
	Trampling		780 m <sup>2</sup>	TF- 65m <sup>2</sup> GW- 83m <sup>2</sup> Total – 148m <sup>2</sup>	Decrease
<b>Medium</b> Potential to moderately change ecosystem structure, composition or function	Sediment/Erosion		0 m <sup>2</sup>	No occurrences	Contained (low frequency of occurrence)
	Rubbish Dumping		Less than 1 time per year in each reserve	Minimal	
	Tree Poisoning, Illegal Clearing, Firewood Collection		0	No occurrences	
<b>Medium</b> Potentially costly remediation	Vandalism		Less than 1 time per year in each reserve	No occurrences	Contained
	Illegal Clearing - Theft of Grass Trees ( <i>Xanthorrhoea</i> sp.) from within reserves		No	No occurrences noted	



## 3.2 Fire

No signs of recent fires were present within George Welby Park and Tom Firth Park. Signs of a previous fire was observed within the western portion of Ron Carroll Reserve during the 2021 survey (Appendix 2). Evidence of fire was observed in charring of tree trunks although the understory vegetation within the area was not affected, indicating this was not a recent fire. No records of bushfires occur within the Eastern Reserves according to the DBCA Fire History dataset (DBCA 2022d). Fire indices are provided in Table 12. Relatively small and localised fires which range from 0.6 to 1.62 ha in size have occurred from 2005 to 2014, these are shown in Appendix 5.

**Table 12: Fire Indices**

Impacts	Fires	Extent of Fires 1995-2004	Extent of Fires 2005-2014	Extent of Fires 2021	Threats
<b>High</b> Potential for local extinctions of ground dwelling species	Large fires	No data	0 ha	No data	Assumed maintained
<b>High</b> Potential for local extinctions of trees and shrubs that regenerate only from seed stored on the plant	Repeated fires		0 ha	No data	
<b>Medium</b> Potential for moderate impact of ground dwelling species	Small spot fires, unauthorized campfires and bonfires	No Data	No Data	~0.08ha	Increased

## 3.3 Weeds

A total of 66 introduced (weed) species were identified during the 2021 survey, undertaken by Natural Area botanist Kylie Sadgrove and Karri Grant and field assistants Shelley Hill and Taryn Brebner. Weed species were then categorised through the categorization plan by the City of Melville under the categories Very High, High, Medium, Low (Table 13).

One significant weed species Bridal Creeper (*Asparagus asparagoides*) was present within Ron Carroll Reserve. Declared pests are listed on the Western Australian Organism List under the *Biosecurity and Agriculture Management Act 2007* (WA). This classification requires the landowner/land manager to control the population to limit damage resulting from the presence of these species (Department of Primary Industries and Regional Development 2022a).

Tables 14 to 17 show the individual weed species and groups rated as Very High and High within the different Eastern Reserves, where they have been assessed as either widespread (highlighted red) or localised. Density weed maps of these Very High and High weed species or groups are provided and examples of weeds are shown in Figure 15. Overall, extent of weed infestation has decreased across the Eastern Reserves with the exception of Annual Clumping Grasses, which showed increase from <1% to 28% and widespread in George Welby and Ron Carroll.

All other medium (perennial) and low (annual) priority weeds were recorded and assessed as localised or not present within the reserves. These weeds were spread throughout the reserves with some concentration along the edges of the reserves and along tracks.







Black Berry Nightshade (*\*Solanum nigrum*)



French Catchfly (*\*Silene gallica*)



Wild Gladiolus (*\*Gladiolus caryophyllaceus*)



Bridal Creeper (*\*Asparagus asparagoides*)

**Figure 15:** Examples of introduced flora species observed within the Eastern Reserves.



**Table 13: Number of Weed Species in each impact category**

Impact	Number of Weed Species in Eastern Reserves		
	George Welby	Ron Carroll	Tom Firth
Very High	2	2	2
High	12	17	10
Medium	7	11	7
Low	17	29	17
<b>Total</b>	<b>38</b>	<b>59</b>	<b>36</b>

**Table 14: Weed Indices – change in extent of infestation over time**

Impact	Species	2005	2014	2021	Threats
Very High	Arum Lily				
	Asparagus Fern				
	Golden Dodder				
	Lantana				
	Narrowleaf Cottonbush	-	0%	0%	Maintained
	One Leaf Cape Tulip				
	Paterson's Curse				
	Tamarisk				
High	Willows				
	Madeira Vine	X	0%	0%	Maintained
	Blackberry*	-	<1%	0%	Decreased
	Bridal Creeper	-	1%	0.6%	
	Soldiers ( <i>Lachenalia reflexa</i> )	-		0.5%	Increased
	Brazilian Pepper ( <i>Schinus terebinthifolius</i> )	-	3%	4.5%	
	Perennial Clumping Grass	X	67%	33.5%	Decrease
	Annual Clumping Grass	X	<1%	28%	Increase
Medium	Giant Grasses	-	0%	0%	Maintained
	Perennial Running Grass	X	2%	0.7%	Decrease
	Clumping Geophytes	X	59%	24.8%	
	Shrubs and Trees	X	26%	15%	
	Perennial Weeds	X	20%	16%	Decrease
Low	Annual Weeds	X	94%	45%	





**Table 15: Extent of infestations within George Welby**

Species or Group	Common Name	Priority	Count	Area			Extent
				>20 grid points	>2ha	>50% of reserve	
<i>Lachenalia reflexa</i>	Soldiers	Very High	1	No	No	No	Localised – isolated population
Perennial Clumping Grasses							
<i>Ehrharta calycina</i>	Perennial Veldt Grass	Very High	17	No	No	Yes	Widespread
Annual Clumping Grasses							
<i>Aria cupaniana</i> <i>Avena barbata</i> <i>Briza maxima</i> <i>Bromus catharticus</i> <i>Ehrharta longiflora</i> <i>Lolium rigidum</i> <i>Poa annua</i>	Silvery Hair Grass Bearded Oat Blowfly Grass Prairie Grass Annual Veldt Grass Wimmera Ryegrass Winter Grass	High	18	No	No	Yes	Widespread
Perennial Running Grasses							
<i>Cynodon dactylon</i>	Couch	High	1	No	No	No	Localised – isolated population
Clumping Geophytes							
<i>Gladiolus caryophyllaceus</i> <i>Oxalis pes-caprae</i> <i>Watsonia meriana</i>	Wild Gladiolus Soursob Bulbil Watsonia	High	18	No	No	Yes	Widespread
Trees and Shrubs							
<i>Acacia iteaphylla</i> <i>Acacia longifolia</i> <i>Callitris pyramidalis</i> <i>Chamelaucium uncinatum</i> <i>Melaleuca nesophila</i> <i>Schinus molle</i> <i>Washingtonia filifera</i>	Swamp Cypress Geraldton Wax Mindiyed	High	7	No	No	No	Localised – isolated populations mainly along footpath

**Table 16:** Extent of infestations within Tom Firth

Species or Group	Common Name	Priority	Count	Area			Extent
				>20 grid points	>2ha	>50% of reserve	
<i>Schinus terebinthifolia</i>		Very High	2	No	No	No	Localised – isolated population
Perennial Clumping Grasses							
<i>Ehrharta calycina</i>	Perennial Veldt Grass	Very High	7	No	No	Yes	Widespread
Annual Clumping Grasses							
<i>Aria cupaniana</i> <i>Avena barbata</i> <i>Briza maxima</i> <i>Bromus catharticus</i> <i>Ehrharta longiflora</i> <i>Lolium rigidum</i> <i>Poa annua</i>	Silvery Hair Grass Bearded Oat Blowfly Grass Prairie Grass Annual Veldt Grass Wimmera Ryegrass Winter Grass	High	5	No	No	No	Localised populations
Clumping Geophytes							
<i>Gladiolus caryophyllaceus</i> <i>Oxalis pes-caprae</i> <i>Watsonia meriana</i>	Wild Gladiolus Soursob Bulbil Watsonia	High	3	No	No	No	Localised populations
Trees and Shrubs							
<i>Acacia iteaphylla</i> <i>Acacia longifolia</i> <i>Callitris pyramidalis</i> <i>Chamelaucium uncinatum</i> <i>Melaleuca nesophila</i> <i>Schinus molle</i> <i>Washingtonia filifera</i>	Swamp Cypress Geraldton Wax Mindiyed	High	5	No	No	No	Localised populations



**Table 17: Extent of infestations within Ron Carroll**

Species or Group	Common Name	Priority	Count	Area			Extent
				>20 grid points	>2ha	>50% of reserve	
<i>Asparagus asparagoides</i>	Bridal Creeper	Very High	3	No	No	No	Localised
<i>Schinus terebinthifolia</i>		Very High	2	No	No	No	Localised
Perennial Clumping Grasses							
<i>Ehrharta calycina</i>	Perennial Veldt Grass	Very High	50	Yes	No	Yes	Widespread
Annual Clumping Grasses							
<i>Aria cupaniana</i> <i>Avena barbata</i> <i>Briza maxima</i> <i>Bromus catharticus</i> <i>Ehrharta longiflora</i> <i>Lolium rigidum</i> <i>Poa annua</i>	Silvery Hair Grass Bearded Oat Blowfly Grass Prairie Grass Annual Veldt Grass Wimmera Ryegrass Winter Grass	High	41	Yes	No	Yes	Widespread
Perennial Running Grasses							
<i>Cynodon dactylon</i>	Couch	High	1	No	No	No	Localised
Clumping Geophytes							
<i>Gladiolus caryophyllaceus</i> <i>Oxalis pes-caprae</i> <i>Watsonia meriana</i>	Wild Gladiolus Soursob Bulbil Watsonia	High	46	Yes	No	Yes	Widespread
Trees and Shrubs							
<i>Acacia iteaphylla</i> <i>Acacia longifolia</i> <i>Callitris pyramidalis</i> <i>Chamelaucium uncinatum</i> <i>Melaleuca nesophila</i> <i>Schinus molle</i> <i>Washingtonia filifera</i>	Swamp Cypress Geraldton Wax Mindiyed	High	5	No	No	No	Localised populations

### 3.4 Habitat Loss

Habitat loss can be assessed through assessment of bare ground and weed coverage percentage over time in order to establish trends. The percentage of bare ground for the Eastern Reserves is shown in Figures 16 to 18 and in Table 18, with percentage weed cover per reserve shown in Table 19.

Overall habitat loss is assessed in Table 20 looking at the extent of bare ground and weed cover greater than 25%. It is recommended that areas with >25% bare ground and weed cover be targeted for future revegetation. To maximise success, it is recommended to undertake revegetation in conjunction with weed control activities and watering if required. Bare ground was mapped as a percentage with 0% representing no bare ground and >25% being the highest recorded bare ground cover.

**Table 18: Bare Ground 2021**

Category	Eastern Reserves			
	George Welby	Ron Carroll	Tom Firth	Total
<5%	23	53	28	105
5-25%	46	28	29	103
>25%	31	19	43	93
<b>Total</b>	100	100	100	

**Table 19: Weed Cover 2021**

Category	Eastern Reserves			
	George Welby	Ron Carroll	Tom Firth	Combined
0%	0	0	0	
<5%	90	85	88	263
5-25%	7	46	12	65
>25%	3	15	0	18
<b>Total</b>	100	114	100	

**Table 20: Habitat Loss Indices**

Impact	Habitat Loss	% of Reserve 2005	% of Reserve 2014	% of Reserve 2021	Threat
<b>Medium</b> Process of moderate ecosystem function modification <ul style="list-style-type: none"> <li>Reduced natural regeneration</li> <li>Increased fire or erosion risk</li> </ul>	Weed Cover > 25%	No Data	15%	GW-3 RC-15 TF-0 Total - 20%	Increased
<b>Low</b> Process of low ecosystem function modification <ul style="list-style-type: none"> <li>Reduced natural regeneration</li> <li>Increased fire or erosion risk</li> </ul>	Bare Ground > 25%		5%	GW-31 RC-19 TF-43 Total - 24%	Increased







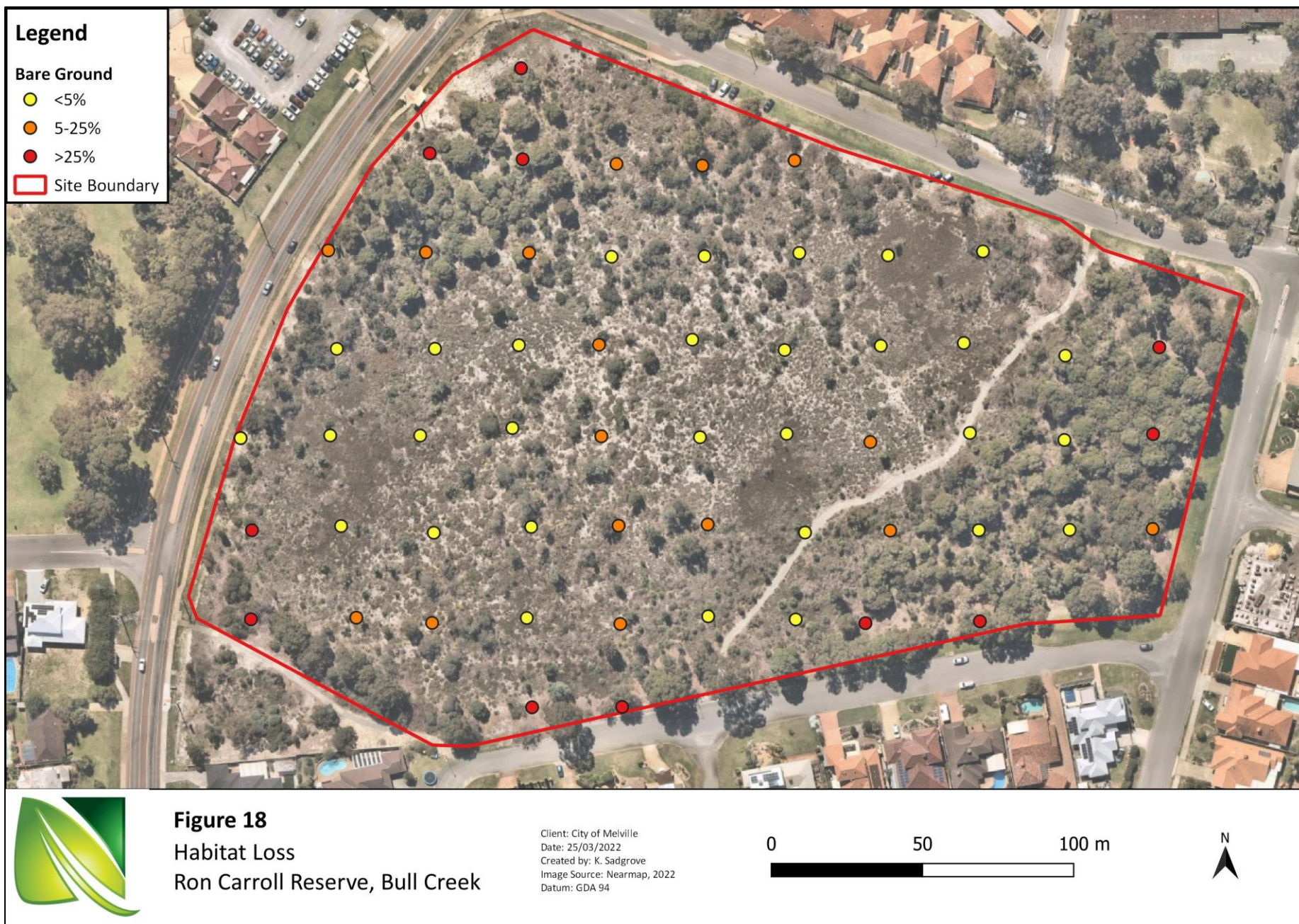
**Figure 16**  
**Habitat Loss**  
**George Welby Park, Bateman**

Client: City of Melville  
 Date: 25/03/2022  
 Created by: K. Sadgrove  
 Image Source: Nearmap, 2022  
 Datum: GDA 94

0 50 100 m











**Figure 17**  
Habitat Loss  
Tom Firth Park, Bateman

Client: City of Melville  
Date: 25/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94

0 25 50 m



### 3.5 Feral Animals

Feral fauna impact native fauna and flora through predation, competition for food, and shelter, spreading disease and destroying habitat. Seven feral fauna species were recorded during the 2021 survey. The presence of cats was observed on trail cameras in George Welby Park. Feral cats are a declared species under the *Biosecurity and Agriculture Management Act 2007 (BAM Act)*. The feral fauna indices are listed in Table 21 and a complete list of feral fauna occurrences (historical and during this survey) are shown in Table 22. Examples of feral fauna observed are shown in Figure 18.



**Figure 18:** Examples of domestic cats within the Eastern Reserves

**Table 21:** Feral Animal Indices (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)

Impact	Feral Animal	Occurrences 1995 - 2004	Occurrences 2005 - 2014	Occurrences 2021	Threat
<b>Very High</b> Key Threatening Process under the EPBC Act 1999	<i>Oryctolagus cuniculus</i> , Rabbit	No Data	No Data	Absent	Unchanged
	<i>Vulpes vulpes</i> , Fox			Confirmed Present -GW Assumed present -TF, RC	Increased
	<i>Felis catus</i> , Feral/Domestic Cat				
<b>High</b> Competition with native birds for hollows and food (impact level variable)	<i>Apis mellifera</i> , Honeybee		1 beehive in 2012	Assumed present	Unchanged



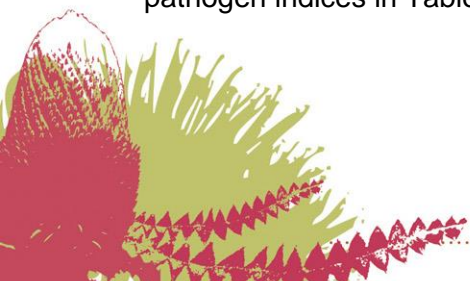
**Table 22: Feral Animal Records (GW-George Welby, TF-Tom Firth, RC-Ron Carroll)**

Feral Animal	Status 2005	Status 2014	Status 2021
<i>Oryctolagus cuniculus</i> , Rabbits	No Data	Not Present	Assumed Absent
<i>Vulpes vulpes</i> , Foxes			
<i>Felis catus</i> , Feral Cats	Assumed Present	Assumed Present	Confirmed Present – GW Assumed present TF, RC
<i>Mus musculus</i> , House Mice			Confirmed Present – GW Assumed present TF, RC
<i>Rattus norvegicus</i> , Brown Rat			Assumed present
<i>Rattus rattus</i> , Black Rat			Assumed present
<i>Streptopelia chinensis</i> , Spotted Dove	No data	Confirmed Present	Assumed present
<i>Trichoglossus haematodus</i> , Rainbow Lorikeet			Confirmed Present – GW, RC Assumed present - TF
<i>Streptopelia senegalensis</i> , Laughing Dove			Confirmed Present – TF, RC Assumed present - GW
<i>Apis mellifera</i> , Feral Honeybee	Confirmed Present 2012	Not Present	Assumed Present
<i>Halyomorpha halys</i> , Brown Marmorated Stink Bug	No data	No data	Confirmed Present – GW Assumed present – TF, RC
<i>Ommatoiulus moreleti</i> , Portuguese Millipede			Confirmed Present
<i>Pieris rapae</i> , Cabbage White Butterfly			Confirmed Present – RC Assumed present – TF, GW

### 3.6 Diseases and Pathogens

Vegetation can be subject to diseases that result in a decline in their vigour or death in the longer term. Common plant pathogens include *Phytophthora* (Dieback), *Armillaria luteobubalina* (Honey Fungus), *Quambalaria* (Marri Canker), Witches Broom and Myrtle Rust. Activities that impact directly on trees, such as the installation of nesting boxes can result in wounds making them more susceptible to infection from pathogens such as Marri Canker. No evidence of *Armillaria*, Marri Canker or Myrtle Rust was found within the Eastern Reserves. Witches Broom is an abnormal growth of plant tissues within the host plant although it is currently unknown what organism causes this response in *Banksia* species (Ranathunge 2019). Witches' Broom was observed on a *Banksia menziesii* in Ron Carroll Reserve, which was observed to not be adversely affecting the health of the infected plant (Figure 19).

Dieback has been recorded (*Phytophthora cinnamomi*) in all reserves with George Welby and Ron Carroll fully infested and Tom Firth partially infested (Appendix 2) (Glevan Consulting 2021). Dying susceptible species in the form of dead and dying *Banksia* trees was noted at all reserves (Figure 19). Locations of dying susceptible Dieback species is provided in Appendix 2 and disease and pathogen indices in Table 23.



**Table 23: Disease and pathogen indices**

Impact	Diseases and Pathogens	Extent 2005	Extent 2014	Extent 2021	Threat
<b>Very High</b> Key Threatening Process under the EPBC Act 1999	<i>Phytophthora cinnamomi</i> Dieback	No Data	93%	Assumed present - TF, GW, RC	Confirmed Dieback occurrence throughout Ron Carroll, George Welby and majority of Tom Firth Park
<b>Medium</b> Native species capable of moderate modification of structure and composition of flora by killing multiple species	<i>Armillaria luteobubalina</i> Honey Fungus		Assumed Absent	Absent	Assumed Prevented
<b>Low</b>	Witches Broom	No Data	No Data	Present - RC	Assumed maintained

**Figure 19: Left: Witches broom, Right: Death of *Banksia* species potentially dieback**

### 3.7 Stormwater

No storm water is directed into the Eastern Reserves with no observed impacts from stormwater observed during Natural Area's 2021 surveys.

### 3.8 Reticulation

No reticulation occurs with any of the Eastern Reserves although George Welby is situated next to an oval that receives reticulated water. No sighting of excessive overspray from reticulation or leakage from reticulations was observed to be affecting the bushland at George Welby Park. Indices for reticulation is found in Table 24 where an occurrence is defined as a recorded sighting of excessive overspray from reticulation or leakage.

**Table 24: Reticulation Indices**

Impact	Water Sources	Occurrences 1995 - 2004	Occurrences 2005 - 2014	Occurrences 2021	Threat
<b>Low</b> Alteration of Surface Water Flows	Overspray / leakages from reticulation	No Data	No Data	No Data	Contained – assumed unchanged

### 3.9 Acid Sulfate Soils

Acid sulphate soils are naturally occurring soils that contain iron sulphides, primarily in the form of pyrite materials, formed under waterlogged conditions in fresh and saline wetlands around Western Australia. If left unexposed to air they do not pose a significant risk to humans or the environment. However, if exposed to air sulphuric acid is formed and this can lead to the release of heavy metals



into the surrounding environment (DER, 2015). Acid sulfate soils can occur when the soils are disturbed, where:

- excavations for drainage maintenance or infrastructure construction are dug below the minimum level of the watertable
- groundwater extraction results in oxidation of soils previously permanently saturated by lowering the minimum level of the watertable.

Maintenance activities that require excavations or groundwater extractions are to be managed so that acid sulphate soil reactions do not occur. If this is done those activities will not be recorded as an occurrence of the threat. A review of the DWER acid sulfate risk map indicated that all the Eastern Reserves occur within an area of Moderate to Low Risk category (DWER, 2022a). No records of previous acid sulfate soils occurring from excavations or groundwater extraction are available. No obvious signs of acid sulfate soils were noted during the 2021 survey as shown in Table 25.

**Table 25: Acid Sulfate Soils Indices**

Impact	Potential Initiation of ASS Reactions	Occurrences 1995 - 2004	Occurrences 2005 - 2014	Occurrences 2005 - 2014	Threat
<b>Very High</b> An occurrence of could result in the reserve being listed as a contaminated site under the Contaminated Sites Act 2003	Excavations below the minimum level of the watertable	No Data	0	0	Prevented (assumed none occurred and no changes)
	Groundwater extraction resulting in lowering of minimum level watertable		0	0	

### 3.10 Climate Change

Climate change within the south-west of Western Australia is expected to cause more frequent and intense weather events, decreasing rainfall, rising sea levels and increasing temperatures. These changes are likely to increase the potential for erosion during storm events and associated strong winds and increased water stress on plants due to rising temperatures and decreasing rainfall.

Water stress has the potential to lead to changes in vegetation types and complexes which has the potential to affect the fauna that these vegetation associations support. Reduced rainfall may decrease the groundwater table and in turn negatively affect groundwater dependent species. As some areas of the Eastern Reserves have plants which are more commonly associated with wet areas, including Melaleuca Woodlands represented by dominant canopy species of *Melaleuca preissiana*, climate change has the potential to impact on these species resulting in changes in vegetation types. The City of Melville has undertaken a risk assessment to establish climate change risks within the Melville area which was used to develop a Climate Change Adaptation Plan.



## 4 Implementation

### 4.1 Management Strategies

The management objectives and implementation of strategies for 2022 – 2027 will be measured in KPIs discussed in the NAAMP (Woodgis, 2019).

#### 4.1.1 Key Performance Indicators (KPIs)

Leading indicators and trends indicate (for the life of a reserve management plan) (Table 26):

- whether guidelines and procedures are being effective in meeting objectives of preventing, eliminating, containing and managing impacts from threats; and
- provide a feedback mechanism as to whether guidelines and procedures need to be modified.

#### 4.1.2 Leading Indicators

Leading indicators are associated with changes in the density/ abundance/ extent/ occurrences of threats. The levels of acceptable changes are determined in the framework established in the NAAMP as summarised in Table 27 and applied in Tables 28.

**Table 26: Application of leading indicators**

Objective	Leading Indicators	Acceptable When
<b>Prevent</b>	Prevent <ul style="list-style-type: none"><li>▪ Introduction to or occurrence of</li></ul>	<ul style="list-style-type: none"><li>▪ Threat absent from reserve</li><li>▪ Unplanned introduction possible</li></ul>
<b>Eliminate</b>	Reduce <ul style="list-style-type: none"><li>▪ rate of density/ abundance/ extent</li><li>▪ eventual complete removal (short term may only reduce numbers or prevent seed set on site)</li></ul>	<ul style="list-style-type: none"><li>▪ Large discrepancy between current and potential impact</li><li>▪ Potential impact high</li><li>▪ Elimination feasible</li></ul>
<b>Contain</b>	Stop, restrict, or reduce <ul style="list-style-type: none"><li>▪ rate of spread or</li><li>▪ frequency of occurrence</li></ul>	<ul style="list-style-type: none"><li>▪ Moderate discrepancy between current and potential impact</li><li>▪ Potential but not current impact high</li><li>▪ Elimination not feasible</li></ul>
<b>Manage</b>	Limit <ul style="list-style-type: none"><li>▪ negative impacts on assets</li></ul>	<ul style="list-style-type: none"><li>▪ Small discrepancy between current and potential impact</li><li>▪ Threat “naturalised” or near maximum extent</li><li>▪ No information on density/ abundance/ extent</li></ul>
<b>Confirm</b>	Identify <ul style="list-style-type: none"><li>▪ number of threats for which their presence/extent is uncertain</li></ul>	<ul style="list-style-type: none"><li>▪ Historic but no records in reserve and/ or</li><li>▪ Presence/ extent uncertain in reserve</li></ul>
<b>None</b>	Not applicable	<ul style="list-style-type: none"><li>▪ Threat absent from reserve</li><li>▪ Only planned introduction possible</li></ul>





**Table 27: Objectives for Weed species in the Eastern Reserves**

Objective	Impact	Weed Species/ Group	2021 Extent	Comment
Prevent	Very High	<ul style="list-style-type: none"> <li>Tamarisk</li> <li>Blackberry</li> <li>Asparagus Fern (<i>aethiopicus</i>)</li> <li>Golden Dodder</li> <li>One Leaf Cape Tulip</li> <li>Madeira Vine</li> <li><i>Lantana camara</i></li> <li>Narrowleaf Cottonbush</li> <li>Paterson's Curse</li> <li>Arum Lily</li> <li>Prickly Pear</li> <li>African Lovegrass</li> </ul>	0	Not present on site
	High	<ul style="list-style-type: none"> <li>Giant Grasses</li> </ul>		
Eliminate	Very High	<ul style="list-style-type: none"> <li>Bridal Creeper</li> </ul>	0.6%	Localised Ron Carroll
		<ul style="list-style-type: none"> <li>Soldiers (<i>Lachenalia reflexa</i>)</li> </ul>	0.5%	Localised George Welby
		<ul style="list-style-type: none"> <li><i>Ehrharta calycina</i></li> </ul>	33.5%	Widespread George Welby, Tom Firth, and Ron Carroll
		<ul style="list-style-type: none"> <li><i>Schinus terebinthifolius</i></li> </ul>	4.5%	Localised Tom Firth and Ron Carroll
	High	<ul style="list-style-type: none"> <li>Annual Clumping Grasses</li> </ul>	28%	Localised Tom Firth, Widespread George Welby, and Ron Carroll
		<ul style="list-style-type: none"> <li>Clumping Geophytes</li> </ul>	24.8%	Localised Tom Firth, Widespread George Welby, and Ron Carroll
		<ul style="list-style-type: none"> <li>Trees and shrubs</li> </ul>	15%	Localised Tom Firth, George Welby, and Ron Carroll
		<ul style="list-style-type: none"> <li>Perennial Running Grasses</li> </ul>	0.7%	Localised George Welby, and Ron Carroll
Contain	Very High	<ul style="list-style-type: none"> <li>Perennial Clumping Grasses</li> </ul>	33.5%	Widespread Tom Firth, George Welby, and Ron Carroll
Manage	Medium	<ul style="list-style-type: none"> <li>All other perennial weeds</li> </ul>	16%	Widespread all reserves usually in area with open understory.
	Low	<ul style="list-style-type: none"> <li>All other annual weeds</li> </ul>	45%	

**Table 28: Objective for all other threats in the Eastern Reserves**

Objective	Impact	Threat	Comment
Prevent	Very High	Acid Sulphate Soils	These should not occur as no excavation or groundwater extraction is proposed, works of this nature should consider potential for acid sulphate soils.
		Diseases and Pathogens ( <i>Armillaria luteobubalina</i> )	Assumed absent- never recorded in the Eastern Reserves. Apply appropriate hygiene standards for on-ground works to prevent introduction.
		Ferals (Foxes and Rabbits)	Absent- implement controls within 10 working days of observation as per the City's Feral Animal Management Guidelines.
	High	Fires (large)	Prevent large fires that burn more than one third of the reserves, work in consultation with the Department Fire and Emergency Services to limit fires and maintain fire breaks.
Eliminate	Very High	Ferals (Bees)	Present- implement controls as per the City's Feral Animal Management Guidelines
Contain	Very High	Habitat Loss	Limit fragmentation (e.g., multiple paths and tracks). Areas with weeds and bare ground >25% prioritise for revegetation and management.
	High	Fire (repeat)	Limit fires burning in the same location within the bushland in consultation with Department of Fire and Emergency Services.
	Medium	Physical Disturbance	Present within the reserves. Limit public access by maintaining existing paths and fencing. Present in the form of rubbish dumping. Report disturbance through regular maintenance inspections to determine locations of dumped rubbish and to identify breaches in fencing and implement controls in accordance with the NAAMP.
Manage	Very High	Feral Animals (Cats)	Likely ongoing presence – difficult to prevent, eliminate or contain. Implement controls outlined in the City's Feral Animal Management Guidelines.  Increased presence of domestic cats, particular in George Welby adds predation pressure on local native fauna. As such, public awareness through letterbox drops, social media platforms to educate neighbouring residents on responsible pet ownership should be undertaken. Cage trapping to remove free-ranging problematic cats should also be considered.
		Diseases and Pathogens (Dieback)	Phytophthora Dieback occurrence across Eastern Reserves have been confirmed. Dieback has been recorded throughout George Welby and Ron Carroll with Tom Firth retaining a small portion which is Dieback free. Appropriate Dieback signage and cleaning stations should be installed to inform the public and promote proper Dieback hygiene protocols.
		Climate Change	Consideration should be given to the wider context of climate change and impacts that may occur over time. Monitor sites that contain groundwater dependent species, such as <i>Melaleuca preissiana</i> by installing reference quadrats.  Management can include: <ul style="list-style-type: none"> <li>▪ undertaking weed control to minimise competition for water with native plants</li> <li>▪ planting and enhancement of native vegetation cover within the reserves particularly where large-scale deaths occur, and potentially substituting species that are declining in the area with more adaptable species that can fill the same niche.</li> </ul> Records should be taken of changes over time to assist with knowledge and understanding of ongoing processes.



Objective	Impact	Threat	Comment
	Medium	Feral Animals (Rainbow Lorikeet)	Declared Pest- Implement controls outlined in the City's Feral Animal Management Guidelines
None	Low	Stormwater	No stormwater to be diverted into the Eastern Reserves
		Reticulation	Not present or required within the natural bushlands (Eastern Reserves). However, monitor for incidence of overspray or leaks from reticulation into native bushlands.

### 4.1.3 Lagging Indicators

Lagging indicators and trends in assets, indicate whether strategic goals of maintaining assets are being met. The levels of acceptable change are discussed in the NAAMP and are summarised in Table 29 and applied to the Eastern Reserves in Table 30 and 31.

**Table 29: Tiered Goals for assets and associated lagging indicators**

Goal	Lagging Indicator	Application When
<b>Enhance</b>	Increase in either: <ul style="list-style-type: none"> <li>▪ extent</li> <li>▪ density</li> <li>▪ number</li> <li>▪ occurrence</li> </ul>	Assets can be enhanced when: <ul style="list-style-type: none"> <li>▪ occurs in only one reserve and/ or</li> <li>▪ at risk of local extinction and/ or</li> <li>▪ minimal cost (e.g., incorporated in revegetation program) and/ or</li> <li>▪ reduces operational costs (e.g., reduced requirements for on-going for threat management)</li> </ul>
<b>Maintain</b>	No decrease in either: <ul style="list-style-type: none"> <li>▪ extent</li> <li>▪ density</li> <li>▪ number</li> <li>▪ occurrences</li> </ul>	Assets can be maintained when: <ul style="list-style-type: none"> <li>▪ asset occurs in a number of reserves and / or</li> <li>▪ not a risk of local extinction and/or</li> <li>▪ occurs in only one reserve but insufficient knowledge/resources to enhance</li> </ul>
<b>Confirm</b>	Decrease in: <ul style="list-style-type: none"> <li>▪ number of assets for which their presence is uncertain</li> </ul>	Assets significant when: <ul style="list-style-type: none"> <li>▪ historic but no recent records in reserve and/or</li> <li>▪ potentially to be in reserve based on habitat and/or proximity to other records</li> </ul>
<b>Monitor</b>	No indices for management effectiveness	Assets that cannot be maintained by action within City of Melville boundaries for which no quantifiable indices exist when: <ul style="list-style-type: none"> <li>▪ reserved are not critical component of habitat (e.g., highly mobile/ wide roaming and/or infrequent/irregular visitors to the City of Melville)</li> <li>▪ there is risk of local extinction from processes that cannot be mitigated by the City of Melville (e.g., climate change, some pathogens)</li> </ul>





**Table 30: Goals for species**

Goal	Priority	Asset	No. of Reserves (NAAMP)	Comments
Maintain Species	Very High	Red-tailed Black Cockatoo ( <i>Calyptrorhynchus banksii</i> )	8	Vulnerable migratory species, utilising the site for foraging. Maintain food sources including <i>Banksia</i> spp. And Eucalypts
		Carnaby's Cockatoo ( <i>Calyptrorhynchus latirostris</i> )	5	Endangered migratory species, utilising the site for foraging. Maintain food sources including <i>Banksia</i> spp. And Eucalypts
		Southern Brown Bandicoot / Quenda ( <i>Isoodon fusciventer</i> )	2	Priority 4. Present within George Welby Park. Maintain the population through maintenance of habitat, feral and weed control.
	Medium	Chocolate Wattled Bat ( <i>Chalinolobus morio</i> )	1	Maintain of this population through maintenance of habitat, healthy canopy, and mature trees.
		Gould's Wattled Bat ( <i>Chalinolobus gouldii</i> )	1	Maintain of this population through maintenance of habitat, healthy canopy, and mature trees.
		Burtons Legless Lizard ( <i>Lialis burtonis</i> )	2	Maintain of this species will occur through the maintenance of habitat particularly understory, leaf litter and habitat logs.
	Low	Pacific Black Duck ( <i>Anas superciliosa</i> )	8	Maintain of this population through maintenance of habitat, healthy canopy, and mature trees.
		Bobtail ( <i>Tiliqua rugosa</i> )	-	Maintain of this species will occur through the maintenance of habitat particularly understory, leaf litter and habitat logs.

Goal	Priority	Asset	No. of Reserves (NAAMP)	Comments
Confirm	High	<i>Beaufortia elegans</i>	-	<p>Maintain habitat through revegetation, weed control and disease management to enhance habit for these species.</p> <p>Further investigation required. Education programs in universities, schools and local community groups to assist in surveys and reporting potential sightings of these species.</p>
	Medium	Southern Forest Bat ( <i>Vespadelus regulus</i> )	1	
		Red-capped Parrot ( <i>Purpureicephalus spurius</i> )	10	
	Low	Striated Pardalote ( <i>Pardalotus striatus</i> )	2	
		Tree Martin ( <i>Hirundo nigricans</i> )	2	
		New Holland Honeyeater ( <i>Phylidonyris novaehollandiae</i> )	5	
		Western Wattlebird ( <i>Anthochaera lunulata</i> )	7	
	High	<i>Melaleuca thymoides</i>	9	Increase population of each species
	Low	<i>Banksia attenuata</i>	38	
		<i>Banksia ilicifolia</i>	39	
		<i>Banksia menziesii</i>	21	



**Table 31: Goals for Site**

Goal	Priority	Asset	Comments
Enhance	Medium	Proposed Revegetation Sites	<ul style="list-style-type: none"> <li>revegetate areas proposed in Figure 9 to 11, in accordance with the standard of rehabilitation in the NAAMP and following City Guidelines</li> <li>where tubestock is available, prioritise 'at risk' species and food sources of black cockatoos (Department of Environment and Conservation, 2011)</li> <li>increase planting of <i>B. attenuata</i> in George Welby and Ron Carroll</li> <li>increase planting of <i>B. ilicifolia</i> in Tom Firth</li> <li>Increase engagement with surrounding schools, TAFE and university in revegetation activities, promote community planting days</li> </ul>
Maintain	Very High	Ecological Communities	<ul style="list-style-type: none"> <li>maintain sites through weed control, revegetation, feral animal management and general reserve management (e.g., rubbish removal, fence maintenance) to manage threats within the reserve.</li> <li>rehabilitation within specific areas using appropriate species for the vegetation type present</li> </ul>
	High	Regional Ecological Linkage	<ul style="list-style-type: none"> <li>ecological linkages can be maintained through the maintenance of ecological communities and enhancement of these communities through proposed rehabilitation, also through avoiding clearing and fragmentation of the reserves.</li> </ul>
		Habitat Trees	<ul style="list-style-type: none"> <li>habitat trees to be protected by the management of threats such as fire and disease and enhancement of these communities via proposed rehabilitation.</li> <li>where safe, maintain dead habitat trees</li> <li>increase planting of large native trees that may in the future have the potential to develop into habitat trees and/or provide foraging sources. Species native to the region and are known to support black cockatoo foraging, roosting and breeding activities include <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i>.</li> <li>Due to the decline in habitat trees observed, targeted plantings of species which will mature to become habitat trees should be considered in future revegetation works.</li> </ul>
	Medium	Community Interest Sites (bat and bird boxes)	<ul style="list-style-type: none"> <li>continued monitoring of assets during the City's current inspection and maintenance works, any damage or repair requirements noted to be reported</li> <li>investigate the use of citizen science applications (e.g., FrogID, iNaturalist) to engage the wide community and provide monitoring and educational opportunities</li> </ul>
		Revegetation Sites	<ul style="list-style-type: none"> <li>maintain revegetation sites via infill planting, weed control and watering as required to complete the revegetation to the standard outlined in the NAAMP.</li> </ul>
Monitor	Low	All assets	<ul style="list-style-type: none"> <li>monitoring of all assets should occur in accordance with the City's policies and guidelines outlined in the NAAMP.</li> </ul>

# Weed Maps























**Perennial Running Grasses  
Distribution  
Ron Carroll Reserve, Bull Creek**

Client: City of Melbourne  
Date: 17/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94

0 50 100 m





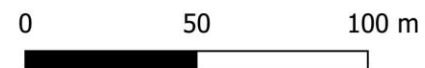




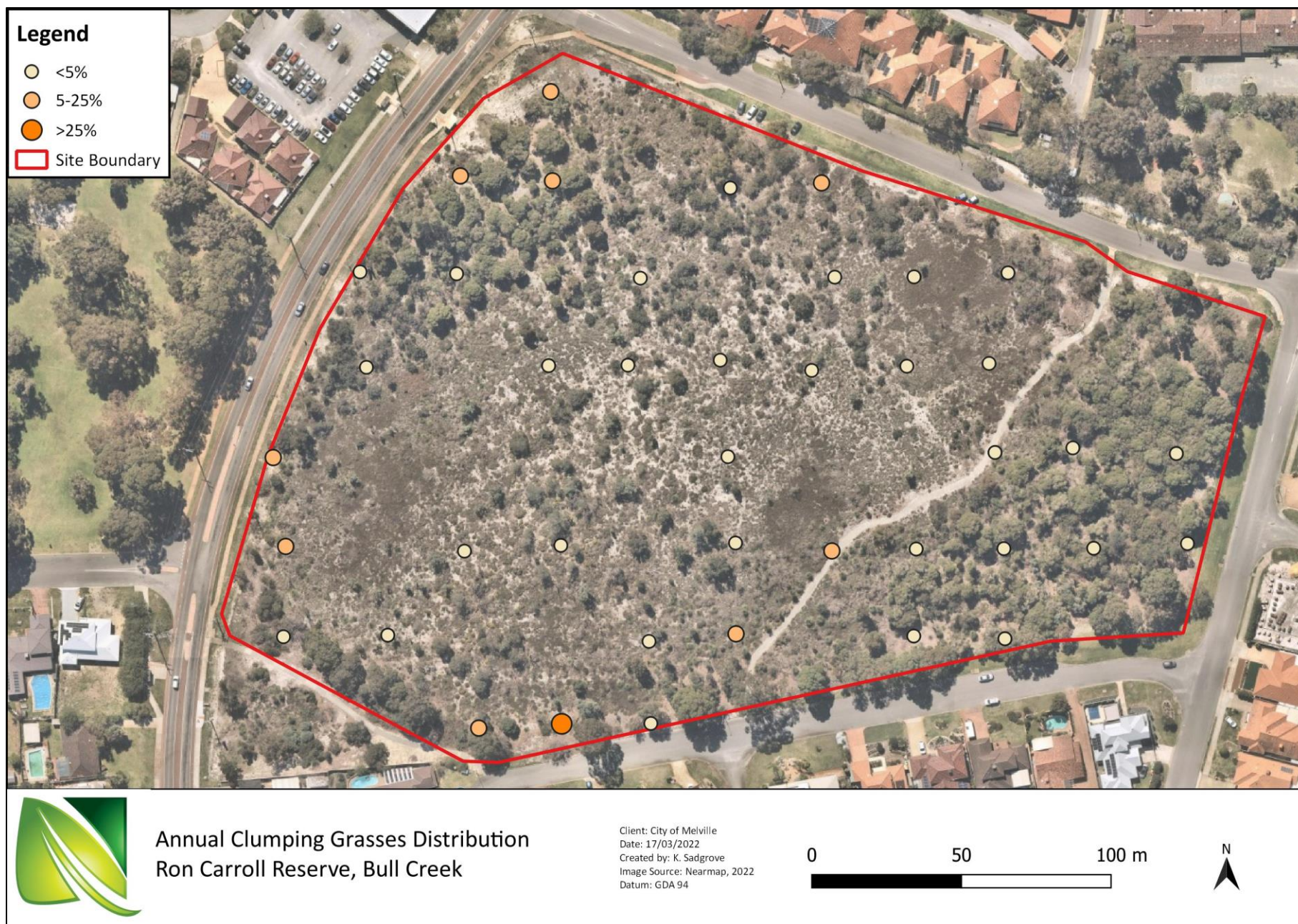


## Annual Clumping Grasses Distribution George Welby Park, Bateman

Client: City of Melville  
Date: 17/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94











## Perennial Running Grasses Distribution George Welby Park, Bateman

Client: City of Melville  
Date: 17/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94

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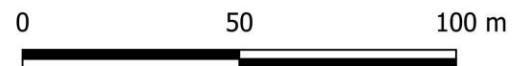






**Perennial Running Grasses  
Distribution  
Ron Carroll Reserve, Bull Creek**

Client: City of Melville  
Date: 17/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94












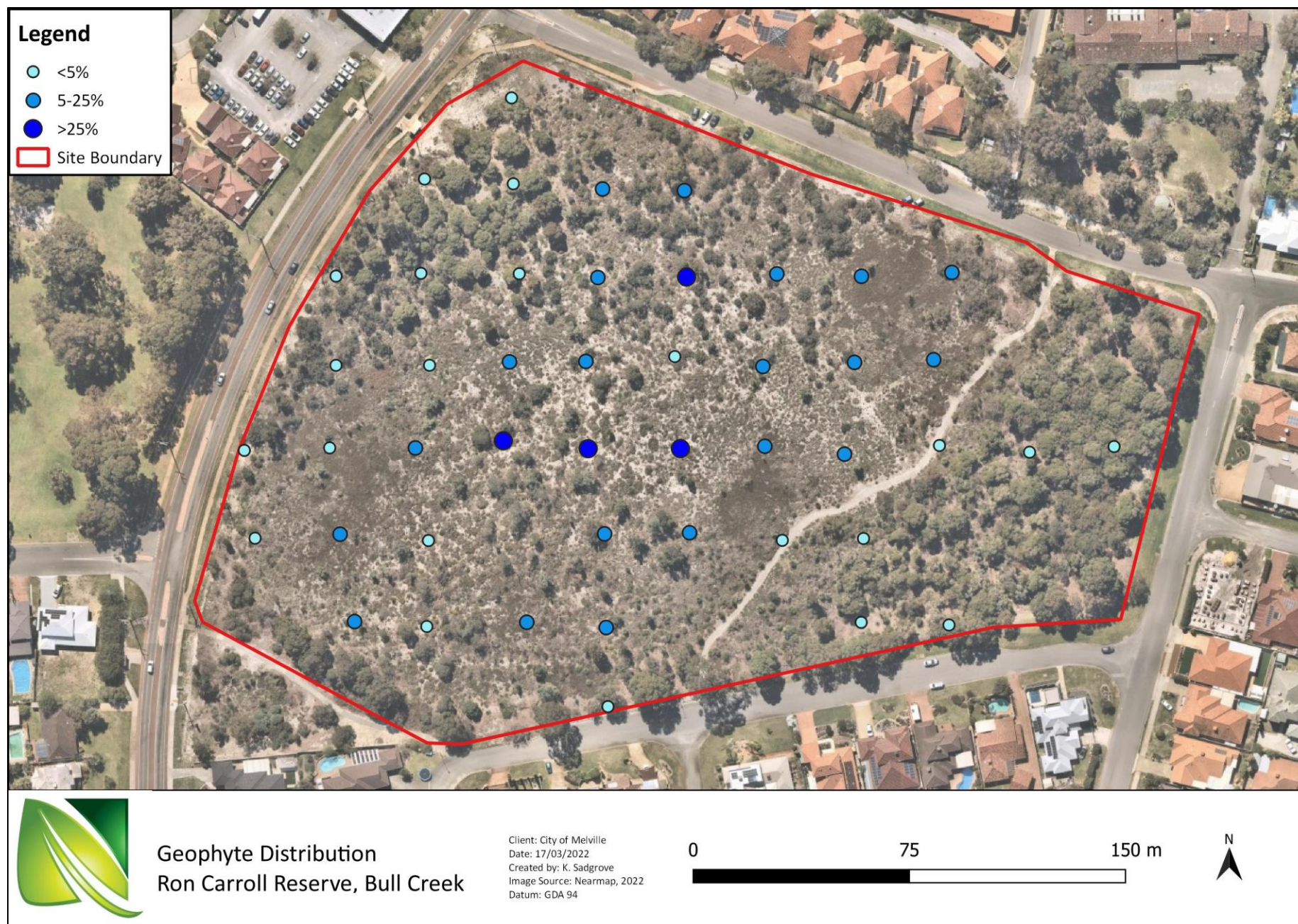
**Geophyte Distribution**  
**George Welby Park, Bateman**

Client: City of Melville  
Date: 17/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94

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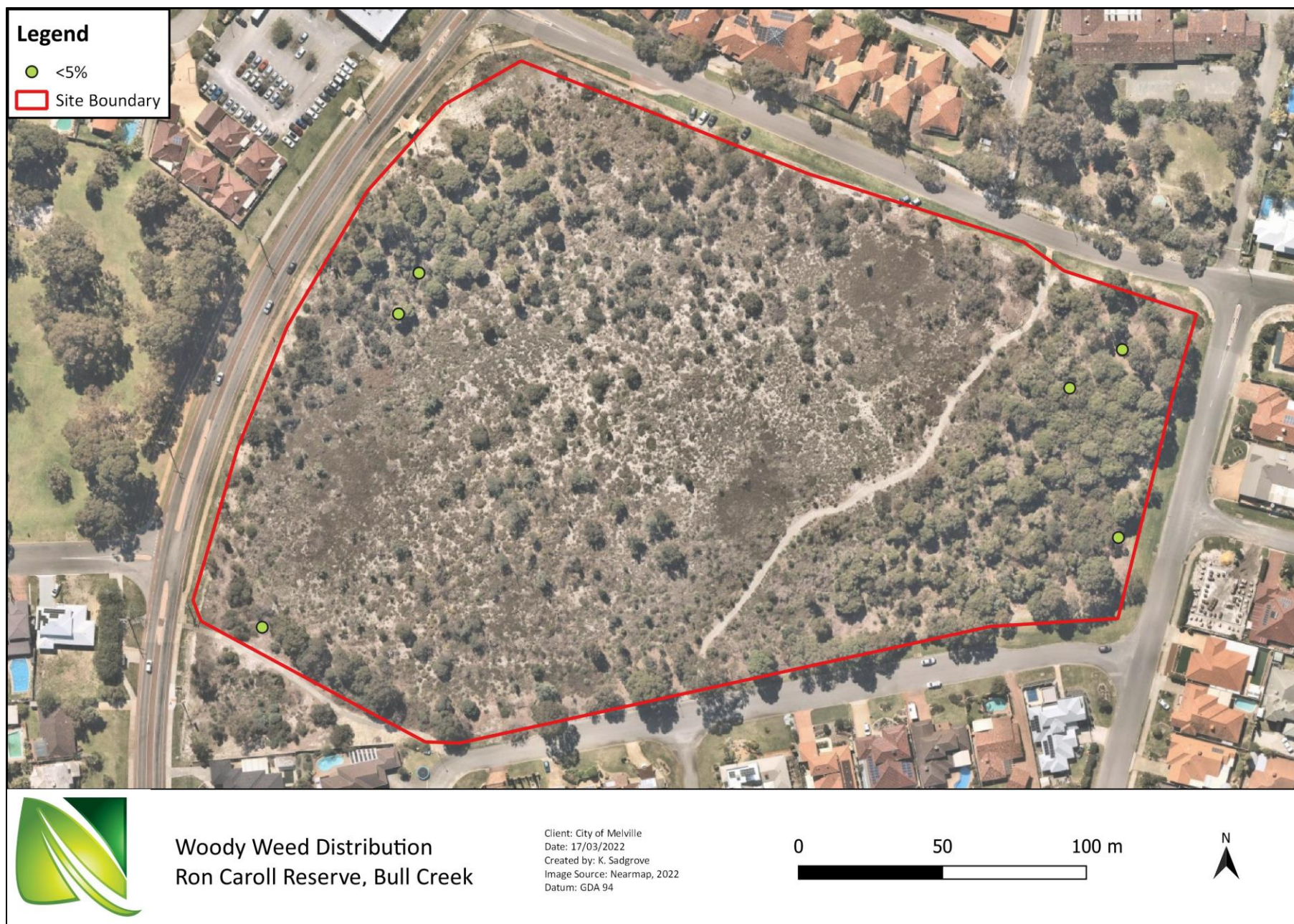
## Woody Weed Distribution George Welby Park, Bateman

Client: City of Melville  
Date: 17/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94

0 50 100 m









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# Appendix 1 – Fauna Trapping Locations







**Legend**

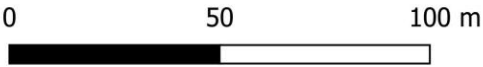
**Fauna Traps**

- Camera
- Elliot
- Trap Line
- Site Boundary



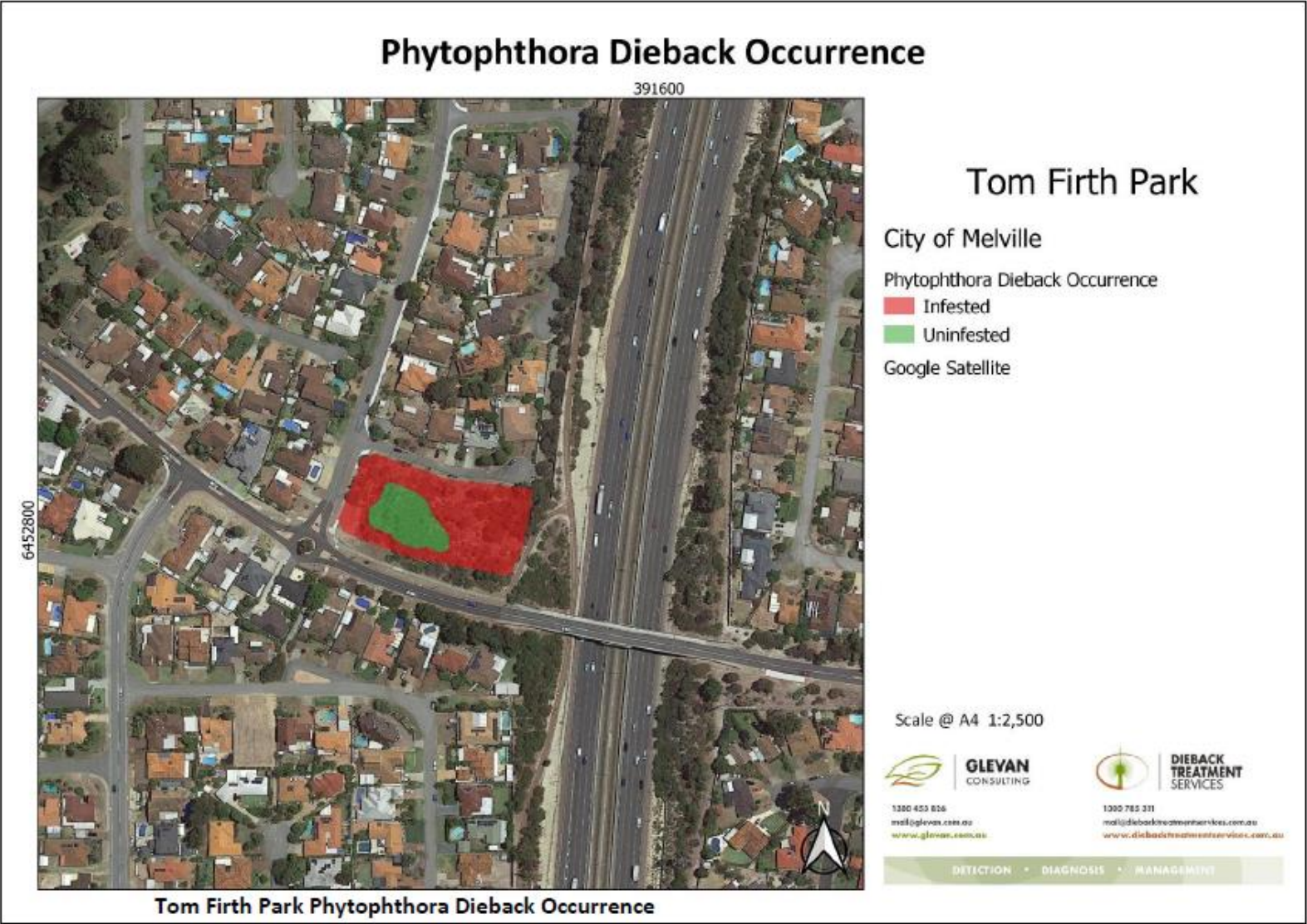
**Fauna Trap Locations**  
**Ron Carroll, Bull Creek WA**

Client: City of Melville  
Date: 16/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94





Appendix 2 – Disturbances













# Legend


-  Possible Dieback (dead Banksia sp.)
-  Site Boundary



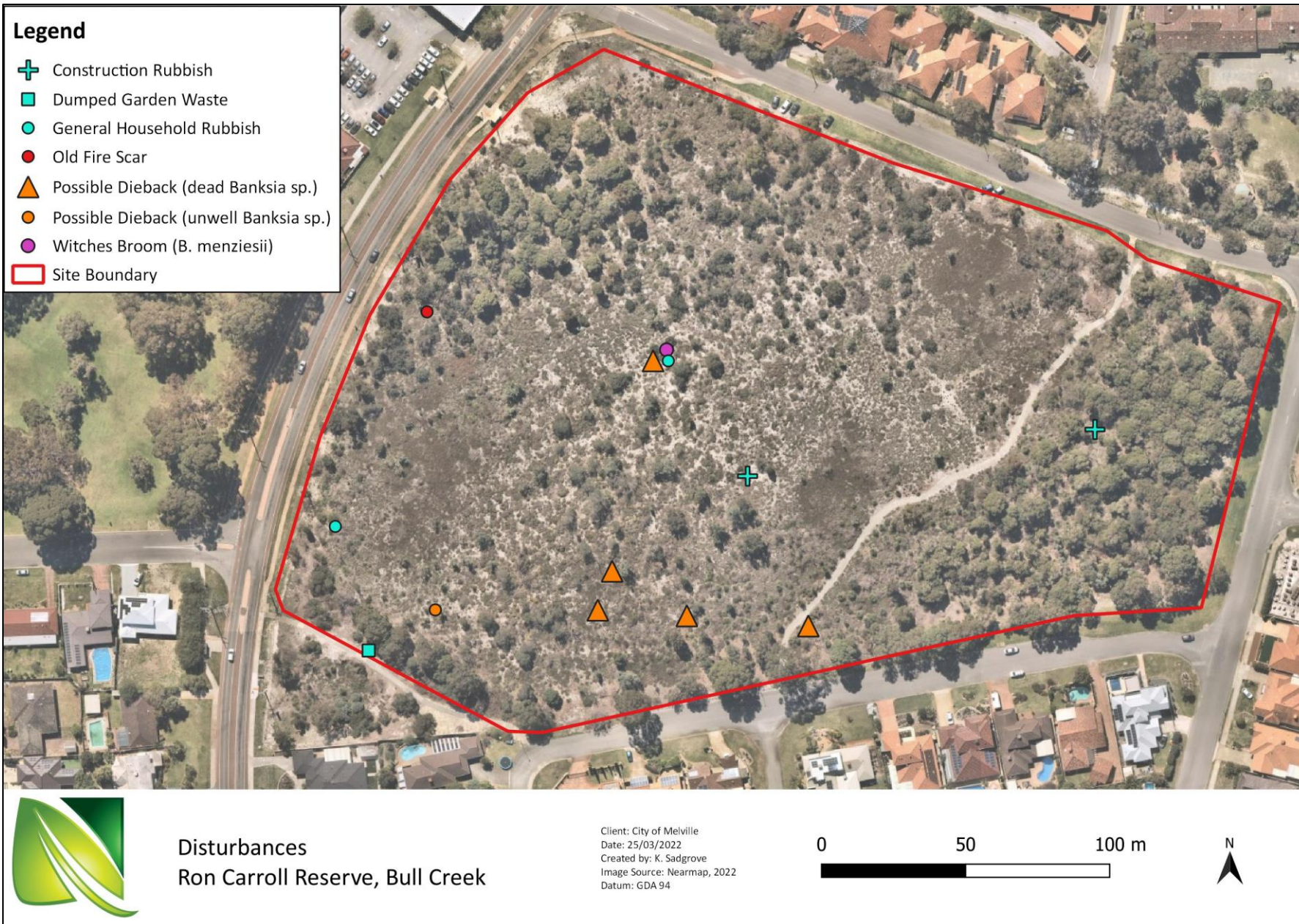
## Disturbances George Welby Park, Bateman WA

Client: City of Melville  
Date: 25/03/2022  
Created by: K. Sadgrove  
Image Source: Nearmap, 2022  
Datum: GDA 94

0 50 100 m





## Appendix 3 – Flora Species List

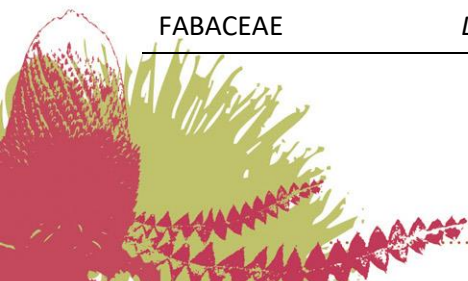
### Native

Family	Species	George Welby	Ron Carroll	Tom Firth	Previously Recorded
FABACEAE	<i>Acacia applanata</i>				X
FABACEAE	<i>Acacia huegelii</i>				X
FABACEAE	<i>Acacia lasiocarpa</i>	X			
FABACEAE	<i>Acacia pulchella</i>		X		X
FABACEAE	<i>Acacia saligna</i>	X	X	X	X
FABACEAE	<i>Acacia stenoptera</i>		X		X
PROTEACEAE	<i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i>	X	X		X
PROTEACEAE	<i>Adenanthos obovatus</i>		X		X
MYRTACEAE	<i>Agonis flexuosa</i>		X	X	
RESTIONACEAE	<i>Alexgeorgea nitens</i>		X		
CASUARINACEAE	<i>Allocasuarina fraseriana</i>	X	X		X
CASUARINACEAE	<i>Allocasuarina humilis</i>		X		X
POACEAE	<i>Amphipogon turbinatus</i>			X	
HAEMODORACEAE	<i>Anigozanthos humilis</i> subsp. <i>humilis</i>		X		X
HAEMODORACEAE	<i>Anigozanthos manglesii</i>		X		X
FABACEAE	<i>Aotus procumbens</i>		X		X
HEMEROCALLIDACEAE	<i>Arnocrinum preissii</i>				X
MYRTACEAE	<i>Astartea fascicularis</i>				X
MYRTACEAE	<i>Astartea scoparia</i>	X			X
POACEAE	<i>Austrostipa compressa</i>				X
POACEAE	<i>Austrostipa flavescens</i>		X		
PROTEACEAE	<i>Banksia attenuata</i>			X	X
PROTEACEAE	<i>Banksia grandis</i>				X
PROTEACEAE	<i>Banksia ilicifolia</i>	X	X		X
PROTEACEAE	<i>Banksia menziesii</i>	X	X	X	X
PROTEACEAE	<i>Banksia prionotes</i>		X		
PROTEACEAE	<i>Banksia sessilis</i>	X			
MYRTACEAE	<i>Beaufortia elegans</i>				X
PITTOSPORACEAE	<i>Billardiera fusiformis</i>				X

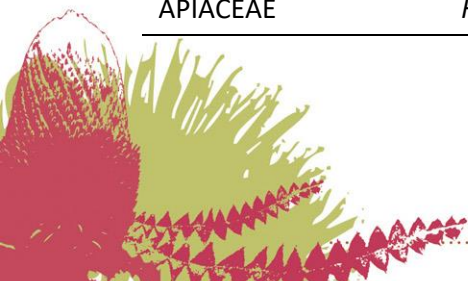




Family	Species	George Welby	Ron Carroll	Tom Firth	Previously Recorded
PITTOSPORACEAE	<i>Billardiera heterophylla</i>	X			
FABACEAE	<i>Bossiaea eriocarpa</i>	X	X	X	X
ERICACEAE	<i>Brachyloma preissii</i>				X
COLCHICACEAE	<i>Burchardia congesta</i>		X		X
ORCHIDACEAE	<i>Caladenia flava</i> subsp. <i>flava</i>	X		X	X
ORCHIDACEAE	<i>Caladenia latifolia</i>	X		X	
MONTIACEAE	<i>Calandrinia corrigioloides</i>		X		
DASYPOGONACEAE	<i>Calectasia narragara</i>		X		X
CUPRESSACEAE	<i>Callitris pyramidalis</i> #	X			
MYRTACEAE	<i>Calothamnus quadrifidus</i>			X	
MYRTACEAE	<i>Calytrix flavescens</i>				X
MYRTACEAE	<i>Calytrix fraseri</i>				X
LAURACEAE	<i>Cassytha racemosa</i>		X		X
LAURACEAE	<i>Cassytha</i> sp.	X			X
CENTROLEPIDACEAE	<i>Centrolepis aristata</i>				X
HEMEROCALLIDACEAE	<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>		X		X
POLYGALACEAE	<i>Comesperma calymega</i>				X
ERICACEAE	<i>Conostephium pendulum</i>			X	X
ERICACEAE	<i>Conostephium preissii</i>		X		X
HAEMODORACEAE	<i>Conostylis aculeata</i>	X	X	X	X
HAEMODORACEAE	<i>Conostylis juncea</i>		X		X
HAEMODORACEAE	<i>Conostylis setigera</i>				X
MYRTACEAE	<i>Corymbia calophylla</i>			X	X
HEMEROCALLIDACEAE	<i>Corynotheca micrantha</i>				X
CRASSULACEAE	<i>Crassula colorata</i> var. <i>colorata</i>				X
CRASSULACEAE	<i>Crassula decumbens</i>				X
RUTACEAE	<i>Cyanothamnus ramosus</i> subsp. <i>anethifolius</i> (syn. <i>Boronia ramosa</i> subsp. <i>anethifolia</i> )				X
GOODENIACEAE	<i>Dampiera linearis</i>	X	X	X	X
DASYPOGONACEAE	<i>Dasypogon bromeliifolius</i>	X	X	X	X
FABACEAE	<i>Daviesia decurrens</i>				X
FABACEAE	<i>Daviesia physodes</i>		X		X

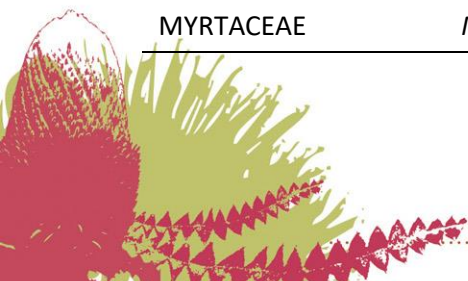


Family	Species	George Welby	Ron Carroll	Tom Firth	Previously Recorded
FABACEAE	<i>Daviesia triflora</i>				X
RESTIONACEAE	<i>Desmocladus flexuosus</i>				X
HEMEROCALLIDACEAE	<i>Dianella revoluta</i>				X
ASPARAGACEAE	<i>Dichopogon capillipes</i>				X
ORCHIDACEAE	<i>Diuris corymbosa</i>				X
DROSERACEAE	<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>				X
DROSERACEAE	<i>Drosera drummondii</i>		X		
DROSERACEAE	<i>Drosera glanduligera</i>				X
DROSERACEAE	<i>Drosera macrantha</i> subsp. <i>macrantha</i>				X
DROSERACEAE	<i>Drosera menziesii</i> subsp. <i>penicillaris</i>				X
MYRTACEAE	<i>Eremaea pauciflora</i>	X	X		X
MYRTACEAE	<i>Eucalyptus camaldulensis</i>	X		X	
MYRTACEAE	<i>Eucalyptus lehmannii</i>			X	
MYRTACEAE	<i>Eucalyptus marginata</i>	X	X	X	X
FABACEAE	<i>Euchilopsis linearis</i>		X		X
ASTERACEAE	<i>Euchiton sphaericus</i>		X		X
FABACEAE	<i>Gastrolobium capitatum</i>				X
FABACEAE	<i>Gompholobium tomentosum</i>	X	X		X
HALORAGACEAE	<i>Gonocarpus cordiger</i>				X
PROTEACEAE	<i>Grevillea crithmifolia</i>	X	X	X	
HAEMODORACEAE	<i>Haemodorum laxum</i>		X		
HAEMODORACEAE	<i>Haemodorum spicatum</i>				X
PROTEACEAE	<i>Hakea prostrata</i>	X		X	X
PROTEACEAE	<i>Hakea varia</i>				X
FABACEAE	<i>Hardenbergia comptoniana</i>		X		X
LAMIACEAE	<i>Hemiandra pungens</i>		X	X	X
DILLENIACEAE	<i>Hibbertia huegelii</i>			X	X
DILLENIACEAE	<i>Hibbertia hypericoides</i>		X	X	X
DILLENIACEAE	<i>Hibbertia racemosa</i>				X
DILLENIACEAE	<i>Hibbertia subvaginata</i>				X
APIACEAE	<i>Homalosciadium homalocarpum</i>				X





Family	Species	George Welby	Ron Carroll	Tom Firth	Previously Recorded
FABACEAE	<i>Hovea pungens</i>	X	X		X
FABACEAE	<i>Hovea trisperma</i>		X	X	X
MYRTACEAE	<i>Hypocalymma angustifolium</i>		X	X	X
MYRTACEAE	<i>Hypocalymma robustum</i>				X
RESTIONACEAE	<i>Hypolaena exsulca</i>	X	X		X
FABACEAE	<i>Jacksonia furcellata</i>	X	X		X
FABACEAE	<i>Jacksonia sternbergiana</i>	X	X		X
MYRTACEAE	<i>Kunzea glabrescens</i>	X	X		X
ASPARAGACEAE	<i>Laxmannia ramosa</i> subsp. <i>ramosa</i>				X
ASPARAGACEAE	<i>Laxmannia squarrosa</i>	X	X		
GOODENIACEAE	<i>Lechenaultia expansa</i>				X
GOODENIACEAE	<i>Lechenaultia floribunda</i>	X	X	X	X
CYPERACEAE	<i>Lepidosperma longitudinale</i>		X		
CYPERACEAE	<i>Lepidosperma oldhamii</i>		X		
CYPERACEAE	<i>Lepidosperma aff. scabrum</i>				X
CYPERACEAE	<i>Lepidosperma longitudinale</i>				X
CYPERACEAE	<i>Lepidosperma pubisquameum</i>				X
CYPERACEAE	<i>Lepidosperma squamatum</i>	X			X
STYLIDIACEAE	<i>Levenhookia pusilla</i>				X
CAMPANULACEAE	<i>Lobelia tenuior</i>				X
ASPARAGACEAE	<i>Lomandra caespitosa</i>	X		X	
ASPARAGACEAE	<i>Lomandra hermaphrodita</i>		X		
ASPARAGACEAE	<i>Lomandra brittanii</i>				X
ASPARAGACEAE	<i>Lomandra caespitosa</i>				X
ASPARAGACEAE	<i>Lomandra hermaphrodita</i>				X
ASPARAGACEAE	<i>Lomandra odora</i>				X
ASPARAGACEAE	<i>Lomandra preissii</i>		X		
RESTIONACEAE	<i>Loxocarya cinerea</i>				X
ANARTHRIACEAE	<i>Lyginia barbata</i>		X	X	X
ANARTHRIACEAE	<i>Lyginia imberbis</i>	X	X	X	X
ZAMIACEAE	<i>Macrozamia riedlei</i>		X		X
MYRTACEAE	<i>Melaleuca huegelii</i>	X			



Family	Species	George Welby	Ron Carroll	Tom Firth	Previously Recorded
MYRTACEAE	<i>Melaleuca lateritia</i>				X
MYRTACEAE	<i>Melaleuca preissiana</i>		X		X
MYRTACEAE	<i>Melaleuca raphiophylla</i>	X			
MYRTACEAE	<i>Melaleuca seriata</i>				X
MYRTACEAE	<i>Melaleuca thymoides</i>	X	X		X
CYPERACEAE	<i>Mesomelaena pseudostygia</i>			X	X
ORCHIDACEAE	<i>Microtis media subsp. media</i>		X	X	X
ASTERACEAE	<i>Millotia tenuifolia</i>				X
EUPHORBIACEAE	<i>Monotaxis occidentalis</i>				X
LORANTHACEAE	<i>Nuytsia floribunda</i>	X	X	X	X
ASTERACEAE	<i>Olearia axillaris</i>			X	
RUBIACEAE	<i>Opercularia vaginata</i>	X	X	X	X
IRIDACEAE	<i>Patersonia occidentalis</i>	X	X	X	X
MYRTACEAE	<i>Pericalymma ellipticum</i>	X	X		X
PROTEACEAE	<i>Petrophile linearis</i>				X
PROTEACEAE	<i>Persoonia saccata</i>		X		
RUTACEAE	<i>Philotheca spicata</i>		X	X	X
HAEMODORACEAE	<i>Phlebocarya ciliata</i>	X	X	X	X
LOGANIACEAE	<i>Phyllangium paradoxum</i>		X		X
THYMELAEACEAE	<i>Pimelea ferruginea</i>		X		
THYMELAEACEAE	<i>Pimelea rosea</i>				X
THYMELAEACEAE	<i>Pimelea sulphurea</i>				X
ASTERACEAE	<i>Pithocarpa pulchella</i>	X			X
ASTERACEAE	<i>Podotheca angustifolium</i>		X	X	
ASTERACEAE	<i>Podotheca gnaphalioides</i>		X		X
PHYLLANTHACEAE	<i>Poranthera microphylla</i>				X
ORCHIDACEAE	<i>Pterostylis sp.</i>		X		
ORCHIDACEAE	<i>Pterostylis recurva</i>				X
ORCHIDACEAE	<i>Pterostylis vittata</i>				X
ASTERACEAE	<i>Quinetia urvillei</i>				X
MYRTACEAE	<i>Regelia ciliata</i>	X			X
MYRTACEAE	<i>Regelia inops</i>	X	X		X





Family	Species	George Welby	Ron Carroll	Tom Firth	Previously Recorded
ASTERACEAE	<i>Rhodanthe chlorocephala</i> subsp. <i>rosea</i>				X
ASTERACEAE	<i>Rhodanthe citrina</i>		X		X
POACEAE	<i>Rytidosperma pilosum</i>				X
GOODENIACEAE	<i>Scaevola crassifolia</i>			X	
GOODENIACEAE	<i>Scaevola repens</i> var. <i>repens</i>		X	X	X
CYPERACEAE	<i>Schoenus brevisetis</i>				X
CYPERACEAE	<i>Schoenus curvifolius</i>				X
CYPERACEAE	<i>Schoenus efoliatus</i>				X
CYPERACEAE	<i>Schoenus grandiflorus</i>				X
CYPERACEAE	<i>Schoenus pedicellatus</i>	X	X		
CYPERACEAE	<i>Schoenus subfascicularis</i>				X
MYRTACEAE	<i>Scholtzia involucrata</i>		X	X	X
ASTERACEAE	<i>Senecio pinnatifolius</i> var. <i>maritimus</i>				X
ASTERACEAE	<i>Siloxerus humifusus</i>		X		X
RHAMNACEAE	<i>Spyridium globulosum</i>			X	
PROTEACEAE	<i>Stirlingia latifolia</i>		X		X
STYLIDIACEAE	<i>Stylidium brunonianum</i>		X		X
STYLIDIACEAE	<i>Stylidium carnosum</i>				X
STYLIDIACEAE	<i>Stylidium piliferum</i>				X
STYLIDIACEAE	<i>Stylidium repens</i>		X		X
STYLIDIACEAE	<i>Stylidium schoenoides</i>				X
STYLIDIACEAE	<i>Stylidium rigidulum</i>		X		
ERICACEAE	<i>Styphelia conostephioides</i>		X		X
ERICACEAE	<i>Styphelia xerophylla</i>		X		
CYPERACEAE	<i>Tetraria octandra</i>				X
ASPARAGACEAE	<i>Thysanotus arbuscula</i>				X
ASPARAGACEAE	<i>Thysanotus patersonii</i>	X	X		
ASPARAGACEAE	<i>Thysanotus manglesianus</i>				X
ASPARAGACEAE	<i>Thysanotus multiflorus</i>		X		X
ASPARAGACEAE	<i>Thysanotus patersonii</i>				X
ARALIACEAE	<i>Trachymene pilosa</i>	X	X	X	X
HEMEROCALLIDACEAE	<i>Tricoryne elatior</i>		X		



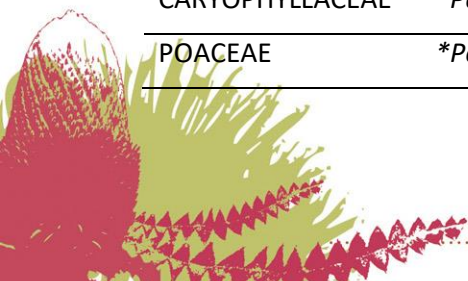
Family	Species	George Welby	Ron Carroll	Tom Firth	Previously Recorded
CELASTRACEAE	<i>Tripterococcus brunonis</i>				X
ASTERACEAE	<i>Waitzia suaveolens</i>		X		X
XANTHORRHOEACEAE	<i>Xanthorrhoea brunonis</i>	X	X	X	X
XANTHORRHOEACEAE	<i>Xanthorrhoea preissii</i>	X	X	X	X
APIACEAE	<i>Xanthosia huegelii</i>		X		X

## Weeds and Dubious species

Family	Species	George Welby	Ron Carroll	Tom Firth
<b>Dubious</b>				
FABACEAE	<i>#Acacia cyclops</i> (planted)		X	X
SCORPHULARIACEAE	<i>#Eremophila glabra</i>			X
MYRTACEAE	<i>#Eucalyptus citriodora</i>		X	
MYRTACEAE	<i>#Eucalyptus grandis</i>	X	X	
PROTEACEAE	<i>#Grevillea olivacea</i> (planted)		X	X
PROTEACEAE	<i>#Grevillea pinaster</i> (landscape hybrid)		X	
EUPHORBIACEAE	<i>#Ricinocarpus glaucus</i> (planted)		X	
<b>Weeds</b>				
FABACEAE	<i>*Acacia iteaphylla</i>	X	X	
FABACEAE	<i>*Acacia longifolia</i>	X	X	
POACEAE	<i>*Aira cupaniana</i>	X	X	X
ASTERACEAE	<i>*Arctotheca calendula</i>	X	X	X
ASPARAGACEAE	<i>*Asparagus asparagoides</i>		X	
POACEAE	<i>*Avena barbata</i>	X	X	X
BRASSICACEAE	<i>*Brassica tournefortii</i>	X	X	X
POACEAE	<i>*Briza maxima</i>	X	X	X
POACEAE	<i>*Briza minor</i>	X	X	
POACEAE	<i>*Bromus catharticus</i>	X	X	
BRASSICACEAE	<i>*Cardamine hirsuta</i>		X	
AIZOACEAE	<i>*Carpobrotus edulis</i>	X	X	
CASUARINACEAE	<i>*Casuarina cunninghamiana</i>	X		
MYRTACEAE	<i>*Chamelaucium uncinatum</i>	X		X
ASTERACEAE	<i>*Cotula coronopifolia</i>		X	
CRASSULACEAE	<i>*Crassula alata</i>	X	X	X



Family	Species	George Welby	Ron Carroll	Tom Firth
POACEAE	<i>*Cynodon dactylon</i>	X	X	
ORCHIDACEAE	<i>*Disa bracteata</i>		X	X
SCROPHULARIACEAE	<i>*Dischisma arenarium</i>		X	
POACEAE	<i>*Ehrharta calycina</i>	X	X	X
POACEAE	<i>*Ehrharta longiflora</i>	X	X	
POACEAE	<i>*Eragrostis curvula</i>			X
GERANIACEAE	<i>*Erodium botrys</i>		X	
GERANIACEAE	<i>*Erodium cicutarium</i>		X	
EUPHORBIACEAE	<i>*Euphorbia peplus</i>	X	X	X
EUPHORBIACEAE	<i>*Euphorbia terracina</i>	X	X	X
PAPAVERACEAE	<i>*Fumaria bastardii</i>		X	X
PAPAVERACEAE	<i>*Fumaria capreolata</i>	X	X	X
RUBIACEAE	<i>*Galium murale</i>	X	X	X
ASTERACEAE	<i>*Gazania linearis</i>		X	X
IRIDACEAE	<i>*Gladiolus caryophyllaceus</i>	X	X	X
BRASSICACEAE	<i>*Heliophila pusilla</i>		X	
ASTERACEAE	<i>*Hypochaeris glabra</i>	X	X	X
ASTERACEAE	<i>*Hypochaeris radicata</i>	X		
ASPARAGACEAE	<i>*Lachenalia reflexa</i>	X		
ASTERACEAE	<i>*Lactuca serriola</i>	X	X	X
ASTERACEAE	<i>*Leontodon rhagadioloides</i>	X	X	X
POACEAE	<i>*Lolium rigidum</i>		X	
PRIMULACEAE	<i>*Lysimachia arvensis</i>	X	X	X
FABACEAE	<i>*Medicago polymorpha</i>		X	
MYRTACEAE	<i>*Melaleuca nesophila</i>			X
PLANTAGINACEAE	<i>*Misopates orontium</i>		X	
ASTERACEAE	<i>*Monoculus monstrosus</i>		X	
ONAGRACEAE	<i>*Oenothera drummondii</i>	X	X	
ASTERACEAE	<i>*Osteospermum ecklonis</i>		X	X
OXALIDACEAE	<i>*Oxalis pes-caprae</i>		X	X
GERANIACEAE	<i>*Pelargonium capitatum</i>	X	X	X
CARYOPHYLLACEAE	<i>*Petrohragia dubia</i>	X	X	X
POACEAE	<i>*Poa annua</i>		X	



Family	Species	George Welby	Ron Carroll	Tom Firth
ASTERACEAE	<i>*Pseudognaphalium luteoalbum</i>		X	
ANACARDIACEAE	<i>*Schinus molle</i>			X
ANACARDIACEAE	<i>*Schinus terebinthifolia</i>		X	X
ASTERACEAE	<i>*Senecio vulgaris</i>		X	X
CARYOPHYLLACEAE	<i>*Silene gallica</i>	X	X	
SOLANACEAE	<i>*Solanum nigrum</i>		X	X
ASTERACEAE	<i>*Sonchus asper</i>	X	X	X
ASTERACEAE	<i>*Sonchus oleraceus</i>	X	X	X
CARYOPHYLLACEAE	<i>*Stellaria media</i>	X	X	
FABACEAE	<i>*Trifolium campestre</i>	X	X	
FABACEAE	<i>*Trifolium dubium</i>		X	
ASTERACEAE	<i>*Urospermum picroides</i>	X	X	X
ASTERACEAE	<i>*Ursinia anthemoides</i>	X	X	X
FABACEAE	<i>*Vicia sativa</i>		X	X
CAMPANULACEAE	<i>*Wahlenbergia capensis</i>	X	X	X
ARECACEAE	<i>*Washingtonia filifera</i>		X	
IRIDACEAE	<i>*Watsonia meriana</i>		X	





## Appendix 4 – Fauna Species List

\*Denotes introduced species

Family	Species Name	Common Name	George Welby	Ron Carroll	Tom Firth
<b>Mammals</b>					
Canidae	<i>Canis lupus familiaris</i>	*Domestic Dog		X	
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	X		X
Vespertilionidae	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	X		
Felidae	* <i>Felis catus</i>	*Cat	X		
Peramelidae	<i>Isodon fusciventer</i>	Quenda	X		
Muridae	* <i>Mus musculus</i>	*House Mouse	X		
<b>Birds</b>					
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck		X	
Meliphagidae	<i>Anthochaera carunculata</i>	Red Wattlebird	X	X	
Cacatuidae	<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo	X	X	
Cacatuidae	<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo			X
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		X	
Corvidae	<i>Corvus coronoides</i>	Australian Raven		X	X
Cacatuidae	<i>Eolophus roseicapilla</i>	Galah	X		
Dicruridae	<i>Grallina cyanoleuca</i>	Magpie Lark		X	
Cracticidae	<i>Gymnorhina tibicen</i>	Australian Magpie		X	X
Meliphagidae	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	X	X	
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	X	X	X
Columbidae	* <i>Streptopelia senegalensis</i>	*Laughing Dove		X	X
Threskiornithidae	<i>Threskiornis moluccus</i>	Australian White Ibis		X	
Psittacidae	* <i>Trichoglossus haematodus</i>	*Rainbow Lorikeet	X	X	
<b>Reptile</b>					
Scincidae	<i>Cryptoblepharus buechananii</i>	Buchanan's Snake-eyed Skink	X		
Scincidae	<i>Hemiergis quadrilineata</i>	Two-toed Earless Skink	X		
Scincidae	<i>Tiliqua rugosa rugosa</i>	Bobtail		X	X

Family	Species Name	Common Name	George Welby	Ron Carroll	Tom Firth
<b>Invertebrates</b>					
Paradoxosomatidae	<i>Antichiropis</i> sp.	Polydesmid Millipede	X		
Gnaphosidae	<i>Anzacia</i> sp.	Spider	X		
Curculionidae	<i>Catasarcus impressipennis</i>	Redlegged Weevil		X	
Acrididae	<i>Coryphistes ruricola</i>	Bark-mimicking Grasshopper	X		
Blattidae	<i>Drymaplaneta semivitta</i>	Cockroach	X		
Gryllotalpidae	<i>Gryllotalpa</i> sp.	Mole Cricket	X	X	X
Pentatomidae	<i>*Halyomorpha halys</i>	*Brown Marmorated Stink Bug	X		
Formicidae	<i>Iridomyrmex</i> sp.	Meat ant	X		
Sparassidae	<i>Isopeda leishmanni</i>	Huntsman spider		X	
Mantidae	<i>Mantis octospilota</i>	Eight-spot Mantis	X		
Julidae	<i>*Ommatoiulus moreletii</i>	*Portuguese Millipede	X	X	X
Pieridae	<i>*Pieris rapae</i>	*Cabbage White Butterfly		X	
Scolopenridae	<i>Scolopendra</i> sp.	Centipede		X	X
Thomisidae	<i>Stephanopis</i> sp.	Crab Spider		X	
Lycosidae	<i>Venator immansueta</i>	Wolf Spider	X	X	
Reduviidae		Assassin Bug	X	X	
Pholcidae		Daddy Long-legs Spider		X	





## Appendix 5 – Fire occurrence – 2005 to 2014



(Source: Woodgis 2015)