City of Joondalup

Shepherds Bush Reserve Management Plan

2016

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Contents

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- Mr Russell Passmore, Data Analyst – Operational Information Systems Branch, Department of Fire and Emergency Services (DFES);
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Acronyms

Acronym/Abbreviation	Definition
AHD	Australian Height Datum
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BoM	Bureau of Meteorology
CALM	Department of Conservation and Land Management
the City	City of Joondalup
CoJ	City of Joondalup
CPSM	Centre for Phytophthora Science and Management
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DEP	Department of Environmental Protection
DEPI	Department of Environment and Primary Industries
DFES	Department of Fire and Emergency Services
DoE	Department of Environment
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DPC	Department of Premier and Cabinet
DPI	Department of Primary Industries
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
DWG	Dieback Working Group
EDOWA	Environmental Defender's Office Western Australia (Inc)
ELA/Eco Logical	Eco Logical Australia
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
EWSWA	Environmental Weed Strategy for Western Australia
FCT	Floristic Community Type
FESA	Fire and Emergency Services Authority
GIS	Geographic Information System
ha	Hectare
IOCI	Indian Ocean Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
JSCWSC	Joint Steering Committee for Water Sensitive Cities
km	Kilometre
mAHD	Elevation in metres with respect to the Australian Height Datum
NAIA	Natural Areas Initial Assessment
MRS	Metropolitan Region Scheme
NWCPAG	National Wildlife Corridors Plan Advisory Group
PEC	Priority Ecological Community
PUBF	Perth Urban Bushland Fungi Project
PMST	Protected Matters Search Tool
Syrinx	Syrinx Environmental PL
TDS	Total Dissolved Solids
WA	Western Australia
WALGA	Western Australian Local Government Association
WC Act	*Wildlife Conservation Act 1950*
WONS	Weeds of National Signficance
WOS	Warwick Open Space

Executive Summary

The *Shepherds Bush Reserve Management Plan* outlines a framework for the environmental management of Shepherds Bush Reserve (referred to as Shepherds Bush) for the next five years.

Shepherds Bush is located approximately 18km north-west from the Perth Central Business District in the suburb of Kingsley. The reserve covers approximately 16.5 hectares (ha) of bushland and is bounded by Newhaven Place to the north, Barridale Drive to the east, Robertson Road Cycleway to the south and Shepherds Bush Drive to the west.

Shepherds Bush is classified as a Major Conservation Area and is ranked in the City of Joondalup's top five bushland natural areas due to the high biodiversity values of the area. Shepherds Bush contains a regionally significant vegetation community comprising of *Banksia* and Jarrah Open Woodland and is recognised for its regional environmental significance by being designated as a Bush Forever site (39) by the Western Australian Planning Commission in 2000. Shepherds Bush is also listed on the State Heritage Register.

As part of the development of the *Shepherds Bush Reserve Management Plan*, a flora, fauna and fungi survey was conducted in spring 2015. The results of this survey were combined with previous surveys to develop a comprehensive species list and ecological assessment of the site.

The majority of the native vegetation on site is in very good or good condition and surveys have identified 110 native flora species (including one priority species and two significant species of the Perth Metropolitan Region), two native mammals, 29 native birds (including two species of conservation significance), 10 native reptile species and 34 native invertebrates.

Environmental threats have the potential to degrade natural areas and reduce biodiversity values. Environmental threats addressed in this Plan include weeds, plant diseases, fire, non-native fauna species, human impacts, antisocial behaviour, access and infrastructure. A total of 56 weed species, six non-native mammals (including the domestic dog and domestic/feral cat), five non-native birds and two non-native invertebrates have been identified at Shepherds Bush.

In order to address the key environmental threats at Shepherds Bush a number of management actions are outlined within the Plan.

Recommended management actions for the next five years include regular weed control, feral animal control, annual fire fuel load assessments, monitoring flora, weed, fungi, fauna, bat and invertebrate species through field surveys, conducting user surveys and implementation of the City's *Pathogen Management Plan*. It is also proposed a community Friends Group be developed, with support by the City of Joondalup to foster ownership and care of Shepherds Bush.

Management actions will be implemented in partnership with key stakeholders and community groups, where relevant.

Firewood Banksia *(Banksia menziesii)*

1.0 Introduction

1.1 Background

The City of Joondalup ('the City') is situated along the Swan Coastal Plain, with the Joondalup City Centre being located 30km from the Perth Central Business District. The City covers an area of 96.5km^2 which encompasses a diverse range of natural areas including 17km of coastal foreshore, a chain of wetlands and a variety of bushland ecosystems (as shown in Figure 1).

The City's southern boundary is located approximately 16km from the Perth Central Business District, and is bounded by the City of Wanneroo to the east and north, the City of Stirling to the south, and the Indian Ocean to the west.

There are a number of regionally, nationally and internationally significant natural areas located within the City, including the Yellagonga Regional Park and a number of Bush Forever sites which contain species of high conservation value. Significant natural areas adjacent to the City include the Marmion Marine Park and the Neerabup National Park.

The City of Joondalup is committed to conserving and enhancing the City's natural assets to ensure the long term protection of the environment for future generations.

1.2 Natural Area Management Plans

The City is developing *Natural Area Management Plans* to provide strategic ongoing management of the City's natural areas and protect native vegetation and ecosystems.

Environmental threats have the potential to degrade natural areas and reduce biodiversity values. Environmental threats addressed in this Plan include weeds, plant diseases, fire, non-native fauna species, human impacts and access and infrastructure.

N*atural Area Management Plans* describe the potential environmental impacts, risks and threats in natural areas and the associated management strategies that will be implemented to minimise potential impacts.

1.3 Study Area

The study area for the *Shepherds Bush Reserve Management Plan* is Shepherds Bush Conservation Reserve, Kingsley. The active recreational area (Shepherds Bush Park) containing the bike skills track, BMX track and a BBQ facility is differentiated from the natural bushland site used for passive recreation, which this Plan focuses on. This site has been recognised for its regional environmental significance by being designated as a Bush Forever site (39)[1, 2], and listed on the State Heritage Register by the Government of Western Australia.[3]

1.3.1 Location

Shepherds Bush covers an area of approximately 16.5 hectares and is bounded by Newhaven Place in the north-eastern boundary, Barridale Drive in the eastern boundary, Shepherds Bush Drive along the north-western and western boundary and the Robertson Road Cycleway in the southern boundary (as shown in Figure 2). Shepherds Bush is bordered by residential properties on all sides and Pinnaroo Valley Memorial Park is located a kilometre to the west.

1.3.2 History of the Site

Metropolitan Region Scheme

The *Metropolitan Region Scheme* (MRS) was established in 1962 by the then Metropolitan Regional Planning Authority. The MRS sets out the broad pattern of land use for the whole Perth Metropolitan Region.

Prior to *MRS Amendment 1082/33 – Bush Forever and Related Lands in 2010*, Shepherds Bush was zoned as Urban. Following the amendment the zoning of the reserve is 'Parks and Recreation,' meaning lands of regional significance for ecological, recreation or landscape purposes.

Within the draft *Perth and Peel Green Growth Plan for 3.5million (*draft *Green Growth Plan)* released in December 2015 by the West Australian State Government, Shepherds Bush is included as a proposed specific conservation commitment, with the reserve being included within the proposed expansion of the state conservation estate. Under the proposed *Green Growth Plan*, Shepherds Bush would be classified as a 'conservation reserve'.

Conservation reserves are areas of Crown Land set aside for the protection and conservation of biodiversity and/or natural or cultural heritage values. There are three main types of conservation reserve in Western Australia – nature reserves, national parks, and conservation parks.[4, 5]

1.3.3 Land Tenure

Shepherds Bush is Crown Land managed by the City of Joondalup and is reserved for the purposes of Parks and Recreation under the *Metropolitan Region Scheme*.

City of Joondalup District Planning Scheme No. 2 Schedule 5

Planning for land use occurs under the *District Planning Scheme No. 2. Schedule 5 (Clause 5.3.1)* of the District Planning Scheme lists *Places and Objects Having Significance for the Purpose of Protection of the Landscape or Environment*, a mechanism to protect identified places of landscape or environmental value within the City.

[1] Government of Western Australia (2000a)
[2] Government of Western Australia (2000b)
[3] Government of Western Australia (2012)
[4] Department of Premier and Cabinet (2015)
[5] Department of Planning (2016)

Shepherds Bush is listed on the *District Planning Scheme No. 2 Schedule 5 (Clause 5.3.1)* as a place having significance for the purpose of protection of the landscape or environment.

1.3.4 Land Uses

Previous Land Use

Up until the early 1970's, the suburb of Kinglsey where Shepherds Bush is located existed primarily for rural purposes, predominately grazing. Aerial photographs from this time show the complete absence of roads and residential houses.[6] The suburb had a rich bush presence which attracted many of the first settlers of the suburb.[7]

The Robertson Road Cycleway abuts the southern boundary of Shepherds Bush. It is a 2.4km bicycle route that services residents within the suburb of Kingsley. The Cycleway provides a direct link for pedestrians and bike riders from the Lake Goollelal path networks in the east to the Mitchell Freeway Principal Share Path in the west. Shepherds Bush is located in the western end of the Robertson Road Cycleway and directly borders the bicycle route for 530m.[8]

The Cycleway was originally a road and was converted to a pedestrian path and cycleway in the late 1980's. An overpass pedestrian/cycle bridge was constructed following the road conversion to aid access to the Robertson Road Cycleway.[6, 7]

The suburb of Kingsley was named by one of the first occupiers of the area who called his property 'Kingsley' after the village of Winchester County Hampshire, England in which he was born. Shepherds Bush was subsequently named after suburbs around London, keeping in theme with the English heritage.[7]

Current Land Use

The main uses of Shepherds Bush are for passive recreational purposes such as walking, cycling (including use of BMX bicycles on the BMX track), dog exercising or use of the playground. Nearby properties to Shepherds Bush are zoned as Low Density Residential.

[6] Murdoch University (1989)
[7] City of Joondalup (2003)
[8] City of Joondalup (2016)

Figure 1: Location of Shepherds Bush Reserve in City of Joondalup

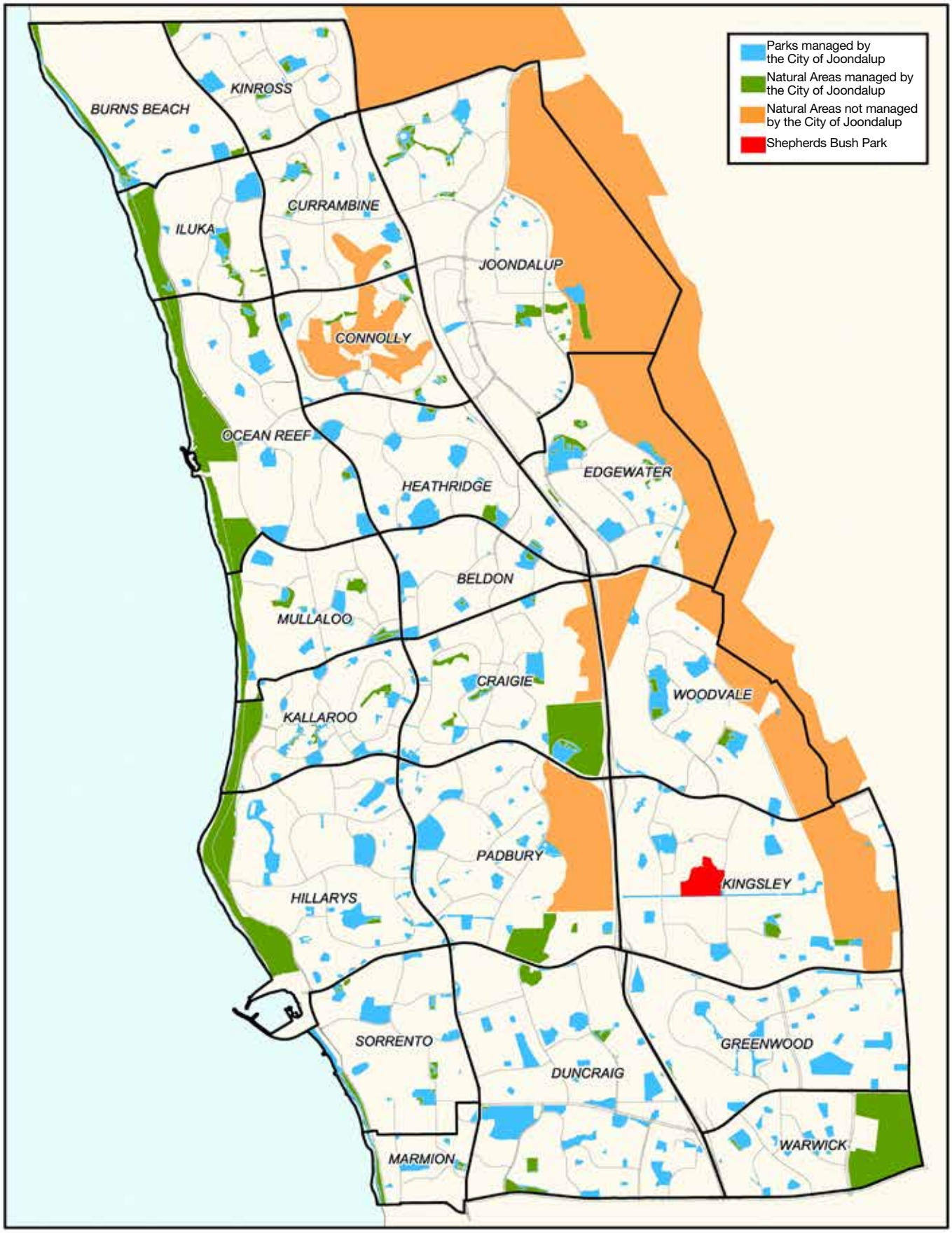
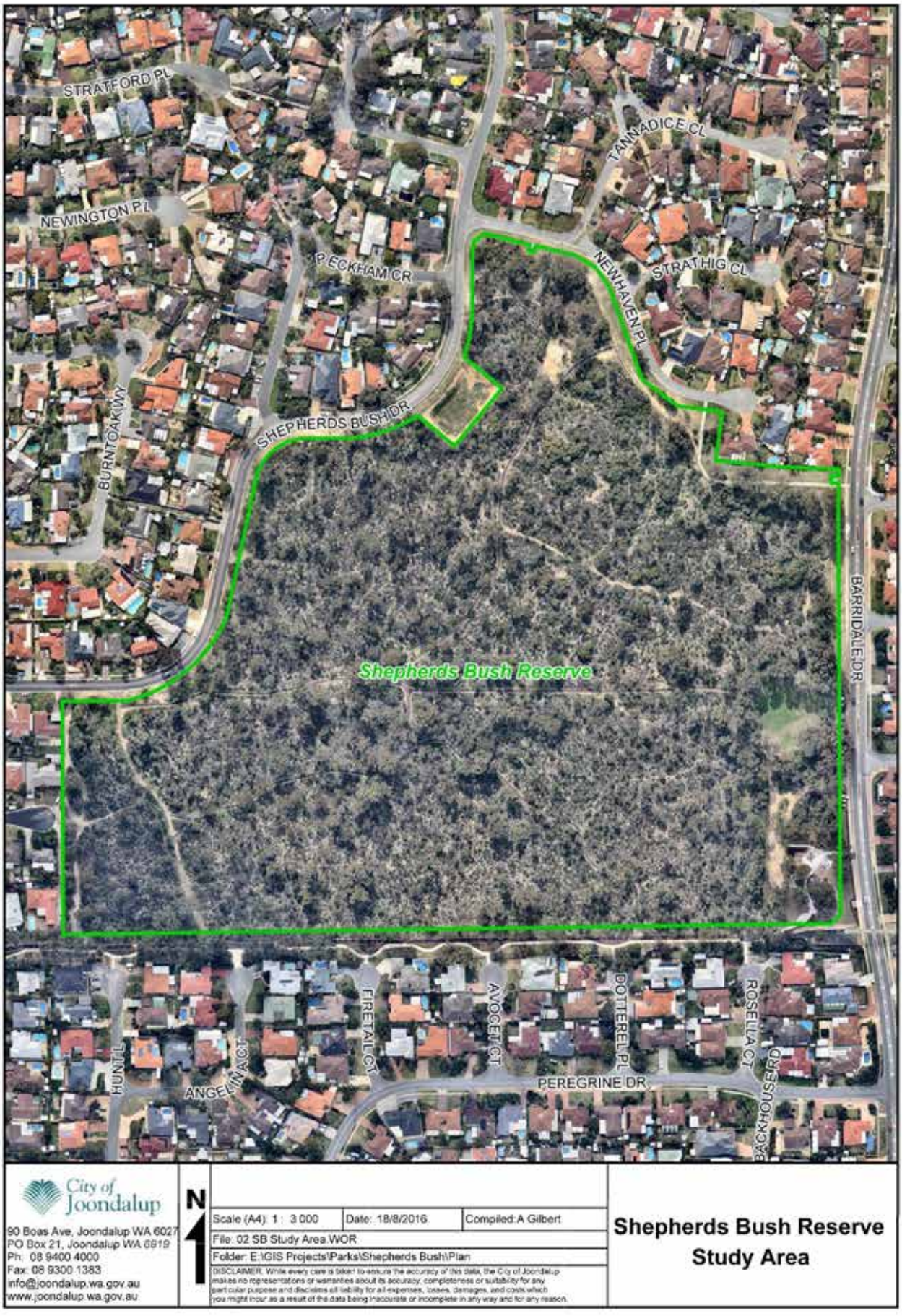


Figure 2: Map of Study Area (2016)



1.4 Aim and Objectives

The aim of the *Shepherds Bush Reserve Management Plan* is to provide a framework to protect and enhance biodiversity values whilst maintaining appropriate community access and awareness of the natural area.

The objectives of this plan:

- Establish a baseline description of the Shepherds Bush environment to guide future environmental planning and recommended management actions.
- Outline key environmental threats and the impact they have on conservation and recreation values.
- Outline management actions to address key environmental threats including monitoring and reporting.

1.5 Purpose

The purpose of the *Shepherds Bush Reserve Management Plan* is to:

- Provide information to assist the City of Joondalup in prioritising maintenance schedules.
- Guide the future development of the City's *Conservation Capital Works Program*.
- Increase opportunities for grant funding by having a detailed schedule of projects.
- Provide guidance to City employees and contractors operating within Shepherds Bush.
- Provide mechanisms to raise community awareness of Shepherds Bush Reserve whilst protecting and enhancing biodiversity values.

1.6 Strategic Context

The aim of the *Shepherds Bush Reserve Management Plan* aligns with the City of Joondalup Strategic Environmental Framework outlined in Figure 3. Details of the relevant local, State and Federal legislation, policies, plans and strategies are outlined in Figure 3.

1.7 Stakeholder Consultation

Key external stakeholders to be consulted for the development of the *Shepherds Bush Reserve Management Plan* include:

- Department of Parks and Wildlife.
- Department of Fire and Emergency Services.
- Department of Planning.
- Department of Transport.
- Western Australian Local Government Association.
- Pinnaroo Valley Memorial Park.
- Kingsley and Greenwood Residents Association.
- Local schools and residents.

Figure 3: City of Joondalup Strategic Environmental Framework

2.0 Description of the Physical Environment

2.1 Geology, Soils and Landforms

Soils of the Swan Coastal Plain

Shepherds Bush is situated in the City of Joondalup which is located within the Swan Coastal Plain. Shepherds Bush is characterised as containing regionally significant *Banksia* and Jarrah open woodland communities with the occasional occurrence of *Allocasuarina fraseriana* (Sheok) and Tuart trees.[9] The majority of the soils of the Swan Coastal Plain are formed by material deposited by rivers and wind. A series of dune systems has been formed with the youngest dunes being the Quindalup Dunes nearest the coast, followed by the Spearwood Dunes and the oldest Bassendean Dunes are farthest from the coast, as shown in Figure 4.[10]

Shepherds Bush is located within the Spearwood Dune System and comprises of sand derived from Tamala Limestone.[11] The Spearwood Dunes have a core of sandy aeolianite with a capping of secondary limestone (Tamala Limestone, predominantly calcarenite) overlain by yellow brown siliceous sands with weak podzol development.[12,13] The Spearwood Dunes are believed to have formed around 40,000 years ago and comprise of red/brown, yellow and pale yellow/grey sands. The Spearwood Sand Phase is characterised by undulating dunes with rocky crests of Aeolian sand over limestone, as in Figure 5.[14] The environmental geological characteristic of Shepherds Bush is sand, impacting on the types of vegetation communities existing at the site.

The land contours of Shepherds Bush range from 27m to 39m Australian Height Datum (AHD), as shown in Figure 10 (page 17).

Acid Sulfate Soils

Potential Acid Sulfate Soils are naturally occurring soils and sediments that contain iron sulphides. Potential Acid Sulfate Soils are predominantly found in low-lying coastal wetlands and tidal flats and are harmless when left undisturbed. Exposure to air can cause the iron sulfides in Potential Acid Sulfate Soils to react with oxygen and water producing Acid Sulfate Soils with high concentrations of iron and sulfuric acid, which can lead to other contaminants, such as heavy metals and arsenic being released into the surrounding environment.[15]

Acid Sulfate Soils are categorised as Potential Acid Sulfate Soils or Actual Acid Sulfate Soils. Potential Acid Sulfate Soils have not been oxidised by exposure to air whilst Actual Acid Sulfate Soils have been disturbed or exposed to oxygen and become acidic.[15]

There is no known risk of Acid Sulfate Soils in Shepherds Bush.[13] The risk of Acid Sulfate Soils is based on the likelihood of Potential Acid Sulfate Soils occurring within soil profiles and has been mapped by the Department of Parks and Wildlife (DPaW) using available desk-top information and limited ground-truthing, within areas where intensive on-ground soil mapping and soil analysis work has been undertaken. The mapping undertaken has found that Acid Sulfate Soils are not known or expected to occur in the environment of Shepherds Bush on the basis of the geological units present, depth to groundwater and partial “ground truthing” or onsite investigation. Within the City of Joondalup, areas of high to moderate acid sulfate soil risk are predominantly in wetlands or areas adjacent to wetlands, as shown in Figure 6.[15,16]

[9] Eco Logical Australia (2016)
[10] Bolland (1998)
[11] Gozzard cited in ELA (2016)
[12] McArthur and Bettenay cited in Syrinx (2012)
[13] DoW (2004)
[14] DAFWA cited in Eco Logical Australia (2013)
[15] DEC no date (a)
[16] Landgate (2006)

Figure 4: Soils of the Swan Coastal Plain (sourced from Department of Agriculture 2002)

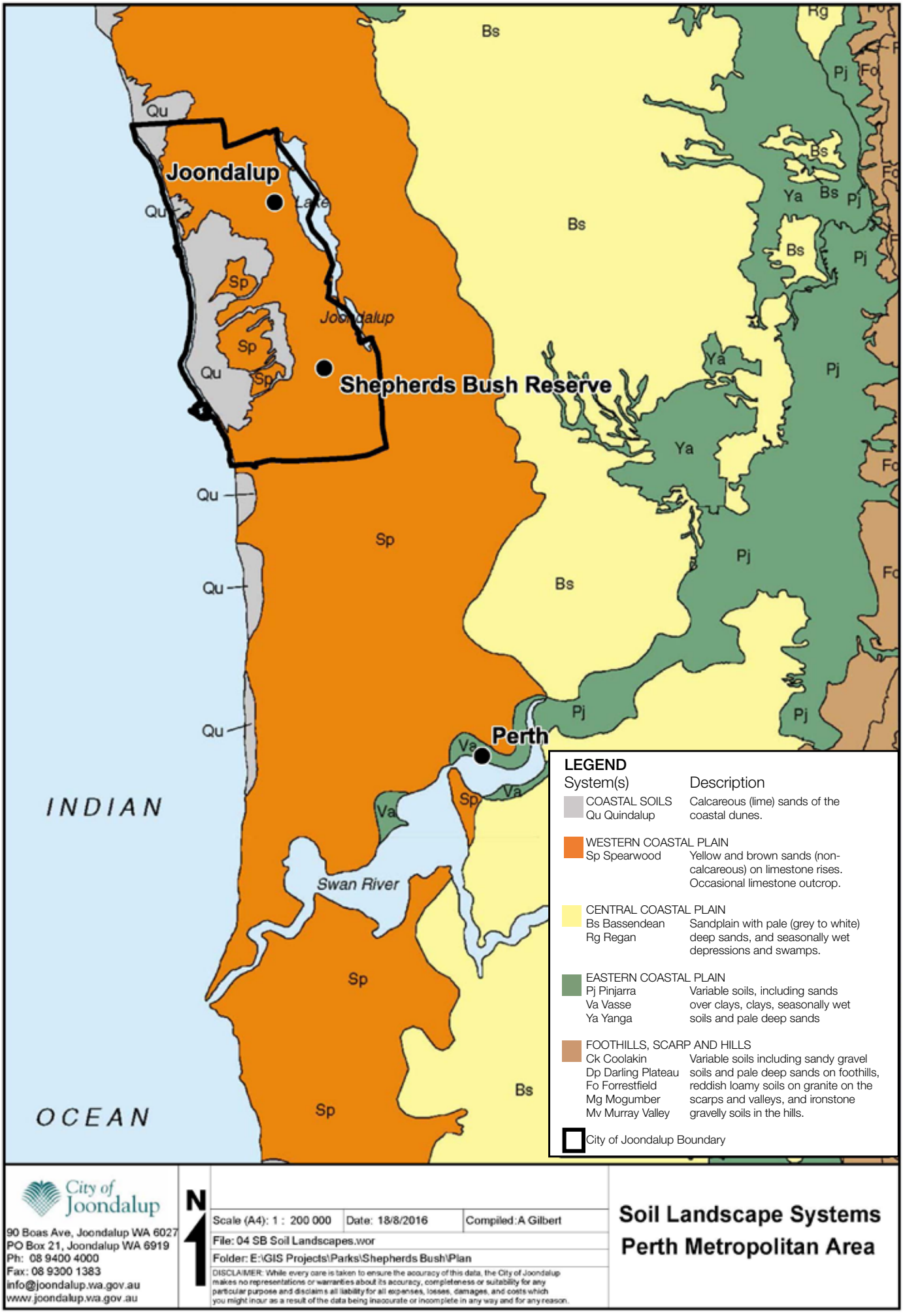


Figure 5: City of Joondalup Environmental Geology (sourced from Department of Mines and Petroleum 2013)

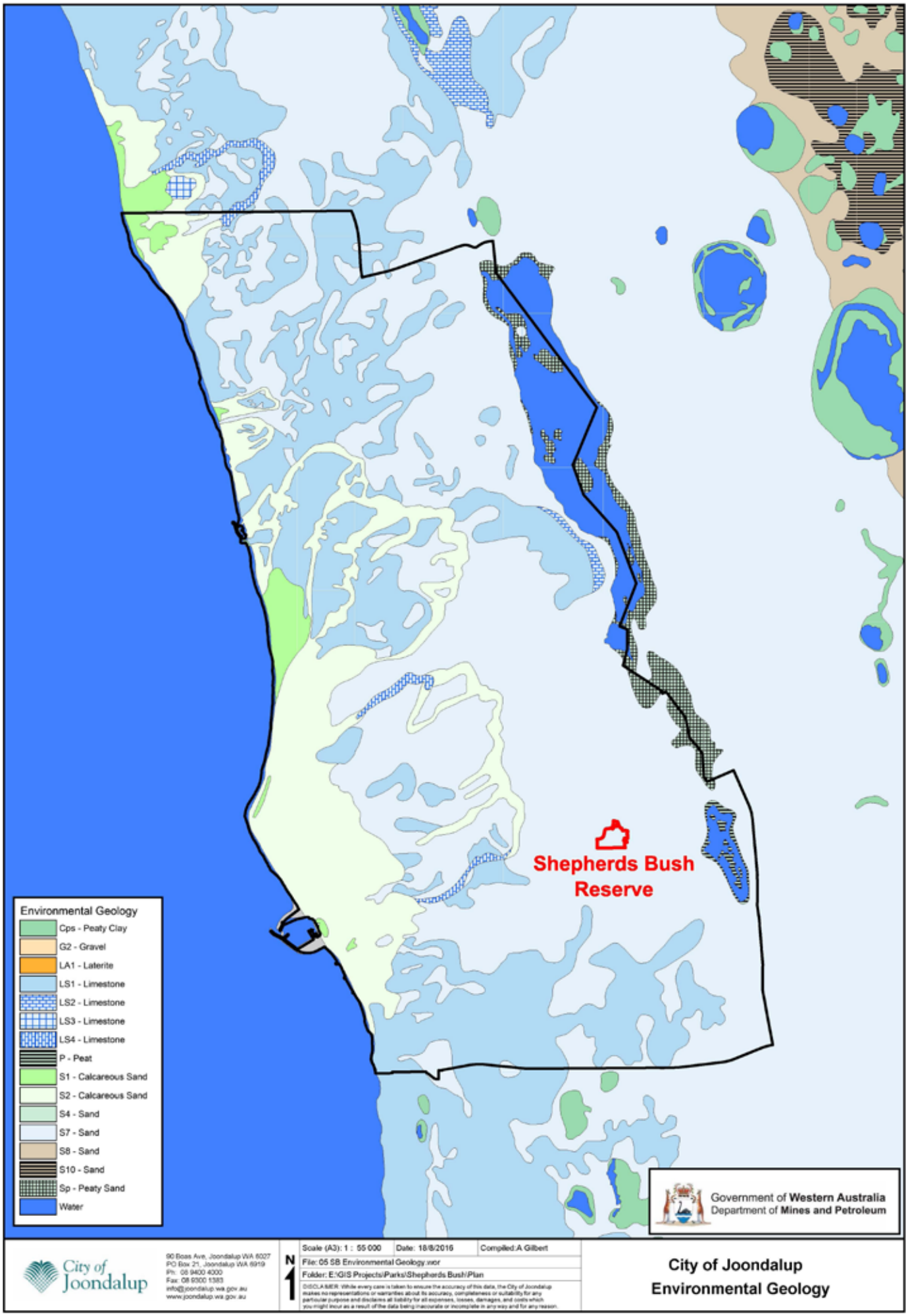
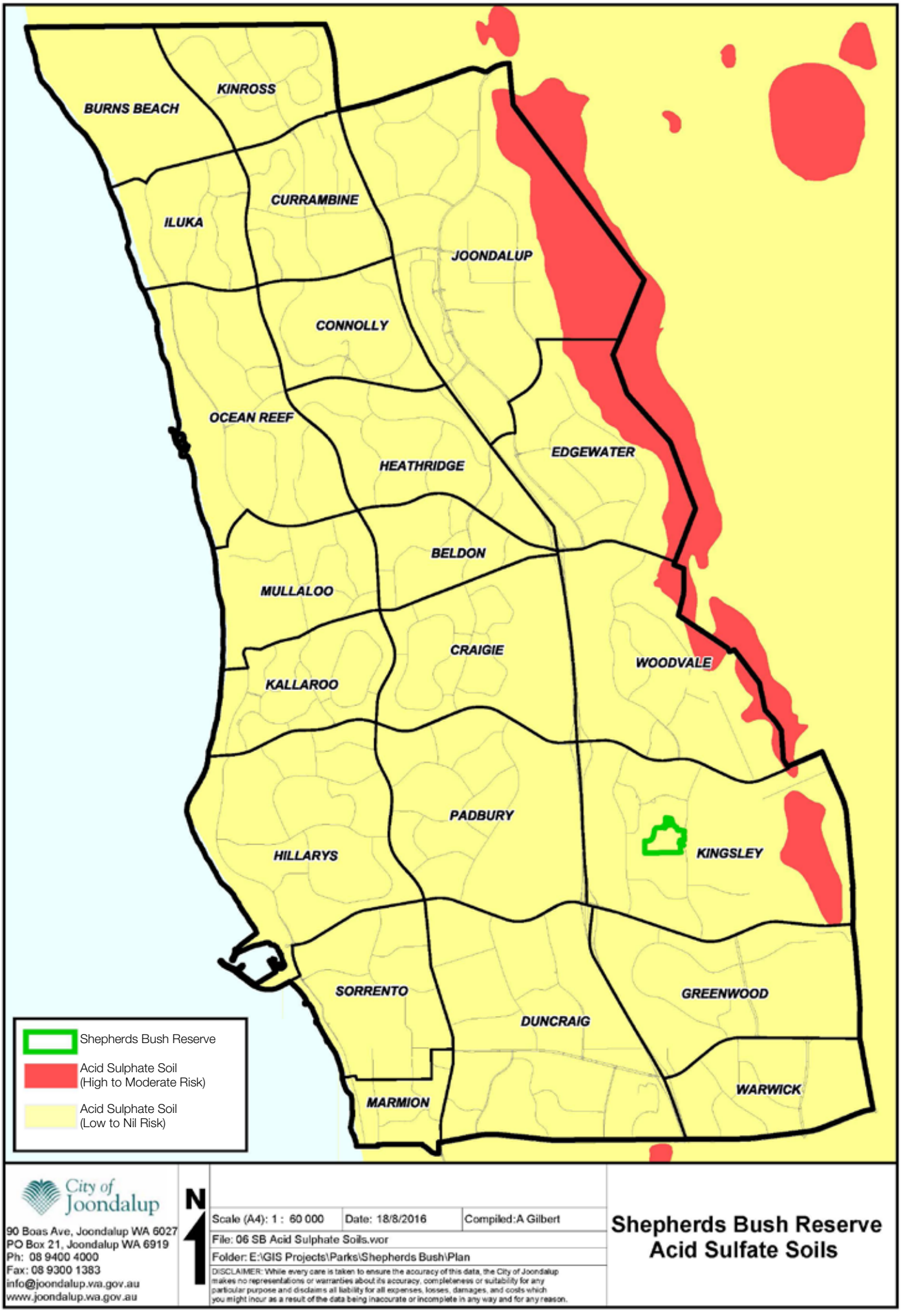


Figure 6: Shepherds Bush Reserve Acid Sulfate Soil Risk



2.2 Hydrology

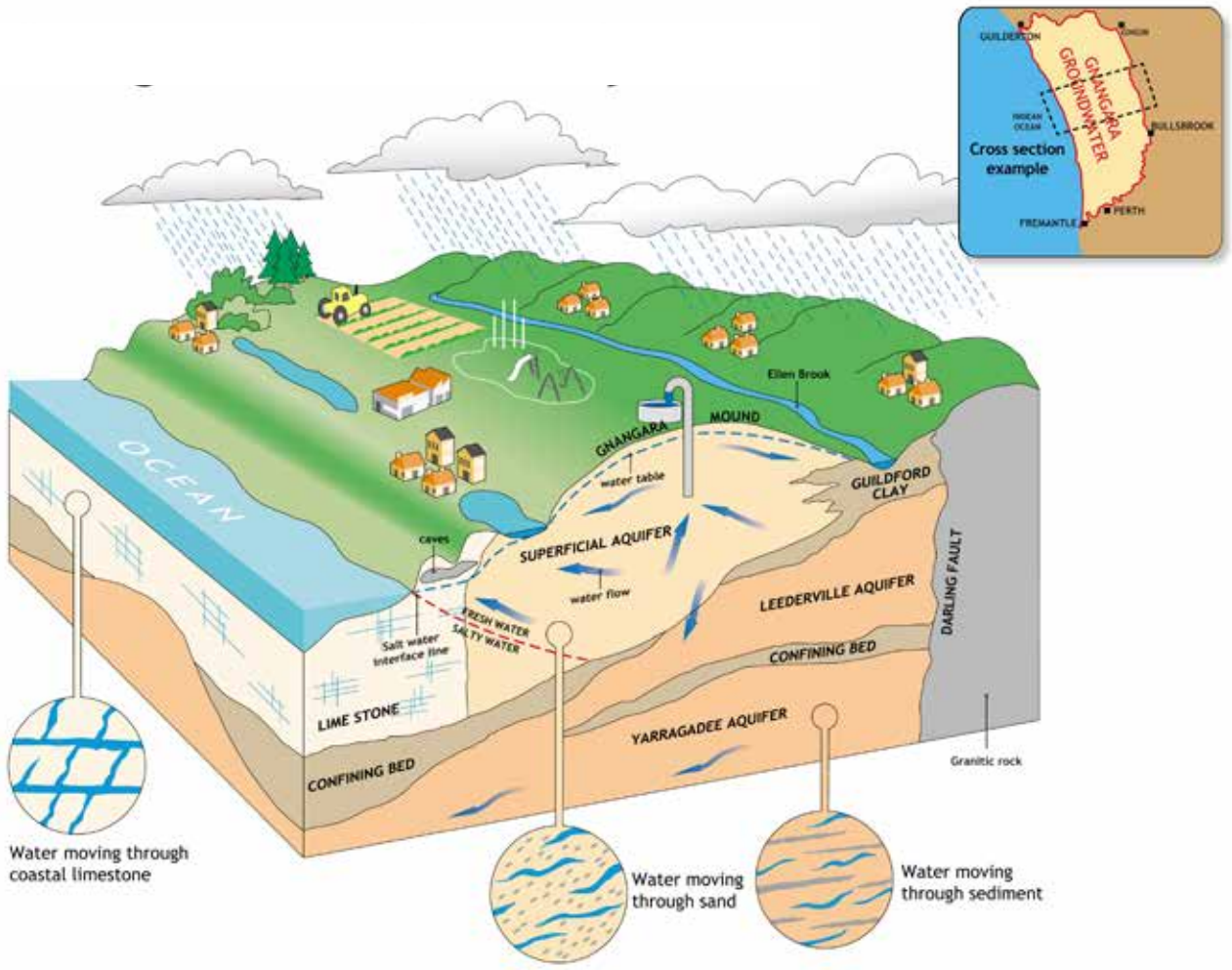
Groundwater

The City of Joondalup is located on Perth's largest source of groundwater, the Gnangara Groundwater System, comprising four main aquifers: superficial (shallow, unconfined), Mirrabooka (deeper, semi-confined), Leederville (deep, mostly confined) and the Yarragadee (deep, mostly confined).

The Gnangara Mound extends across most of the superficial aquifer and refers to the water table creating a mound shape, as shown in Figure 7. Groundwater levels in the superficial aquifer have been declining over recent years due to pressure from extraction and the impacts of climate change, as shown in Figure 8.[17]

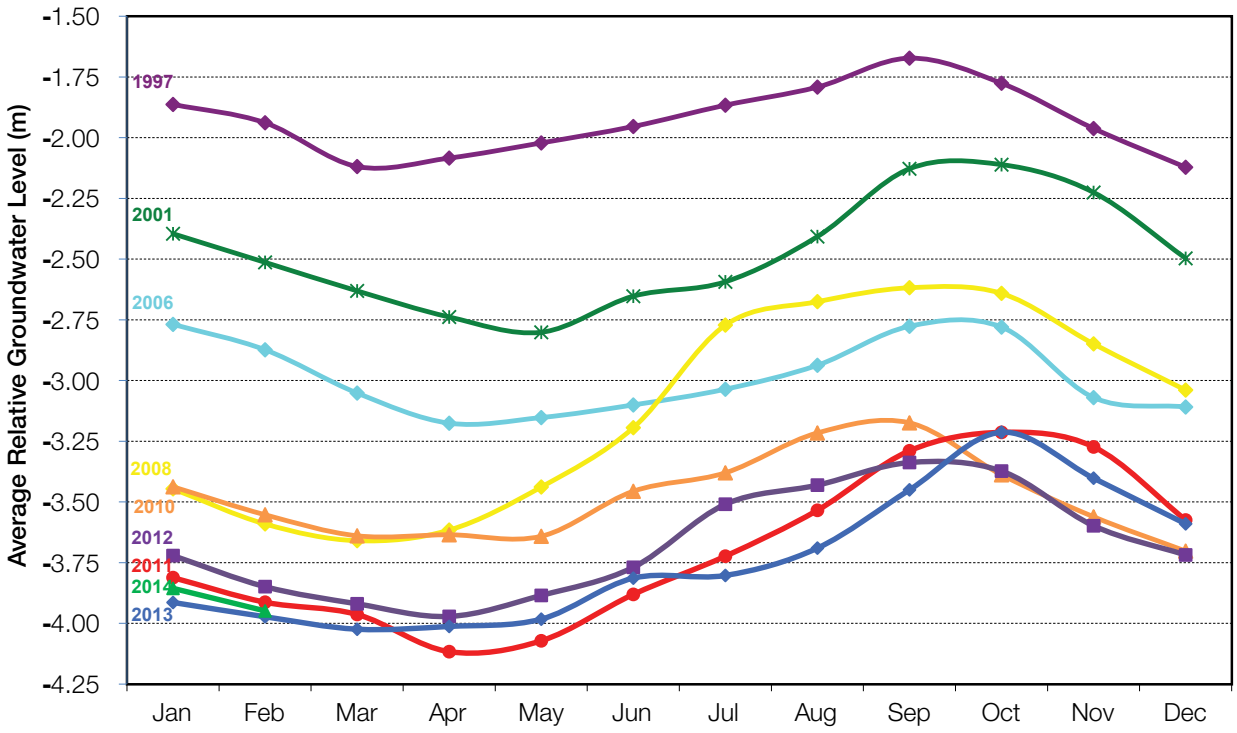
There is a natural seasonal variance in Perth's groundwater system due to annual rainfall recharge, as shown in Figure 8.

Figure 7: Gnangara Groundwater System (sourced from DoW 2016)



[17] City of Joondalup (2012a)

Figure 8: Gnangara Mound Average Relative Groundwater Levels (sourced from DoW 2015)



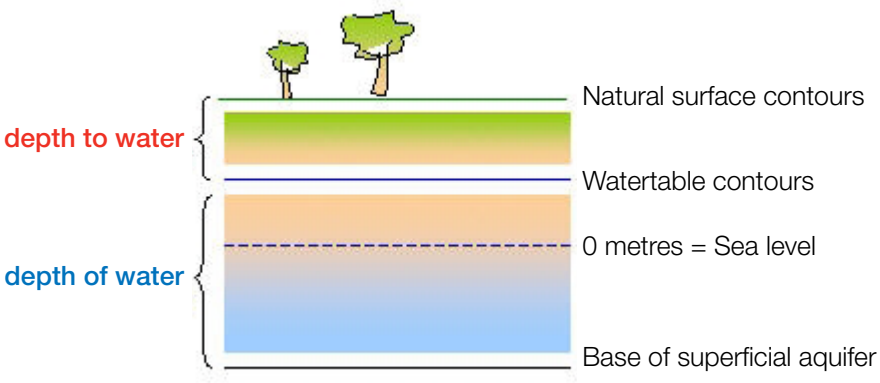
It is unlikely that plant species at Shepherds Bush utilise groundwater as the depth to water varies from 21m in the centre of the site up to 33m in the north-eastern corner, with a +/- range of 3m seasonal variance.[13] In general, some plant species (usually larger tree species) in the Perth metropolitan area within approximately 10m of groundwater are likely to access the water table.[18] Depth to water is the depth from the natural surface contours to the water table (see Figure 9). Groundwater salinity at Shepherds Bush is marginal (500 – 1000 TDS in mg/L).

No current information is available on groundwater levels located directly beneath Shepherds Bush. There are two groundwater monitoring bores located within Shepherds Bush, however the last groundwater level measurements were taken in 1983.[19]

The effect of long-term persistent hydrological change can cause changes in vegetation community composition and structure, with a potential loss of some species and a gradual replacement by more drought-tolerant species. The rate (m/yr) and magnitude (metres) of groundwater level change are also relevant to potential vegetation impact.[20]

The use of groundwater for domestic irrigation through bores is deemed suitable in the area and is supported in preference to scheme water. The area is high in iron concentration, resulting in a high iron staining risk.[13]

Figure 9: Groundwater Depth Explanation (sourced from DoW 2004)



[18] A Paton (DoW) 2013, pers. comm., 26 March
[19] DoW (2015)
[20] Loomes and Froend (no date)

Shepherds Bush Reserve

Stormwater Drainage

Stormwater consists of runoff from rainfall and material mobilised and dissolved in its path of flow. Stormwater is channelled and collected in sumps and swales to recharge the superficial aquifer and prevent the spread of weeds, pollutants, pathogens and sediment to vegetation.[21]

Sumps allow some stormwater to infiltrate retention basins (sumps), detain the water, collect sediment and over time the water is absorbed back into groundwater. Most sumps are steeply graded rectangular excavations with an inflow at the bottom. Sumps are fenced off in the interest of community safety due to the potential for rapid stormwater inflow.[22]

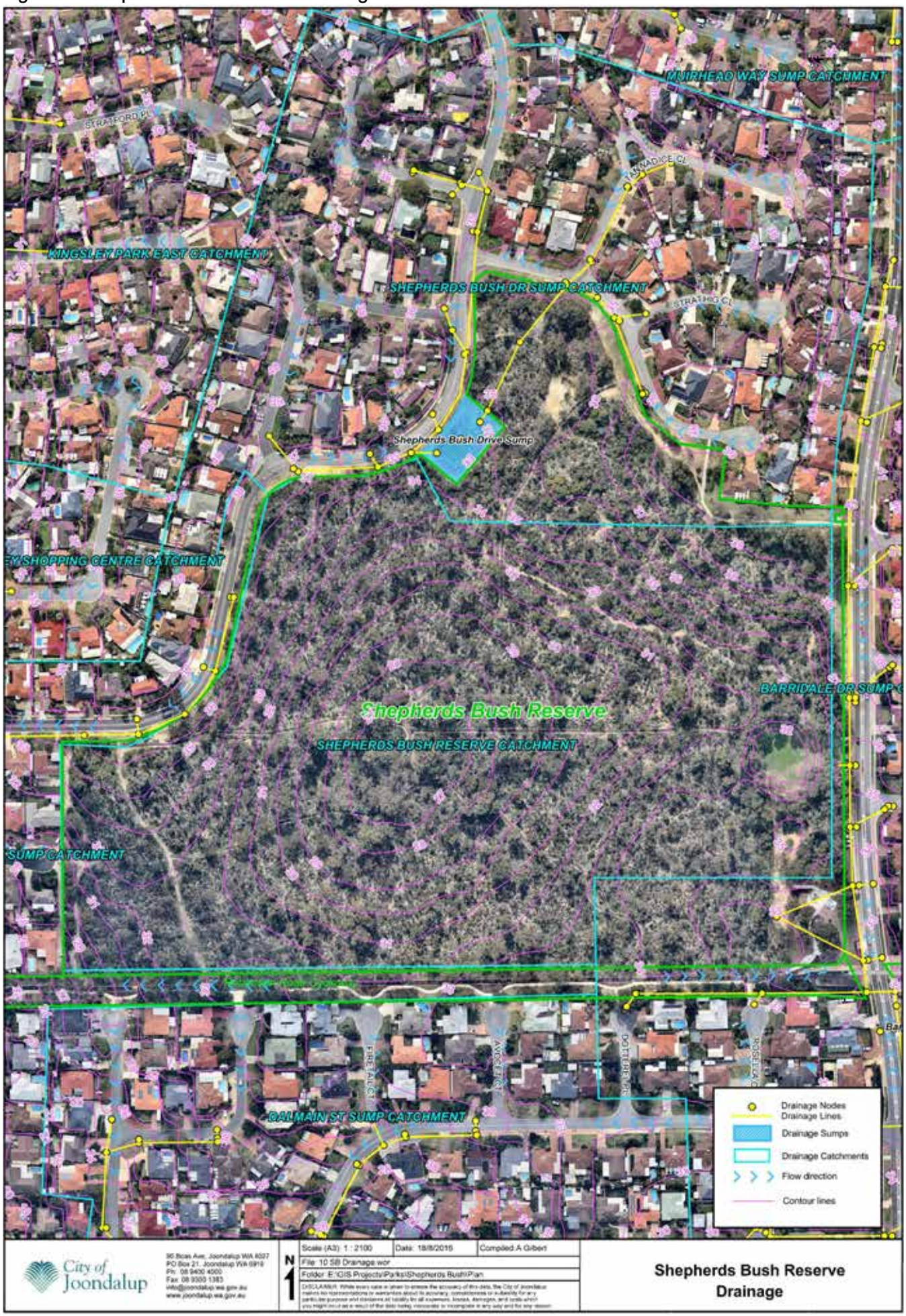
Shepherds Bush contains several drainage lines and a sump. The drainage line from the Shepherds Bush Drive Sump into the drainage line entering Shepherds Bush is in the south-east corner of the site, as shown in Figure 10. The Shepherds Bush Reserve catchment area is 124,737m^2.

Swales are broad, shallow channels that are grassed or vegetated and used to collect and convey stormwater flows, promote infiltration and removal of sediment.[23] A swale is located on Barridale Drive, labelled as Barridale Drive Sump on Figure 10.

The natural contours of the site also channel water to the centre of the site.

[21] DoE (2004)
[22] Grose and Hedgcock (no date)
[23] DoW (2011)

Figure 10: Shepherds Bush Reserve Drainage



2.3 Climate

The City of Joondalup experiences a Mediterranean climate of hot dry summers with an average temperature of 32°C during the day and mild wet winters with an average day time temperature of 20°C.[24]

In the Perth metropolitan area mean maximum air temperatures range from approximately 16.5°C in July to 34.5°C in February, with mean minimum air temperatures ranging from approximately 4.5°C in July to 21°C in February.[25]

The average annual rainfall in the City of Joondalup from 2004 to 2015 was 660mm. The average annual rainfall from 1993 to 2003 was 716mm, indicating an annual decrease of approximately 56mm in the past two decades. Approximately 77% of the annual rain falls between the months of May and September, as shown in Figure 11.[26]

Current Climate Change

The City of Joondalup is located in the southwest of Western Australia, an area that is already being impacted by the effects of climate change particularly through rising temperatures and decreasing rainfall.

The long-term trend in WA's average temperature has been steadily increasing since the 1950's with overall temperature rising approximately 0.8°C in this time, as shown in Figure 12.[27]

Figure 11: Mean Monthly Rainfall Recorded at Perth Airport Weather Station 2004-2015 (sourced from BoM 2016)

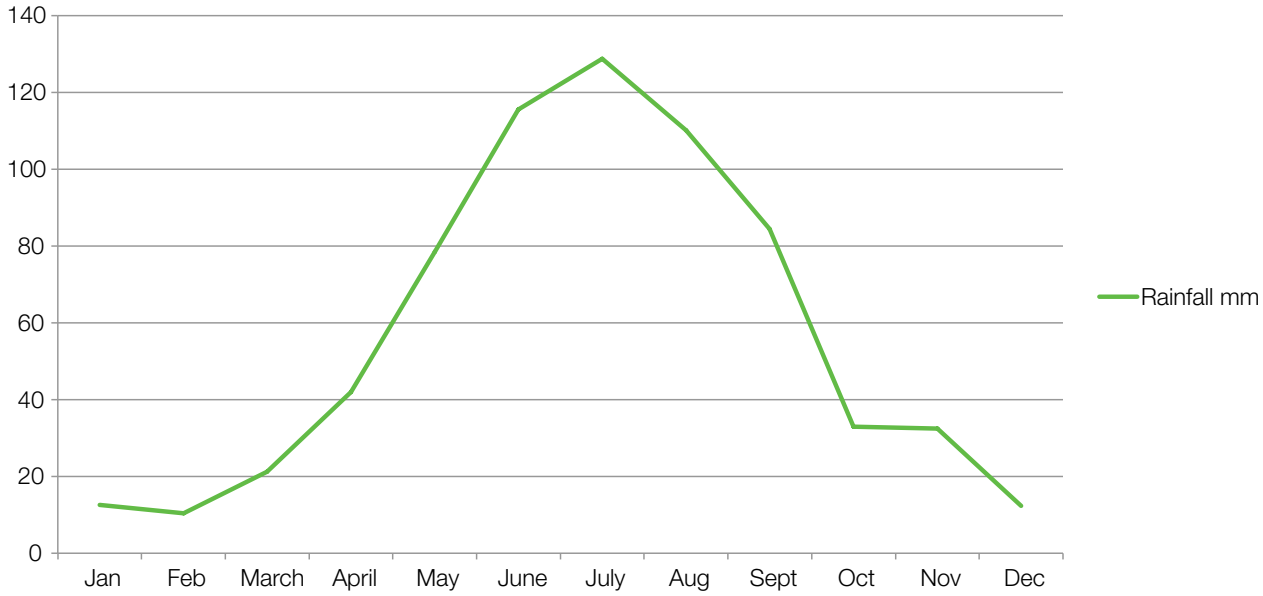
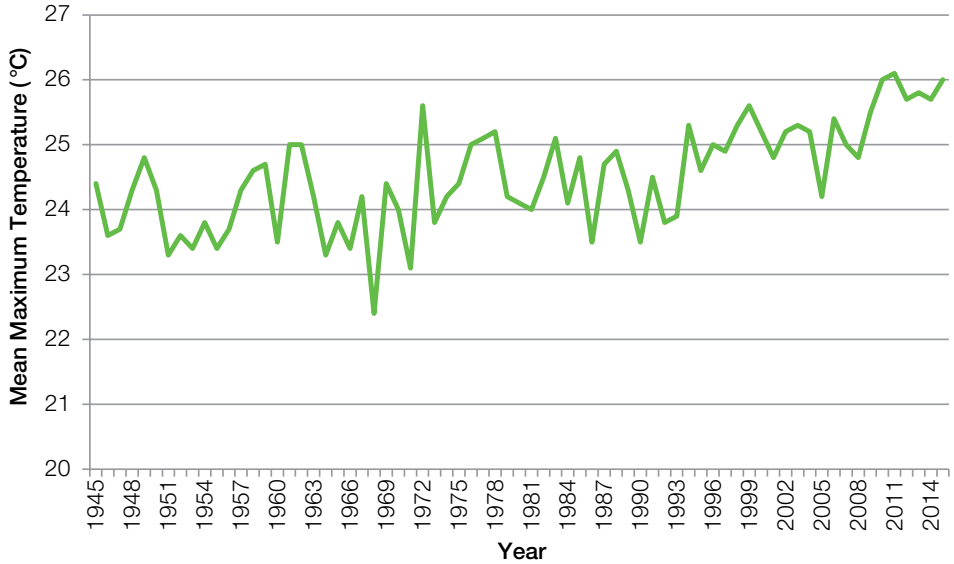


Figure 12: Mean Maximum Temperature Recorded at Perth Airport Weather Station 1945-2015 (sourced from BoM 2016)



[24] Perth Tourist Centre (2016)
[25] BoM cited in Eco Logical Australia (2016)
[26] BoM (2016)
[27] Climate Commission (2011)

In addition, the south-west of WA has experienced a 15% reduction in rainfall since the mid-1970s. This is a result of fewer winter low pressure systems, more prevalent high pressure systems and, since 2000, a decrease in the rainfall associated with each system, as shown in Figure 13.[28]

Future Climate Change

The hotter drier climate within the south-west Western Australian region is impacting on bushland areas and ecosystems, particularly through reduced water availability. Adaptation to the drying climate is critical, particularly as the impacts of climate change will increase in the future.

The City has adopted a future climate scenario in its *Climate Change Strategy 2014-2019*, based on the best available science and best-practice climate adaptation planning. Under this scenario in 2070 the City of Joondalup will have hotter, drier and windier summers with the number of days over 35°C nearly doubling. Winters will be drier, warmer and less windy as a result of fewer low pressure systems, see Table 1. More extreme weather events are also predicted, including more frequent and severe droughts.[29]

Figure 13: Mean Annual Rainfall Recorded at Perth Airport Weather Station 1975-2015 (sourced from BoM 2016)

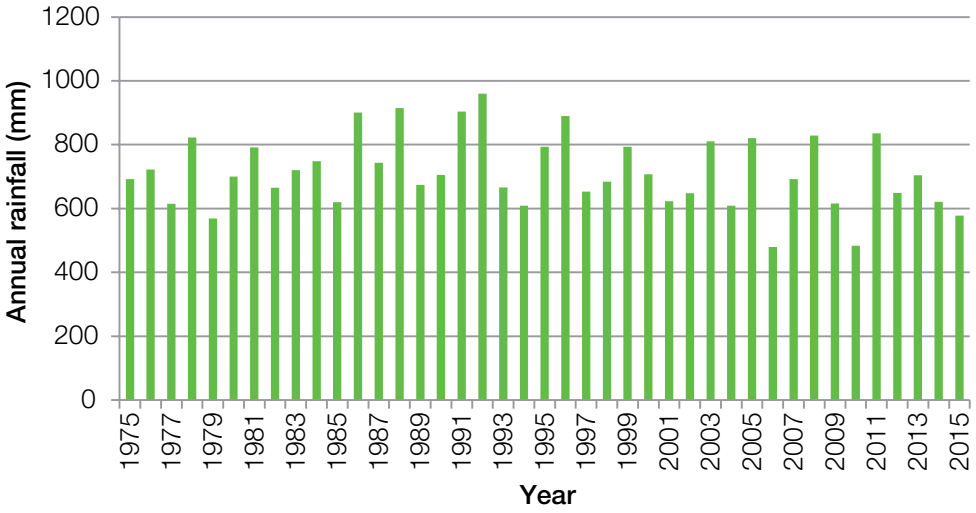


Table 1: Climate Change Scenario for the City of Joondalup in 2070

Climate Change Scenario for the City of Joondalup in 2070
2.7°C ↑ Temperature
Extreme Heat days ↑ from 28 to 54
19% ↓ Rainfall
7% ↑ Potential Evaporation
Wind Speed ↑ 8% in Summer ↓ 14% in Winter
2% ↓ Relative Humidity
1.4% Solar Radiation

Note: Climate Change projections for Perth in 2070 compared to 1990 under a high emissions scenario (A1FI). The projections have been generated using data from 23 climate models and global warming estimates *IPCC Fourth Assessment Report 2007*.[29]

The future changes to the climate are expected to have the following impacts on local bushland areas:

- Increase threats to the natural environment such as incidence of weeds, fire and disease;
- Changes to habitats and distribution patterns of species. A drier climate will result in reduced water availability for ecosystems and fauna and flora species; and
- Greater occurrence of extreme weather events such as heat-waves and intense storms.

Whilst climate change is difficult to address directly, many of the management actions in this Plan focus on maintaining vegetation resilience and will assist to minimise the effects of climate change.

[28] IOCI (2010)
[29] CSIRO (2007)

Shepherds Bush Reserve

2.4 Vegetation

Vegetation Complexes

Vegetation complexes are classified by the soil and landforms contained in medium to large areas along the Swan Coastal Plain. Regional scale mapping shows the study area is classified as having Karrakatta Complex - Central and South (see Figure 14). This complex is described as predominantly open forest of *Eucalyptus gomphocephala – Eucalyptus marginata – Eucalyptus calophylla* and woodland of *Eucalyptus marginata – Banksia* species.[30] This vegetation complex currently has 23% of pre-European extent remaining within the Swan Coastal Plain IBRA region.[31]

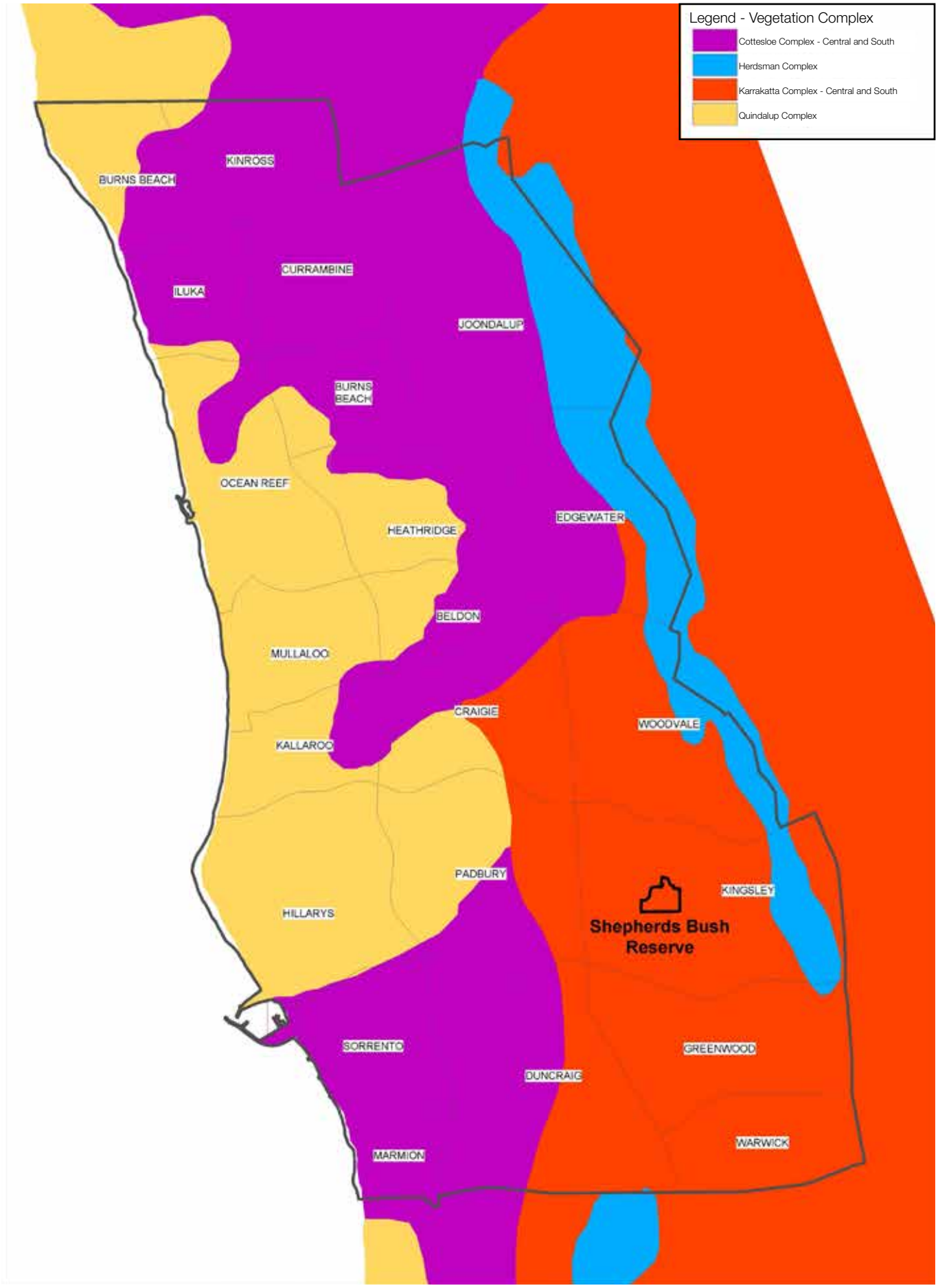
The State Government's *Bush Forever Strategy (2000)* aims to protect 51,000 ha of regionally significant vegetation within the Swan Coastal Plain portion of the Perth Metropolitan Region. The State Government has established targets under Bush Forever which aim to protect at least 10% of each of the 26 vegetation complexes,[1, 31] to achieve a comprehensive representation of all the ecological communities originally occurring in the region.[32] The Strategy identifies 287 bushland sites. Shepherds Bush has been identified as an area containing regionally significant bushland and is included within the *Bush Forever Strategy* as site 39.[1, 33]

The predominant vegetation complex in Shepherds Bush is Karrakatta Complex – Central and South. Approximately 24% (11,906 ha) of the original extent of Karrakatta Complex – Central and South vegetation complex remains within the Perth and Peel region,[34] with 7% (350ha) of this remaining vegetation existing within the City of Joondalup.[32]

Due to the limited extent of the Karrakatta Complex – Central and South vegetation complex remaining within the Perth Metropolitan Region, it is important to retain bushland within Shepherds Bush for its conservation value.

[30] Heddle et. al. cited in ELA (2016)
[31] EPA cited in ELA (2016)
[32] WALGA (2010)
[33] Government of Western Australia cited in ELA (2016)
[34] WALGA (2013)

Figure 14: City of Joondalup Vegetation Complexes



Floristic Community Types

The vegetation of the Swan Coastal Plain has been systematically surveyed and defined into Floristic Community Types (FCTs). This floristic analysis defined 30 FCTs with some groups further subdivided, with a total of 43 types and sub-types recognised.[35]

The Spearwood Dunes unit supports FCTs 24, 25, 26a, 26b, 27 and 28. The following FCTs were inferred to occur in the study area through the State Government's Bush Forever assessment in 2000:

- FCT 24 – Northern Spearwood shrublands and woodlands.
- FCT 28 – Spearwood *Banksia attenuata* or *B. attenuata* – *Eucalyptus* woodlands.

FCT 24 is currently listed as a Priority 3 (i), Priority Ecological Community (PEC)[36] which means that it is poorly known from several to many occurrences but does not appear to be under threat of habitat destruction or degradation.

Only FCT 28 was identified in Shepherds Bush during the October 2015 field survey by consultants, Eco Logical Australia.[9]

FCT 28 is largely restricted to the Spearwood landform and has been recorded from Thompson's Lake north to Seabird. Species richness averages for FCT 28 is 55.2 native species per quadrat and average weed frequency is at eight species per quadrat. The quadrats surveyed by ELA recorded an average of 33 native species per quadrat and 13 weed species. However, it must be noted that these comparisons are based on quadrats being established in the highest condition and species diverse sites, therefore lower species counts are expected when sampling areas with poorer vegetation condition.[9]

The ELA quadrats recorded the typical species that represent FCT 28, which are known to occur in more than 75% of quadrats.[9, 35]

Although FCT 24 Northern Spearwood shrublands and woodlands was also identified in the State Government's Bush Forever Strategy (2000),[38] this FCT was only inferred to be present within the study area and was not supported by field sampling.

FCT 24 was inferred based on the floristics of the general area and the site's geographic location, therefore this does not necessarily indicate that FCT 24 exists at the site.[9]

The FCT flora survey and the statistical analysis conducted by Eco Logical Australia did not support similarities with FCT 24, therefore the vegetation community in the study area does not represent this FCT. This is largely due to the absence of an indicator mid storey species, *Banksia sessilis* from the bushland at Shepherds Bush. *Banksia sessilis* is a key dominate species that defines FCT 24.[9, 34, 35] Although *Banksia sessilis* was recorded from Shepherds Bush, it did not form a dominate species within the mid storey.[9]

Whilst FCTs can be a useful way of describing groups of flora species, or defining Threatened or Priority Ecological Communities on the Swan Coastal Plain, vegetation communities are more commonly used to define plant communities.

Vegetation Communities

Field sampling confirmed one vegetation community occurring within the study area. Although only one main vegetation community exists within the Shepherds Bush area, consisting of 87% of the site, it is of high conservation value and described in full in Table 2 and shown in Figure 15.

No Threatened Ecological Communities were identified within Shepherds Bush.[9]

The Commonwealth Government, Department of the Environment is undergoing a review of the Banksia Woodlands ecological community of the Swan Coastal Plain, to assess whether the vegetation community meets the criteria of 'Endangered,' under the *EPBC Act 1999*. The assessment is due for completion in July 2016.[39] The findings of the assessment may result in increased importance and protection of the vegetation community present at Shepherds Bush.

Table 2: Vegetation Community at Shepherds Bush Reserve

Vegetation Community Reference	Vegetation Community Description	Site Coverage
BaEmHlXpEc	*Banksia attenuata* and *Eucalyptus marginata* open woodland with occasional *Allocasuarina fraseriana* and *Eucalyptus gomphocephala* over *Hakea lissocarpha* and *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides* low open shrubland over **Ehrharta calycina* very open grassland over *Desmocladus flexuosus* very open sedgeland.	14.8 ha or 87%

*Indicates weed species.
Note: The remaining vegetation on site has been cleared for parkland (and BMX jumps). (Approximately 2.2ha or 13%).

[35] Gibson et al cited in ELA (2016)
[36] DPaW (2015b)
[37] DEC (2010a)
[38] Government of Western Australia (2000)
[39] Australian Government, DoE (no date a)

Vegetation Condition

The Keighery Scale is a tool used to rate the condition of vegetation from pristine to completely degraded, as detailed in Appendix 5. The City of Joondalup conducted Natural Areas Initial Assessments in April 2004 and 2014 to assess the vegetation condition at the site. Eco Logical Australia conducted a vegetation condition assessment in October 2015, with the majority of the vegetation condition being rated as "very good", followed by "good", as shown in Table 3.

The vegetation condition at Shepherds Bush ranges from very good to good to completely degraded. Shepherds Bush contains various formal paths and informal tracks and these have been categorised as completely degraded. The majority of the remnant vegetation within the site is in very good condition, with the condition reducing to good to completely degraded in the eastern section of the site and areas directly surrounding pathways, known as 'edge effects'.

The good condition areas surrounding pathways and the Robertson Road Cycleway reflects the reduction in vegetation condition caused by disturbances, through the construction of formal and informal paths. Reduction in vegetation condition also commonly exists on the boundary edges of bushland areas, due to various factors including the introduction of invasive species from surrounding areas, informal access and garden refuse dumping.

Degraded to completely degraded areas generally surround the BMX (bike jump) park, the lawned swale and the road boundary in the north-east of the site. Vegetation condition is shown in Table 3 and Figure 16.

Vegetation condition assessments include observations regarding the numbers of native species, weed cover, vegetation structure, species diversity, amount of understorey, health condition of most species' populations and physical disturbance.

The vegetation condition assessment undertaken by Eco Logical Australia in 2015 incorporated the assessment of tracks, including formal and informal pathways within Shepherds Bush. As a result of the inclusion of these tracks within the survey, the percentage of vegetation classified as Completely Degraded has increased from previous surveys, which did not consider tracks as part of the survey. The Completely Degraded classification has been applied to tracks due to the complete removal of the original vegetation.

Changes in the vegetation condition can also be attributed to differing interpretations of Keighery Scale definitions by assessors as well as external factors such as different seasonal timings of vegetation assessments, frequency and intensity of recent fire occurrences and other disturbances such as the incidence of weeds can also result in variance in vegetation assessments.

Additionally the State Government's *Bush Forever Strategy (2000)*, rated the vegetation condition of Shepherds Bush as more than 75% very good to good, less than 25% degraded, with areas of severe localised disturbance.

High resolution multi-spectral imagery has been obtained for the City of Joondalup in October 2012 and October 2014 and analysed to measure canopy cover and change in vigour of vegetation in key City conservation areas. The vegetation vigour change in Shepherds Bush over a two year period is shown in Figure 17. The majority of the site has increased in vegetation vigour with some minor areas showing decline.

Vegetation Cover

The height of the majority of vegetation cover at Shepherds Bush is 0-3m, with a moderate amount of vegetation with a height of 3-15m and a very minor amount of vegetation with a height of 15m or more, as shown in Figure 18 (see page 27).

Table 3: Shepherds Bush Reserve Vegetation Condition Assessment (2004, 2014 and 2015) using Keighery Scale

Year	Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded	Total
October 2015 (ELA)	0%	0%	57.3%	31.4%	1.1%	10.2%	100%
April 2014 (City of Joondalup)	0%	10%	45%	25%	15%	5%	100%
April 2004 (City of Joondalup)	0%	10%	45%	25%	15%	5%	100%

Figure 15: Shepherds Bush Reserve Vegetation Communities (sourced from ELA 2016)

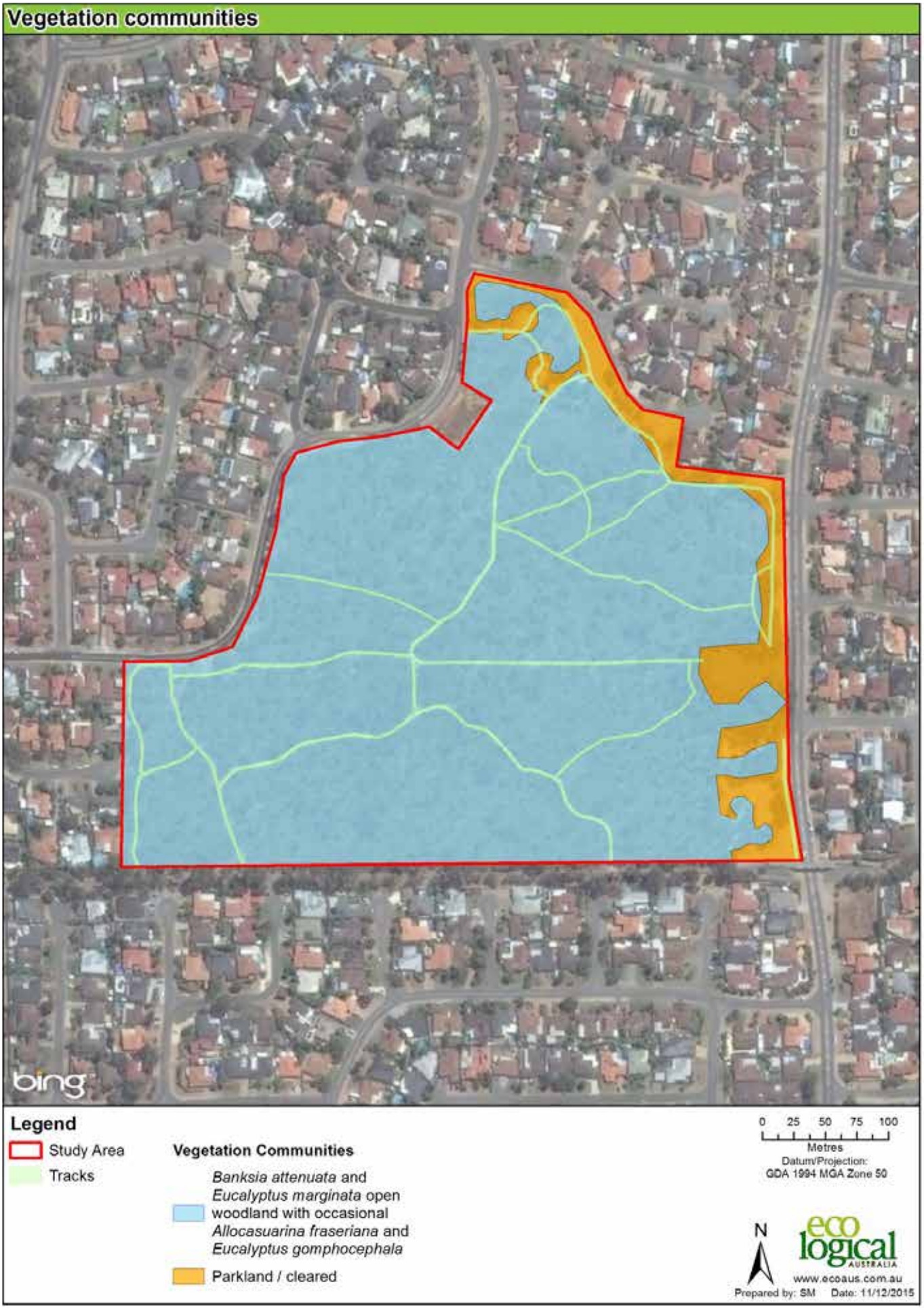
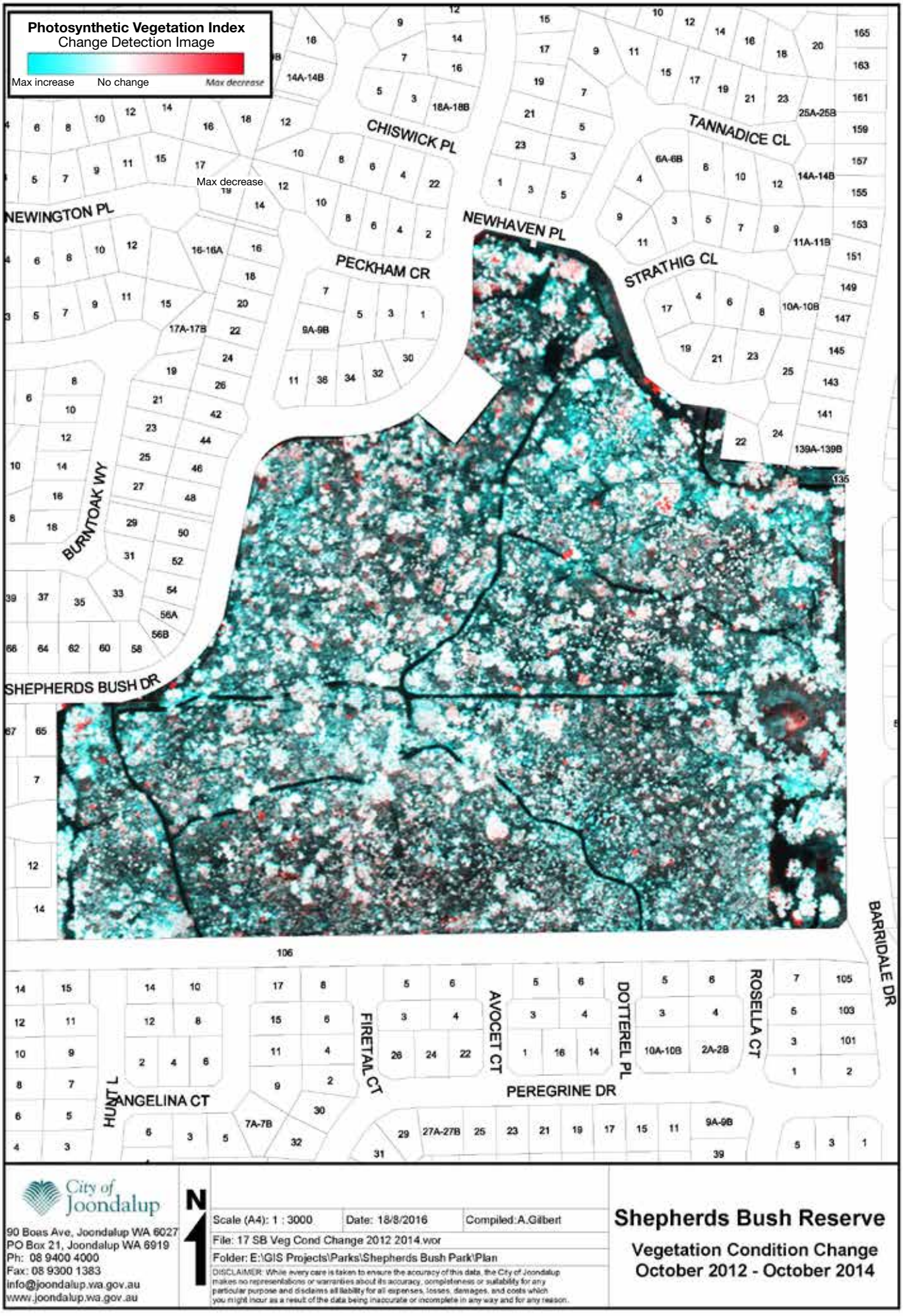


Figure 16: Shepherds Bush Reserve Vegetation Condition – October 2015 (sourced from ELA 2016)

Figure 17: Shepherds Bush Reserve Vegetation Condition Change Oct 2012 – Oct 2014 (Arbor Carbon 2014)



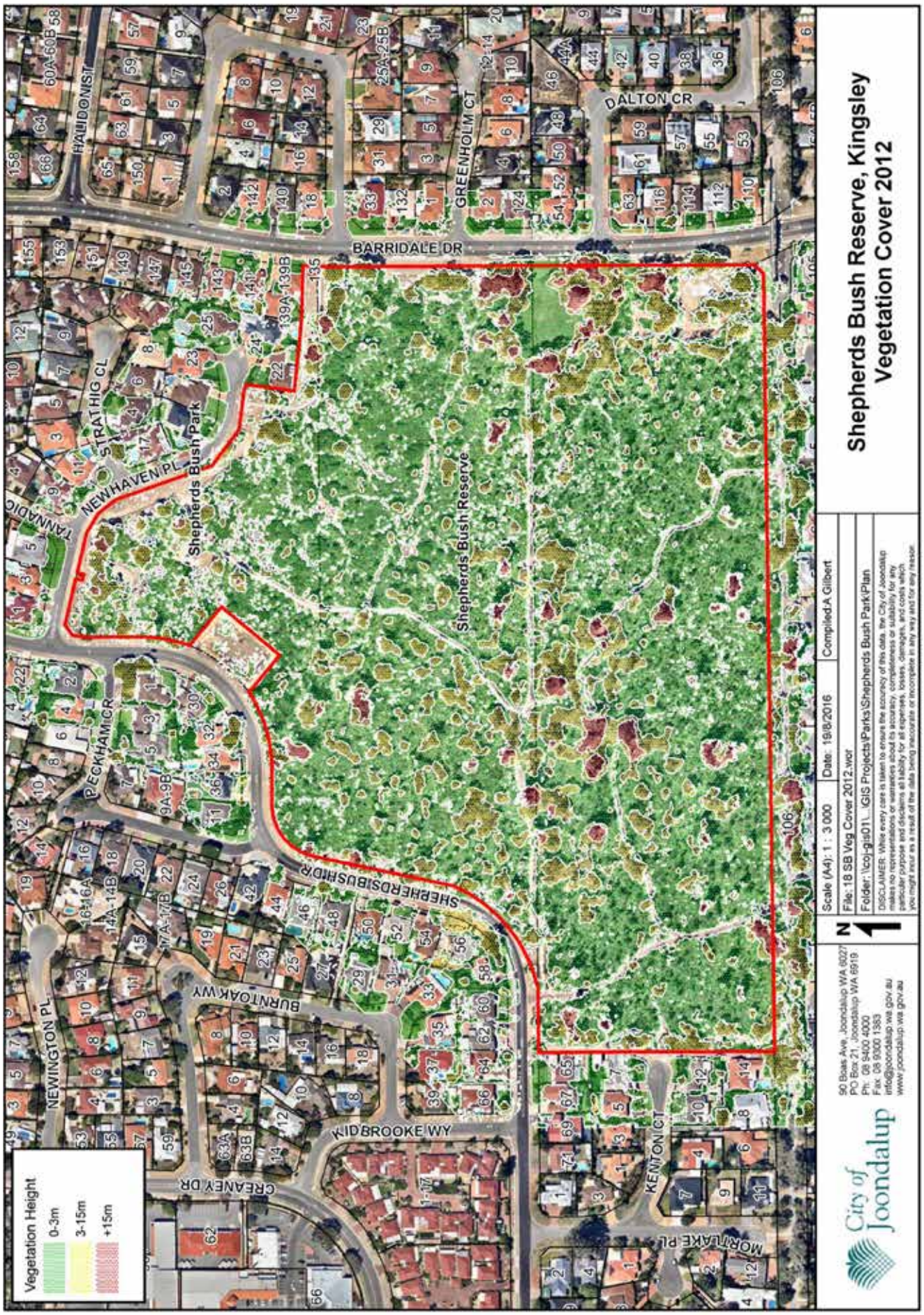
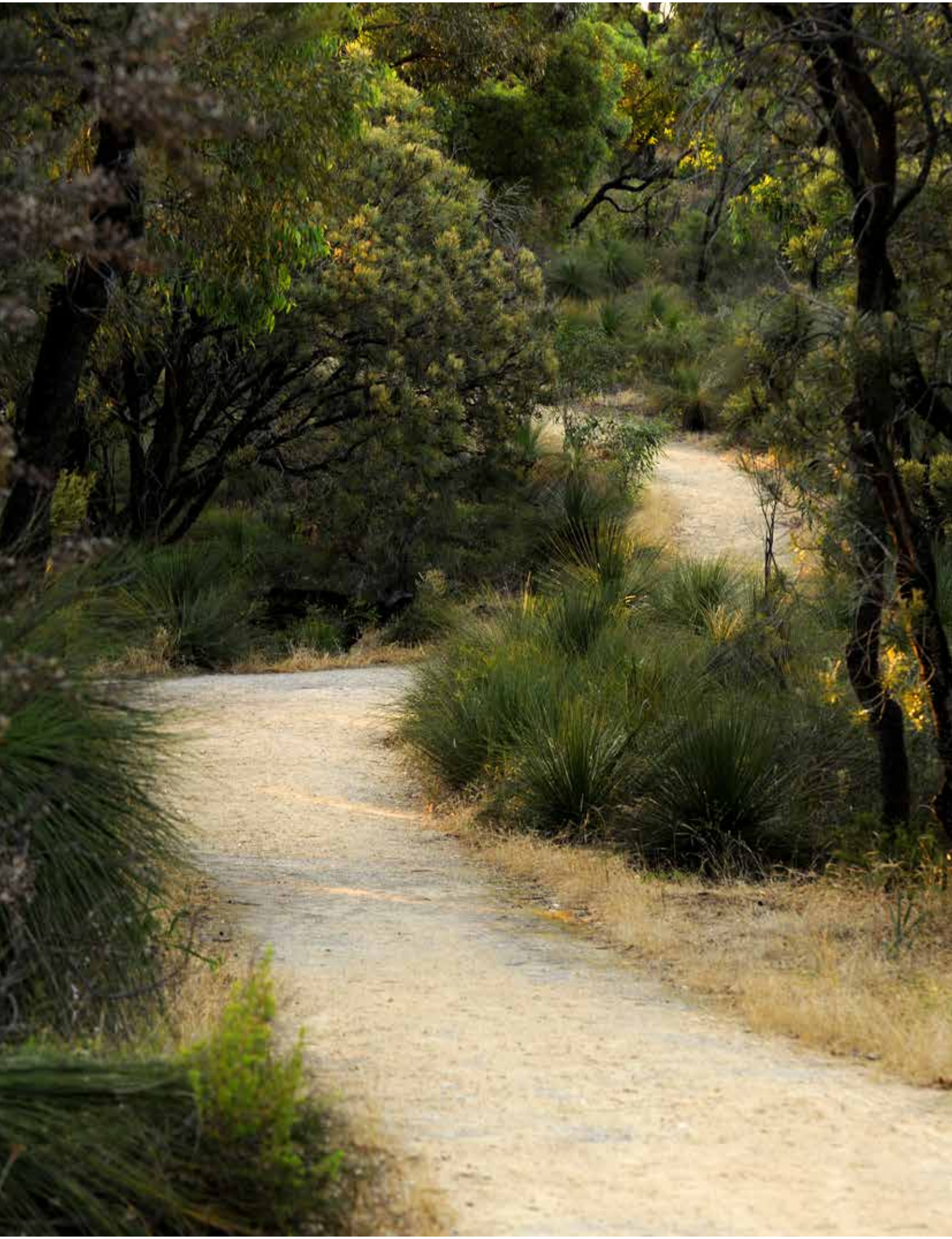


Figure 18: Shepherds Bush Reserve Vegetation Cover (Arbor Carbon 2012)



Formal pathways in Shepherds Bush Reserve

3.0 Biodiversity Management

Shepherds Bush supports an abundance of plant and animal species, including species listed as priority based on their endangered, threatened and migratory status. The long term protection of biodiversity values within Shepherds Bush is critical to ensure the conservation of this important bushland habitat. The protection and enhancement of biodiversity within Shepherds Bush also benefits the community through the provision of ecosystem services such as:

- the production of oxygen and capture of carbon dioxide;
- noise and air quality regulation;
- cooling of urban environments;
- regulation of freshwater supplies;
- generation and maintenance of topsoil;
- generation and recycling of nutrients;[40]
- control of pests and diseases;
- supporting seed dispersal and pollination;
- providing a genetic store;[41] and
- a number of recreational and cultural experiences.[42]

There are a number of environmental threats that pose a risk to the biodiversity of Shepherds Bush. The key environmental threats at Shepherds Bush addressed in this Section include:

- Weeds;
- Pathogens and disease;
- Non-native fauna species;
- Human impacts;
- Access and infrastructure; and
- Fire.

Management actions to address the key environmental threats have been established and are discussed in the following sections.

There are other additional environmental threats that are out of the scope of this Plan and therefore not addressed such as climate change and groundwater decline.

3.1 Flora

Shepherds Bush is located within the south-west Australia biodiversity hotspot. South-west Australia, from Shark Bay in the north to Israelite Bay in the south, is one of 35 biodiversity hotspots in the world with over 1,500 endemic plant species occurring in this region. Approximately 30% of the original vegetation extent of this area remains, with habitat loss being primarily due to agricultural and urban expansion and biological factors such as feral animals, weeds and the plant pathogen *Phytophthora cinnamomi*.[43, 44]

Flora surveys enable collection of scientific data related to the occurrence and distribution of flora species and vegetation communities. Information obtained from flora surveys is used as a baseline to monitor the ecological health of flora populations and vegetation communities.[43]

The City engaged consultants, Eco Logical Australia (ELA/Eco Logical), to undertake a desktop and field flora survey of Shepherds Bush in October 2015.

The design of the flora survey was aligned with methodology outlined in EPA *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (2004)*. The survey was undertaken in accordance with the requirements of the Western Australian (WA) *Environmental Protection Act 1986* (EP Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The survey methodology included the use of 10m x 10m quadrats and opportunistic sampling of species not recorded within the quadrats, to inform a species inventory of the study area. Six quadrats were installed within the study area, following analysis of aerial imagery, review of previous City of Joondalup field survey reports and ground-truthing.

Eco Logical recorded a total of 139 flora taxa at Shepherds Bush during their survey. This total included 89 native (64%) and 50 (36%) introduced taxa. The taxa comprised 43 families and 107 genera. The most commonly occurring family was *Fabaceae* (20 taxa) and *Acacia* was the most common genus with five taxa.

Previous flora surveys conducted in Shepherds Bush include:

- City of Joondalup Natural Areas Initial Assessments (NAIAs) (2004 and 2014)
- Murdoch University (1989) Shepherds Bush Park Management Proposal

The combination of results from Shepherds Bush flora surveys indicates that there are 166 species, including 110 native species (66%) and 56 introduced species (34%).

The optimal time for surveying is spring for native flora and winter for weeds. Rainfall was not recorded during the five day survey conducted by ELA, and a total of 237mm of rainfall was received in the three months prior to the survey.[25] This is below the long-term average for the period June – August (354.4 mm), however it is still considered suitable for flora and fauna survey timing.[9]

Native Flora

Native flora is an important part of the Shepherds Bush ecosystem. The loss of native plant species can lead to a loss of fauna that depend on flora for food and shelter. A total of 110 native flora species have been recorded at Shepherds Bush (see Appendix 2).

[40] Burbidge (2004)
[41] Millennium Ecosystem Assessment (2005)
[42] City of Joondalup (2012b)
[43] Conservation International (2012)
[44] Australian Government, DoE (no dateb)

The number of native flora species recorded at Shepherds Bush is comparable to the number of species recorded in similar bushland areas nearby.[45] The diversity is also considered to be very good for remnant vegetation in a built-up urbanised area.[9]

One naturally occurring priority species rated by the Department of Parks and Wildlife (DPaW) listed under the *Wildlife Conservation Act 1950* has been recorded at Shepherds Bush, *Jacksonia sericea*, which is listed as Priority Four (Rare, Near Threatened and other species in need of monitoring). This species is also listed as Significant Flora of the Perth Metropolitan Region, under the State Governments' Bush Forever Strategy (2000). Other significant flora species of the Perth Metropolitan Region recorded at Shepherds Bush include the Prickly Conostylis (*Conostylis aculeata subsp. cygnorum*), see Appendix 3.

Lomandra hermaphrodita and *Lomandra maritima* are the food source for the threatened fauna species the Graceful Sun Moth (*Synemon gratiosa*). These species were listed through database searches as potentially occurring within Shepherds Bush Reserve and have been observed in Hepburn Heights Conservation Area, (located approximately 1.8km west of the study area), although no specimens were observed in the spring 2015 survey.

The 2004 City of Joondalup NAIA assessment recorded *Lomandra hermaphrodita* as one of the dominant herbaceous species present, although there is a possibility this species was mistaken for another *Lomandra* species, as three species of *Lomandra* have been recorded at Shepherds Bush. The priority and significant flora species recorded in Shepherds Bush are shown in Appendix 3.

Evidence of chewed vegetation (seeds and pods) have been observed at Shepherds Bush and are attributed to foraging activity by the Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and potentially the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii subsp. naso*). The diversity of flora species present at Shepherds Bush Reserve, particulary those belonging to the *Proteaceae* family, provide foraging habitat for these Cockatoos.[9, 46]

The large Tuart (*Eucalyptus gomphocephala*) trees at Shepherds Bush provide potential breeding and roosting habitat for Carnaby's Black-Cockatoos.[47] Tuarts take 200 years to develop hollows that are a suitable size for nesting.[47] Many Tuart trees on the Swan Coastal Plain have died in the past 20 years due to stress factors such as the lowering of the water table, insect infestations and fungal pathogens.[48] Planting of Tuart trees in Shepherds Bush may provide habitat for nesting and roosting in the long term for Carnaby's Black Cockatoos.

There are a number of dead or declining mid storey and upper storey trees at Shepherds Bush. These large trees (dead or alive) provide habitat for nesting, shelter and protection for fauna and should be retained on site.

Weeds

Weeds are exotic or native species that grow in ecosystems where they did not originally belong. Weeds are commonly introduced and distributed within bushland areas through the dispersal of seed by water, wind and animals such as birds, fire, through dumping of garden refuse, and by human or vehicle movement in natural areas.

Weeds have major economic, environmental and social impacts in Australia and can:

- displace native plant species;
- alter ecosystems, nutrient recycling and soil quality;
- harbour pests and diseases;
- increase fuel loads for fires;
- impact negatively on fauna and flora and their habitats; and
- compete with native species for space, water and nutrients.[49]

Over 28,000 known alien plant species have been introduced to Australia with approximately 10% now being established in the environment.[50] Garden plants are the main source of Australia's weeds, accounting for 66% of recognised weed species.[49]

A combined total of 56 weed species have been recorded at Shepherds Bush (see Appendix 2), from the flora surveys undertaken by Eco Logical (2015), City of Joondalup NAIA assessments (2004 and 2014) and Murdoch University (1989). From these 56 weed species, 29 have been identified as priority species.

Environmental weeds are classified as priority if they meet any of the following criteria:

- Weed species listed as a Weed of National Significance (WONS) by the Australian Government,
- The weed species is listed as a Declared Pest Plant according to the *Biosecurity and Agriculture Management Act 2007*,
- The weed species is rated as High Priority in regards to its ecological impact according to the *Draft DPaW Weed Prioritisation Process for the Swan Region (2013),*
- The weed species is listed as a Pest Plant under the City's *Pest Plant Local Law 2012*, and
- The City of Joondalup has determined that the weed species; poses a major threat to vegetation or the structure of vegetation communities; is likely to lead to a significant outbreak of individual weed species; and/or contribute to a high fuel load (e.g. grasses). These species are classed as priority weeds in the City of Joondalup.

The majority of the weed species recorded are daisies from the *Asteraceae* family and grasses from the *Poaceae* family.

[45] ELA 2013 cited in ELA (2016)
[46] DEC (2011a)
[47] DEC (2010b)
[48] Matusick, Hardy and Ruthrof (2012)
[49] DSEWPC (2012)
[50] Groves, Boden and Lonsdale (2005)

Many of the weed species adjoin disturbed areas, particularly pathways and informal tracks. Areas surrounding the boundary of Shepherds Bush, where the bushland meets the road, particularly in the northern section of the site, contain a high weed presence. The most common species observed in the 2015 survey at Shepherds Bush were *Hypochaeris glabra* (Smooth Catsear), *Ehrharta calycina* (Perrenial Veldt Grass), *Euphorbia terracina* (Geraldton Carnation Weed) and *Pelargonium capitatum* (Rose Pelargonium).[9]

Weeds have been recorded using density coverage percentages ranging from less than 5%, to 6-30% and 31-60%. *Cynodon dactylon* (Couch Grass) was the only weed species recorded to occur in more than 60% coverage of a given area. This was due to the species comprising in the designated cleared parkland area and the swale and sump on site.[9]

Twenty four weed species recorded in Shepherds Bush are rated as priority weed species in the City of Joondalup, one of which is ranked as a Pest Plant under the City of Joondalup Local Law.

The City of Joondalup has a *Pest Plant Local Law (2012)* for the management of Caltrop (*Tribulus terrestris*). This species was recorded in the City's 2014 NAIA assessment (see below section *Pest Plant Local Law*), although no caltrop was recorded in the 2015 weed survey undertaken by Eco Logical.

Two species recorded are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (one of which is also listed on the City's priority weed list).

Twenty six species recorded at Shepherds Bush are ranked as high priority in regards to their ecological impact, under the *Draft Department of Parks and Wildlife Swan Region Species Prioritisation Process 2013*.

Examples of identified priority weeds are illustrated in Appendix 6 and their recommended weed treatment methodology is detailed in Appendix 7, which is used for City of Joondalup on ground management of priority weeds.

Current Management Approach

The City's current approach to monitoring, conserving and protecting native flora in Shepherds Bush is outlined below.

Site Assessments

Flora surveys are conducted approximately every five to seven years in Shepherds Bush to record the occurrence and distribution of flora species and vegetation communities. Information obtained from flora surveys is used to monitor the ecological health of flora populations and vegetation communities on site.

Natural Area Initial Assessments are conducted approximately every five to ten years in Shepherds Bush to assess site-specific ecological values, biodiversity significance and threatening processes, at a level that is consistent with regional scientific standards.[51]

Weed Management

The City undertakes an integrated approach to weed management, including:

- Preventing weed introduction through weed hygiene measures;
- Regular monitoring and reporting of weed populations.
- On ground weed control, including prioritisation of natural areas and priority weeds to target.
- Community education initiatives; and
- Fire prevention measures.

Weed Monitoring

The following table outlines the various weed monitoring methods undertaken by the City in Shepherds Bush.

Weed Monitoring Method	Detail
Monthly weed inspections	Monthly weed inspections are conducted at Shepherds Bush to establish the extent and distribution of weed species and to identify priority weeds. Monthly weed inspections are used to inform on ground weed management programs.
Annual weed percentage cover monitoring	The City monitors the percentage cover of environmental weeds in Shepherds Bush on an annual basis, measured by three transects within the reserve.
Flora surveys	Flora surveys are conducted every five to seven years in Shepherds Bush. Flora surveys include mapping of priority weeds and a vegetation condition assessment. The vegetation condition assessment (see Figure 16) also informs weed management as the vegetation in the best condition can be prioritised for weed control. Comparisons will be made between flora surveys to assess site changes every five to seven years.
Natural Area Assessments	Natural Area Assessments are conducted every five to ten years at Shepherds Bush using a variety of ecological criteria to monitor the environmental health of the site, including identifying weed species.

[51] WALGA (2004)

Annual weed percentage cover monitoring is conducted in Shepherds Bush, measured by three quadrats within the reserve. There has been a significant decrease in the percentage cover of weeds in 2014/15, compared to 2013/14, however the methodology for calculating the percentage cover of weeds has been amended to include quadrats at three different locations in the bushland, to increase the comprehensiveness of the sampling. Therefore it is difficult to make direct comparisons and the 2014/15 data should be treated as baseline information to enable comparisons in future years (see Figure 19).

Weed Control

In accordance with the City's Annual Bushland Schedule, on ground weed management in Shepherds Bush occurs through weed spraying and hand weeding methods. In addition to this, contractors are engaged to spray weeds and hand weed. City of Joondalup staff use a weed spraying procedure and conduct weed control trials periodically to evaluate the most effective weed management methods.

Resources, such as the DPaW's Florabase website, the *Western Weeds*, *A guide to the Weeds of Western Australia* book or *Southern Weeds and their Control* (DAFWA Bulletin 4744) are consulted in regards to weed control. Weeds on verges within and surrounding Shepherds Bush are managed by mowing verges to reduce seed spread, spraying weeds and spreading certified mulch, where required.

Weed control is also conducted regularly in the Robertson Road Cycleway, adjacent to Shepherds Bush Reserve, to prevent weed spread into the natural area.

A *City of Joondalup Weed Management Plan* was developed during 2015/16 to provide an ongoing strategic approach to weed management in the City and reduce the incidence of weeds.

Pest Plant Local Law 2012

The purpose of the *Pest Plant Local Law 2012* is to prescribe pest plants within the City of Joondalup that are likely to adversely affect the value of property in the district or the health, comfort or convenience of the inhabitants of the district.

Pest plants are generally highly adaptable, out compete native species and spread easily, leading to quick establishment, particularly after a disturbance event such as fire, or through unrestricted access. If pest plants are allowed to establish they have the potential to decrease the City's unique floristic diversity.

The *Pest Plant Local Law 2012* requires the owner or occupier of private land within the City of Joondalup district to destroy, eradicate or otherwise control scheduled pest plants on notice by the City. Currently one weed species is scheduled under the Local Law – Caltrop (*Tribulus terrestris*). Caltrop has previously been identified at Shepherds Bush and was removed at the time of identification.

There is signage installed at Shepherds Bush indicating the species should be reported to the City if sighted.

Community Education

A number of education initiatives are undertaken to raise the awareness of weeds in the community, these include:

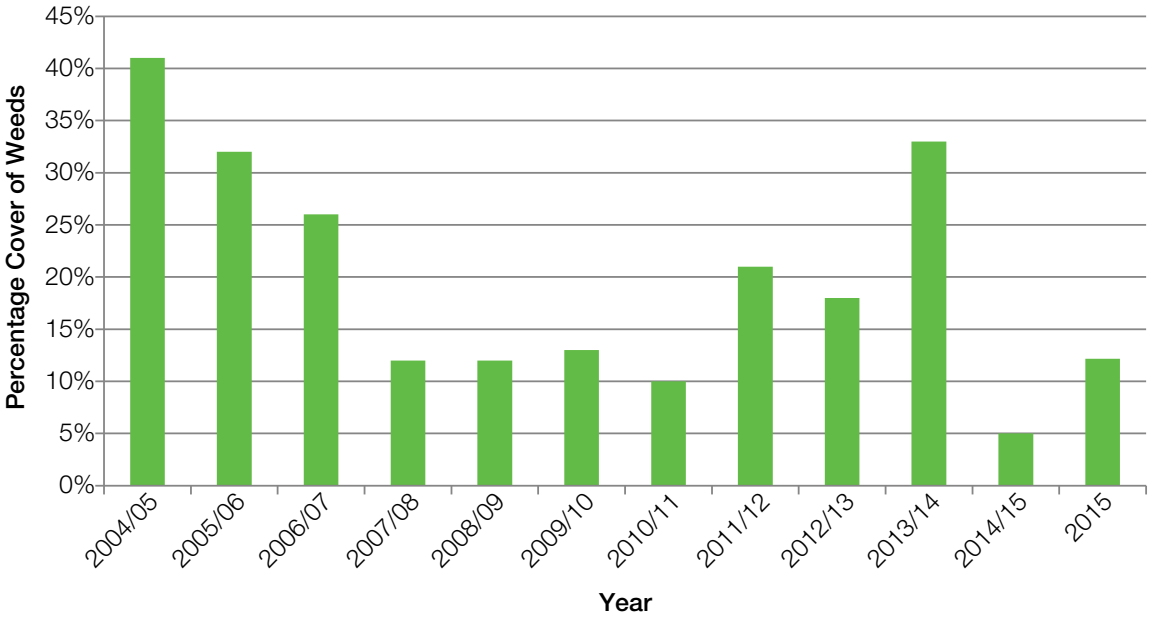
- Delivery of Gardening Workshops, promoting the use of native species in residential gardens;
- Development and distribution of brochures including *Environmental Weeds, Garden Escapees, Protecting our Natural Areas and Parks* and a series of *Growing Locals* brochures (available in hard copy and on the City's website); and
- Weed Education Workshops for Local Friends Groups.

Revegetation

The City of Joondalup encourages natural bushland regeneration through weed management and conservation fencing, to allow natural regeneration to occur and vegetation to re-establish itself. This is important in maintaining species diversity and populations.

The City supports revegetation in degraded or completely degraded areas using direct seeding techniques with local provenance seeds and seedlings, as required.

Figure 19: Percentage Cover of Weeds in Shepherds Bush Reserve 2004 – 2015



Recommended Flora Management Actions

To monitor, conserve and protect native flora in Shepherds Bush, the following management actions are proposed:

Action	Details
Flora survey	Undertake a follow up flora survey in spring to supplement previous flora surveys, within five years. Make comparisons between flora surveys to assess site changes every five to seven years.
Weed survey	Undertake a follow up weed survey in winter to supplement previous weed surveys, within five years.
Investigate planting trees (and vegetation) for habitat	Investigate planting Tuart (*Eucalyptus gomphocephala*) and Marri (*Corymbia calophylla*) trees in Shepherds Bush to provide nesting and roosting habitat and a feeding resource in the long term for Carnaby's Black Cockatoos.[52] Investigate planting other species of local trees and shrubs (such as Jarrah and *Hakea* species) to provide opportunities for nesting sites and shelter for fauna.
Revegetation	Support revegetation being conducted in degraded or completely degraded areas using local provenance species, as required.
Monthly weed inspections	Conduct monthly weed inspections to establish the extent of weeds and to identify priority weed species.
Natural Areas Initial Assessment	Conduct five to ten yearly follow up of Natural Areas Initial Assessment to monitor ecological health of site.
Annual weed percentage cover monitoring and reporting	Monitor and report on the percentage cover of environmental weeds in Shepherds Bush on an annual basis, using three quadrats.
Weed control	Undertake a coordinated approach to regular weed control by implementing the Annual Bushland Schedule.
Weed control on verges	Conduct weed management of weeds on verges within Shepherds Bush including mowing of verges to reduce seed spread, spraying of weeds and spreading of certified mulch, where required.
Weed Management Plan	Implement the *City of Joondalup Weed Management Plan* to provide an ongoing strategic approach to the management of natural areas in order to reduce the incidence of weeds.

3.2 Fungi

It is estimated that there are 10 times more species of fungi than plants in the world, equating to approximately 140,000 fungi and 14,000 plant species in Western Australia.[53] Fungi is an important part of an ecosystem as they recycle and break down organic matter and debris to provide nutrients for plants. Many plants can thrive in poor soils because they have beneficial connections with fungi. The amount of species of fungi present in bushland can be an indicator of ecosystem health.[54] Fungi also provide food and habitat for mammals such as bandicoots and other fauna including invertebrates.[55]

Research into the importance of fungi is leading to the discovery of how fungi can help reduce the likelihood of extinction of plants, animals and the loss of ecological communities.[55]

Fungi surveys are important in providing baseline information and to highlight changes in fungi occurrence over time. Undertaking fungi surveys also enables the comparison of ecological data with other natural areas within the City of Joondalup.

Fungi Survey (2015)

Whilst undertaking the flora and fauna survey in October 2015, consultants Eco Logical Australia were also engaged to undertake an opportunistic fungi survey of Shepherds Bush and record all incidental sightings of fungi. The optimum time for fungi surveys is in autumn or winter after substantial rainfall.[56] Due to time limitations, the incidental fungi survey was conducted in spring (dry conditions) and no fungi were recorded by the consultant.

The City of Joondalup has reported observing fungi species at the site, although no formal records of this have been kept.

The Perth *Urban Bushland Fungi (PUBF)* project started in 2004 as a community initiative in response to growing public interest about local fungi. The aims of the PUBF project were to raise awareness about the role of fungi in the ecosystem, increase the capacity of the community to confidently identify fungi and conduct surveys of fungi in bushland areas to collect baseline data, with the objective of integrating fungi into biodiversity management strategies.[56] In 2005 a fungi workshop was undertaken in Warwick Open Space through the PUBF project, which recorded 47 species of fungi.[57]

[52] DEC (2011b)
[53] Bougher (2009)
[54] Robinson (no date)
[55] DPaW (no date a)
[56] Urban Bushland Council (2016)
[57] Perth Urban Bushland Fungi Project (2005)

In August and September 2013, the City engaged consultants, Syrinx Environmental PL, to undertake a fungi survey at Hepburn Heights Conservation Area, located 1.8kms from Shepherds Bush. Fourteen species of fungi were recorded during this survey.

In September 2012, the City engaged the same consultants (Eco Logical Australia) to undertake a fungi survey at Warwick Open Space, located 5kms from Shepherds Bush. Three species of fungi were recorded during this survey.

Fungi species recorded in the nearby natural areas of Warwick Open Space and Hepburn Heights are potentially likely to be present in Shepherds Bush. The full list of fungi recorded in the these areas and photographic examples is provided in Appendix 11 and 12 respectively.

Current Management Approach

The City of Joondalup currently monitor fungi in Shepherds Bush through recording incidental sightings of fungi species during the City's five yearly flora and fauna surveys.

Recommended Fungi Management Action

To monitor fungi health in Shepherds Bush, the following management action is proposed:

Action	Details
Fungi survey	Undertake a comprehensive fungi survey in autumn or winter after substantial rain, to supplement previous incidental fungi surveys, within five years.

3.3 Plant Diseases

Organisms such as fungi, bacteria and viruses that cause plant diseases are known as pathogens. Whilst some pathogens are naturally occurring within the soil, others have been introduced to the environment through the movement of plant materials and soils.[58]

The symptoms produced by plants that are affected by pathogens vary depending upon the species of pathogen, host species, environment and climatic conditions. Some pathogens can live in the soil for a long period without impacting the health of plants, whilst others can cause rapid death or result in a slow, perennial decline in health.[59]

Phytophthora dieback refers to the disease caused by the introduced plant pathogen *Phytophthora cinnamomi*. While there are numerous species of *Phytophthora*, the most aggressive species affecting native plants throughout south-western Western Australia is *Phytophthora cinnamomi*. Previously *Phytophthora* dieback was commonly referred to as 'Jarrah dieback' as Jarrah (*Eucalyptus marginata*) trees were one of the first plant species observed to be impacted by *P.cinnamomi*.[60]

However as the pathogen has become more widespread, up to 22% of plant species in south-western Western Australia are likely to be susceptible to the pathogen,[61] thus the term *Phytophthora* dieback is most appropriate when describing *P.cinnamomi*.[62]

Whilst *Phytophthora cinnamomi* is the most common species of *Phytophthora* dieback within Western Australia, other species of *Phytophthora* are common in urban areas of Perth.

Pathogen sampling of the City's parks, natural areas and coastal sites in accordance with the City of Joondalup *Pathogen Management Plan 2013-2016* has recovered a number of *Phytophthora* species, which include *P.alticola*, *P.arenaria, P.multivora* and *P.nicotianae*. Of these *Phytophthora* species, *P.multivora* and *P.nicotianae* are the most prevalent.[59, 62]

Phytophthora multivora is a common pathogen in urban areas of Perth, particularly along the inland dune systems. It is widespread throughout the south-west of Western Australia with a similar distribution to *Phytophthora cinnamomi. Phytophthora multivora* is named due to its wide host range, including *Banksia* and *Eucalypt* species. *Phytophthora multivora* can cause rapid death of plants, or a slow, perennial decline in the health of the tree crown and is commonly associated with individual spot deaths and areas of tree decline.[59]

Phytophthora nicotianae has been identified in herbaceous and woody plants used in agriculture and horticulture, although it is now considered established within natural ecosystems in Western Australia. The pathogen is widely found within nursery stock and therefore has a higher probability of infecting parks and reserves, rather than natural areas due to the introduction of nursery stock and soil through planting programs and the regular use of machinery and vehicles. *Phytophthora nicotianae* is associated with large lesions at the base of Eucalyptus trees and causes collar rot of *Grevillea* species. *Phytophthora nicotianae* has also been identified as causing fine root death of numerous other native plant species.[59]

Armillaria luteobubalina has also been identified within a number of parks within the City of Joondalup. *Armillaria* is a soil-borne fungus that causes root rot of a wide variety of plants including many species of native flora. The fungus is native to Australia and can also cause major damage to natural ecosystems. *Armillaria luteobubalina* is commonly known as the "Honey Fungus" due to the colour of the fruiting body seen above the ground during certain times of the year, as shown in Figure 20. Fruiting bodies (mushrooms) are not evident at all infected sites and their presence is usually a sign that the fungus is well established in that area.[59]

At present there is no reliable mechanism for the complete eradication of *Phytophthora* species and the control of *Armillaria luteobubalina* is both expensive and labour intensive.[59]

[58] City of Joondalup (2013a)
[59] ArborCarbon (2014)
[60] DWG (no date)
[61] CPSM (2012)
[62] ArborCarbon (2015)

Figure 20: Fruiting Bodies of Armillaria luteobubalina (sourced from City of Joondalup 2013a)

Current Management Approach

The City of Joondalup has developed a *Pathogen Management Plan 2013-2016* to protect native vegetation and ecosystems by establishing the level of risk for areas to be infected by pathogens, prioritise areas and detail preventative and management actions to be implemented within the City, including guidelines for dieback-free purchasing of plant stock and materials and a hygiene procedure. The City has further developed *Pathogen and Weed Hygiene Guidelines and Purchasing of Landscaping Materials Guidelines* to minimise the spread of pathogens.

Pathogen sampling was also undertaken in Shepherds Bush in May 2014 and fungi belonging to the known canker and latent pathogen family *Botryosphaeriaceae* was confirmed from diseased material. The confirmed occurrence of this fungi from sampled areas within the City, have in most cases been associated with distinct lesions causing decline or death of individual plants.[63]

Botryosphaeriaceous fungi are considered latent (dormant) pathogens or endophytes meaning they will exist within healthy trees without causing disease, unless the tree experiences stress such as drought, wounding, extreme climatic events or insect predation. The symptons displayed by vegetation likely to be impacted by *Botryosphaeriaceous* fungi in the City's parks and natural areas suggest that deaths due to this fungi have been occurring for a number of years, particularly to older *Banksia* trees, which is evident in Shepherds Bush.[63]

Shepherds Bush was previously thought to be infested with *Phytophthora cinnamomi.* As a result, 'dieback' awareness signage was installed at a number of access points to the reserve.

Previous *Phytophthora cinnamomi* assessments undertaken in Shepherds Bush include:

- Dieback Treatment Services (2008) Shepherds Bushland *Phytophthora* Assessment.
- Dieback Working Group (2004) Management of *Phytophthora* Dieback in Shepherds Bush Reserve, Kingsley.

Laboratory testing of samples collected from these assessments did not detect *P.cinnamomi*.[64, 65]

In March 2016, further sampling was undertaken in the southern area of Shepherds Bush, adjoining the Robertson Road Cycleway and along the Cycleway itself. *Phytophthora multivora* was recovered from Marri (*Corymbia calophylla*) trees along the Roberston Road Cycleway and other species were observed to be showing severe decline, which is consistent with data the City has obtained from previous assessments, indicating there has been an approximate 4% reduction in canopy cover aloing the Robertson Road Cycleway from 2014 to 2015.[63]

Although *Phytophthora* species were not specifically recovered through laboratory testing at Shepherds Bush Reserve, other pathogens belonging to *Botryosphaeriaceous* and *Fusarium* fungi are having an impact on the vegetation within the reserve.[63].

[63] ArborCarbon (2016)
[64] Dieback Treatment Services (2008)
[65] DWG (2004)

Rainbow Bee-eater *(Merops ornatus)*

Therefore it is recommended the current dieback signage be upgraded to continue raising awareness about hygiene practices to the community, in an attempt to limit the spread and introduction of plant pathogens into Shepherds Bush.

Recommended Pathogen Management Action

To prevent pathogen and weed spread and protect biodiversity values at Shepherds Bush, the following management actions are proposed:

Action	Details
Pathogen Management	Implement recommendations from the *Pathogen Management Plan* that are applicable to the management of Shepherds Bush Reserve.
Hygiene Guidelines	Implement *Pathogen and Weed Hygiene Guidelines and Purchasing of Landscaping Materials Guidelines* to prevent the introduction or spread of weed or pathogens into Shepherds Bush Reserve.
Education and Training	Investigate the upgrade and installation of signage within Shepherds Bush Reserve to raise the awareness of the threats of pathogens within the site.

3.4 Fauna

Fauna surveys document the occurrence, distribution and population of fauna species. Information from fauna surveys is used as a baseline to monitor the health of fauna species.

The City engaged consultants, Eco Logical Australia (ELA), to undertake a fauna survey of Shepherds Bush in October 2015. As part of the fauna survey, ELA reviewed data from previous surveys provided by City of Joondalup to compile a comprehensive data set to be used in the development of this Plan.

The fauna survey design was aligned with *EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (2004)*, the principles outlined in *EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection, and the Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*.[9]

Two conservation listed fauna species were recorded during the survey, both were species of birds and include the Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and the migratory Rainbow Bee-eater (*Merops ornatus*).

The fauna survey method included a variety of sampling techniques, both systematic and opportunistic. Systematic trapping was conducted over four nights in October 2015 using a combination of pitfall traps, Elliot box traps, cage traps and funnel traps in six trapping transects. Other fauna survey methods included a bird census at each transect, a bat survey, hand searches, installation of motion sensor cameras (over four nights) and a nocturnal search (over one night), in addition to opportunistic sampling and sightings.

The optimum season for fauna detectability in the south west bioregions is spring. Trapping periods of five to seven nights are recommended to show species diversity, richness trends and provide reliable indications of species composition and abundance data.

Previous fauna records at Shepherds Bush include:

- City of Joondalup (CoJ) Natural Area Initial Assessments (NAIA) (2004 and 2014).
- Murdoch University (1989) Shepherds Bush Park Management Proposal.

The combination of results from the 2015 fauna survey and the previous fauna assessments undertaken (City of Joondalup and Murdoch University) indicate the following species inhabit Shepherds Bush:

- Two native mammals;
- 29 native birds (including two species of conservation significance);
- Ten native reptile species; and
- 34 native invertebrates (including one short range endemic species).

In addition, the following non-native fauna have been identified at Shepherds Bush:

- Six mammals (including the domestic dog and domestic/feral cat);
- Five birds; and
- Two invertebrates.

The full fauna species list incorporating all the above assessments is provided in Appendix 8.

Fauna Habitat

The bushland at Shepherds Bush provides an important area of remnant fauna habitat within the City of Joondalup. The vegetation community and habitat resources it contains support a relatively diverse and species-rich assemblage of native birds and reptiles and the bushland is considered to have high local conservation value.[9]

The vegetation condition at Shepherds Bush ranges from excellent to completely degraded. There are large areas of localised disturbance due to the BMX park, the drainage sump, the swale and several established pathways. Vegetation, trees, leaf litter, soil, fungi, sticks, logs and dead trees at Shepherds Bush provide habitat for fauna to nest, shelter, forage and roost. The *Banksia* and *Eucalyptus* species and the Marri trees at the site provide significant habitat value for nesting, roosting and foraging for the endangered Carnaby's Black-Cockatoos as well as many other native bird species. The conservation significant Rainbow Bee-eater has been also been recorded at Shepherds Bush. The Rainbow Bee-eater usually selects a spot in the ground to nest, commonly in bare sand or along turfed areas, located closeby to mature trees, where it can perch from to watch over its nest.

Western Grey Kangaroos *(Macropus fuliginosus)* at Shepherds Bush

The study area contains one broad vegetation community type described by having an upper stratum of mixed open woodland of *Banksia attenuata* (Slender Candlestick Banksia) and *Eucalyptus marginata* (Jarrah) with occasional *Allocasuarina fraseriana* (Sheok) and *Eucalyptus gomphocephala* (Tuart). The lower shrub and ground strata are composed of mixed shrubs including *Hakea lissocarpha* (Honey Bush) and *Xanthorrhoea preissii* (Grasstree) over *Hibbertia hypericoides* (Yellow Buttercups) and mixed grasses, including *Desmocladus flexuosus* and an open sedgeland. This community provides foraging and nesting habitat for a diversity of nectar and seed eating birds, as well as habitat for a range of reptiles and invertebrates.[9]

Whilst the site provides habitat for a large diversity of avifauna, the highly developed urban surroundings of Shepherds Bush limit the ability for other fauna such as mammals to access and use the ecosystem at Shepherds Bush.

The ELA fauna survey in 2015 highlighted the invertebrate species diversity within Shepherds Bush is expected to be higher than what was recorded, given the extent of good quality remnant native bushland habitat present and the diversity of flora species at the site.[9]

Native Fauna

Fauna and flora are interconnected in complex relationships with each other and with factors such as soil, water, climate and landscape. The decline of native fauna can cause loss of plant species and changes to ecological communities.[49] Alternatively, the decline of native flora can cause loss of fauna species.

Mammals

Two native mammals were recorded at Shepherds Bush, the Western Grey Kangaroo (*Macropus fuliginosus*) and the Gould's Wattled Bat (*Chalinolobus gouldii*).

During the 2015 fauna survey, only three kangaroos were identified together at any one time, indicating that only a few individuals currently reside in the study area.[9] The Murdoch University survey (1989) indicated only two kangaroos were sighted during the survey. The 1989 report also stated that *'as recently as a couple of years ago local residents had observed "a dozen or so" kangaroos*.'[6] The City of Joondalup NAIA (2014) recorded only one had been observed at the site previously, which supports the most recent assessment that only a few kangaroos inhabit the site.

It is not known whether these kangaroos are permanent or transient within the study area, although given the habitat isolation and the unavailability of ecological linkages, it is likely the small group of kangaroos recorded are marooned or are present at Shepherds Bush most of the time. However, anecdotal evidence provided during the development of this Plan by nearby residents, suggests the kangaroos do not become permanent within Shepherds Bush as they move seasonally along the Robertson Road Cycleway.

It is possible the kangaroos may have originated from Pinnaroo Valley to the west or Yellagonga Regional Park to the east and may have been living in Shepherds Bush for a significant period of time.[9]

Depending on factors such as vegetation community type and kangaroo gender, home range size is known to vary widely, with estimates for individual kangaroos between 30 and over 200ha.[66] Given the size of the study area (16.5ha), it is unlikely to be large enough to support three Western Grey Kangaroos. It is likely the kangaroos could be feeding on primarily introduced grasses, herbs and other weeds within the study area during winter and spring and the irrigated lawns of the designated parkland area during summer and autumn.[9]

There is a likelihood the kangaroos at Shepherds Bush are providing an ecological benefit due to weed reduction.[9]

It is difficult to ascertain whether the kangaroos are also feeding and subsequently impacting on native vegetation in the study area, as the impact from grazing does not appear to be significant. If the kangaroos reproduce and remain in the study area in the medium term, they could potentially have a negative impact on the native vegetation.[9]

Investigation into how the kangaroos access or previously accessed the site is recommended to determine whether the kangaroos can move onto other natural areas or if they are marooned at Shepherds Bush.

Gould's Wattled Bat (*Chalinolobus gouldii*) is one of approximately 75 species of bat in Australia. These native mammals fall into two main groups: the megabats and the microbats. Two groups of bat occur in Western Australia, flying-foxes (megabats) and insectivorous bats (microbats). Bats can be useful for pest control, feeding on moths, beetles, mosquitoes, invertebrate larvae, flying ants and other invertebrates.[67] A comprehensive bat survey would require a one week remote monitoring bat survey during summer.[68] Bats can be encouraged to roost in the area by installing bat boxes.

The Eucalypt trees within the study area provide suitable breeding habitat for Gould's Wattled Bat. Although the size of the bushland at Shepherds Bush is limited, the high mobility and the known occurrence of the species across the metropolitan area, indicate the Gould's Wattled Bat may utilise the habitat at Shepherds Bush for breeding and foraging.[9]

Reptiles

Ten native reptile species have been recorded at Shepherds Bush, the most common being species from the Scincidae family (skinks). All species recorded are considered common and widespread throughout the Perth region and wider south-west WA. None are considered conservation significant. [9, 69, 70]

Several species not recorded are considered likely to occur; these include but are not limited to *Anilios australis* (Southern Blind Snake), *Lerista elegans* (Elegant Skink), and *Pogona minor* subsp. *minor* (Western Bearded Dragon).

One species recorded, *Lialis burtonis* (Burton's Legless Lizard) is a specialist predator of skink lizards, and its occurrence indicates adequate abundance of skinks to support a population of this species.[9]

The 2015 fauna survey noted that all reptile specimens trapped were considered to be in good physical condition and that some were noted as immature or sub-adult age reptiles. These are likely to be offspring from the 2014 spring breeding season and indicate that the study area supports viable populations.[9]

Skeletal remains of three *Tiliqua rugosa* subsp. *rugosa* (Bobtails) were recorded throughout the study area, however no live individuals were identified during the survey. This indicates that feral predators are impacting upon native species within the study area.[9]

Amphibians

No amphibians have been recorded at Shepherds Bush. Two species have been recorded from within 5km of the study area in nearby bushland areas of Hepburn Heights and Warwick Open Space, including *Limnodynastes dorsalis* (Western Banjo Frog) and *Myobatrachus gouldii* (Turtle Frog) (see Appendix 8). The Turtle Frog in particular is considered likely to occur at Shepherds Bush as this species does not rely on wetlands for breeding. It is most readily detected via breeding call during rainy spring nights.[9]

Bobtail *(Tiliqua rugosa* subsp. *rugosa)*

[66] DPaW cited in ELA (2016)
[67] DEC (2007)
[68] J Tonga (2012), pers. comm., 6 July
[69] Australian Government, Atlas of Living Australia (no date a)
[70] Australian Government, Atlas of Living Australia (no date b)

Birds

A total of 29 native birds have been recorded at Shepherds Bush, including the endangered Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and the migratory Rainbow Bee-eater (*Merops ornatus*), both of high conservation significance (see Appendix 9).

Carnaby's Black-Cockatoos

Carnaby's Black-Cockatoos (Carnaby's) are endemic to the south-west of Western Australia and are listed on state, national and international threatened species lists. The *Banksia, Hakea* and Marri species on site provide a significant food source which Carnaby's use for foraging. Carnaby's Black-Cockatoos nest in hollows of smooth-barked eucalypts, including Tuarts (*Eucalyptus gomphocephala*) and Marris (*Corymbia calophylla*) which are found on site.[71]

Evidence of foraging activity has also been observed within the study area (chewed Banksia and Marri pods), which are most likely from either the Carnaby's Black-Cockatoo or the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*), which are also known to regularly feed on Marri trees locally. The Forest Red-tailed Black Cockatoo is also of conservation significance,[72] although no sightings have been recorded at Shepherds Bush.

The vegetation community throughout Shepherds Bush provides foraging habitat for both species of Black Cockatoo. This includes Jarrah, Marri, *Banksia sessilis,* B. *attenuata, B. menziesii,* and *Hakea* species, which are all primary foraging species for Carnaby's Black-Cockatoo.[73] The Marri is also highly likely to be a local food source for the Forest Red-tailed Black Cockatoo.[9]

The large Tuart trees within Shepherds Bush provide potential breeding and roosting habitat for Carnaby's Black-Cockatoo,[9, 73] although no indication of current breeding (such as Cockatoos observed within hollows) was observed in the 2015 fauna survey and bird census undertaken during the development of this Plan.

Artificial hollows could be installed in trees such as Tuart or Marri to encourage Carnaby's Black-Cockatoos or Forest Red-tailed Black Cockatoos to nest, however research indicates that they are most successful when placed where Carnaby's are already known to breed. Further research is still required to ascertain whether it is possible to encourage the birds to breed in areas where they currently aren't breeding. Artificial hollows have been used successfully at Murdoch University and resulted in the breeding of Forest Red-tailed Black Cockatoos. Artificial hollows require regular monitoring due to competitors for nests including European Honey Bees, Galahs, non-native Corellas and Rainbow Lorikeets.[73, 74]

Carnaby's Black-Cockatoo *(Calyptorhynchus latirostris)*

[71] DEC (2011a)
[72] BirdLife Australia (no date a)
[73] DEC (2011b)
[74] DPaW (2015c)

Southern Boobook Owl *(Ninox novaeseelandiae).* Image: Simon Cherriman

In February 2016, Carnaby's Black-Cockatoos were sighted breeding in a large mature tree in the car park at Edith Cowan University, Joondalup campus, located approximately 8km from Shepherds Bush.[75]

Due to the endangered status of the Carnaby's Black-Cockatoo and the limited remaning vegetation within the Perth Metropolitan Area, it is important that good quality vegetation and a diversity of flora species known to be used by the endangered Carnaby's Black-Cockatoo is maintained for habitat at Shepherds Bush.

Rainbow Bee-eaters

The Rainbow Bee-eater builds nests in sandy banks and digs tunnels approximately 90cm long which lead to a nesting chamber, making it vulnerable to trampling by humans or dogs or predation by foxes and cats.[76] Shepherds Bush provides an abundance of food (bees) during the spring-summer breeding period for when the Rainbow Bee-eater is present in the south west of WA.[9] Monitoring for Rainbow Bee-eater nesting sites through monthly inspections and the installation of fencing and signage around exposed nesting sites may decrease trampling of nests by humans or dogs and non-native fauna.

Common Native Birds

The most common bird species recorded at Shepherds Bush included a range of seasonal and resident nectar feeders such as honey eaters and wattle birds, opportunistic insectivores such as *Gerygone fusca* (Western Gerygone), *Pardalotus striatus* (Striated Pardalote), and *Smicrornis brevirostris* (Weebill), as well as raptors such as *Falco longipennis* (Brown Goshawk), and nocturnal species such as *Podargus strigoides* (Tawny Frogmouth). The *Manorina flavigula* (Yellow-throated Minor) recorded within the study area is known to occur locally, although this record is towards the south-western limit of this species' current distribution. All species observed at Shepherds Bush are known to be widespread throughout the south-west of WA and considered as common on the northern Swan Coastal Plain.[9]

Shepherds Bush was included in a study investigating Southern Boobook Owls (*Ninox novaeseelandiae*) in the northern metropolitan area. In 2015, a nest hollow with a pair of Southern Boobook Owls and two of their fledglings were recorded in a large mature Tuart tree (*E. gomphocephala*) in the south-west of Shepherds Bush. The tree was observed to contain feral bees which are known to impact bird species particularly owls and Cockatoos utilising nest hollows. These birds are often found dead or engulfed by feral bees competing for the same hollow.[77]

Retaining large trees containing known and potential nesting hollows, along with the management of feral bees is recommended to improve nesting opportunities for the Southern Boobook Owls utilising Shepherds Bush.[77]

[75] ECU (2016)
[76] Birdlife Australia (no date (b))
[77] M Lohr (2016), PhD candidate ECU University, email 19 May

Invertebrates

Invertebrates are animals without backbones such as insects, worms and molluscs. Invertebrates constitute more than 95% of all living animal species, with Australia having documented 100,000 species and an estimated 200,000 undescribed invertebrate species.[78] Some invertebrates are important indicators of ecosystem health, such as ants (seed dispersers), bees (pollinators) or spiders (top invertebrate predators).[79]

Invertebrates recycle organic matter, putting it back into circulation for use by other parts of the ecosystem and are instrumental in controlling the numbers of other species.[80]

During the 2015 fauna survey, invertebrates were recorded opportunistically by observations, during hand searching for vertebrates, or as bycatch within vertebrate pitfall traps.

A total of 34 native invertebrates were recorded during the survey, reflecting a somewhat rich invertebrate diversity given the isolated nature of Shepherds Bush.[9] The majority of invertebrate species recorded were spiders and beetles.

One millipede species recorded was identified down to the genus *Antichiropus*, which is known to include many species of Short Range Endemics (SREs). One potential SRE millipede from this genus was recorded approximately 1.8km west in Hepburn Heights (City of Joondalup 2015). At the time of the 2015 survey, only one specimen was recorded at Hepburn Heights and it has also been discovered at Salter Point, approximately 25km to the south (City of Joondalup 2015).

One conservation significant invertebrate species, *Synemon gratiosa* (Graceful Sun-moth), was identified from the database searches as potentially occurring in the study area. This species is listed as a Priority four species by Parks and Wildlife, and has previously been recorded from nearby areas including Hepburn Heights and Warwick Open Space. The Graceful Sun-moth is considered unlikely to occur, as the study area did not contain its known host plants *Lomandra maritima* and *L. hermaphrodita,* which provide breeding habitat for this species.[9]

The invertebrates recorded during the survey, in most cases were only able to be identified to the taxonomic order level, therefore it is assumed based on the limited identification available that the 34 out of the 36 species identified were native. Therefore a targeted invertebrate survey is recommended to formally assess invertebrate species richness. A targeted survey would determine the presence of any Short Range Endemics in the study area (including the locally occurring SRE millipede *Antichiropus* sp.).[9]

Non-native Fauna

Non-native fauna impact native fauna and flora through predation, competition for food and shelter, spreading diseases and destroying habitat. These impacts can result in the diminishing or extinction of native species.[49, 81]

Non-native animals such as cats, foxes, rabbits, rats, mice, birds, millipedes, ants and bees inhabit the City's bushland, wetland and coastal areas.

Native West Australian Bee

[78] DEC (no date b)
[79] V Framenau (2012), email, 9 July
[80] DPaW (no date b)
[81] Australian Government, DoE (no date c)

Feral Cat *(Felis catus)*

Mammals

Australia is home to some of the world's most unique animals. More than 80 per cent of our mammals occur nowhere else on earth,[82] however Australian mammals are becoming extinct at an alarming rate due to non-native (feral animal) predation.[83]

No non-native mammals were recorded in the 2015 survey. Although, the fauna survey undertaken in 1989 by Murdoch University identified six non-native mammals, these include the house mouse (*Mus musculus*), rat (*Rattus* sp.), fox (*Vulpes vulpes*) and rabbit (*Oryctolagus cuniculus*). The survey also recorded free roaming dogs (*Canis lupus*) and cats (*Felis catus*) but it was not possible to determine whether they were feral at the time of the survey. Large numbers of rabbits were reported during the survey and these were noted as potentially impacting the establishment of native flora species.[84]

The lack of small native mammals recorded (other than the Gould's Wattled Bat) is expected due to the small size, fragmented nature and location of Shepherds Bush, however the likely presence of feral predators could also be having an impact on the microbat population.

Three recorded skeletal remains of bobtail (*Tiliqua rugosa* subsp. *rugosa*) in the 2015 fauna survey are likely to be a result of feral predation. Given no live bobtails were trapped or observed during the survey, predation by feral animals is a key concern for native animals present in Shepherds Bush.

Although no fox sightings were recorded in the 2015 fauna survey, foxes are common within the City's bushland areas and have caused the decline of many native birds, reptiles and small mammals.[85] Anecdotal evidence provided during the development of this Plan suggests foxes have been recently sighted within the reserve.

Domestic animals such as dogs (*Canis lupus*) can also cause damage to the City's natural environment, particularly when exercised unleashed within natural areas. Shepherds Bush is a dog on lead area. Dogs can harass native fauna, including large mammals such as kangaroos, often resulting in stress and harm to the animals. Dogs can also spread pathogens if they disturb the soil, particularly around trees which may contain soil-based diseases. Dog droppings, if not removed, contribute a significant amount of nutrients to the site, encouraging weed growth and potentially polluting groundwater. Some dog droppings contain harmful bacteria.[86]

The City Rangers patrol Shepherds Bush Reserve to ensure dogs are kept on leads and their droppings are collected.

Domestic and feral cats (*Felis catus*) have the potential to cause significant environmental harm when allowed to roam within urban natural areas. Feral cats are attributed to be the major threat to mammalian fauna extinction in Australia. The Australian Wildlife Conservancy estimates feral cats kill at least 75 million native animals every night across Australia.[83] The Federal Government in 2015 endorsed the *National Declaration of Feral Cats as Pests*.[87] In order to combat this threat to native fauna populations, the Australian Government has set an objective through the *Threatened Species Strategy 2015*, for 2 million cats to be culled across Australia by 2020.

[82] Australian Government, DoE (2015a)
[83] Australian Wildlife Conservancy (2014)
[84] Murdoch University (1989)
[85] DPI (2012)
[86] DEPI (2013)
[87] Australian Government, DoE (2015b)

Rainbow Lorikeet *(Trichoglossus haematodus)*

Under the *Cat Act 2011* the City of Joondalup may seize cats if they are reported to be on private property without the consent of the owner/occupier. The *Cat Act 2011* encourages responsible pet ownership by ensuring cats are registered, sterilised and microchipped.

The City has a fox and rabbit control program and operates under the *Cat Act 2011* to manage these non-native mammals at Shepherds Bush.

Birds

A total of five non-native species of birds have been recorded at Shepherds Bush including T*richoglossus haematodus* (Rainbow Lorikeet), *Columba livia* (Domestic Pigeon), Dacelo novaeguineae (Laughing Kookaburra), *Streptopelia chinensis* (Spotted Turtle Dove) and *Streptopelia senegalensis* (Laughing Turtle-dove).

The Laughing Kookaburra has been widely introduced into Western Australia and Tasmania where they breed in tree hollows that would usually be used by parrots and owls. Laughing Kookaburras also prey on small reptiles, mammals and nestlings, placing undue pressure on these native species.[88]

Rainbow Lorikeets are a declared pest in WA and were one of the most commonly occurring birds recorded in Shepherds Bush. They compete with native species for hollows and for food, are aggressive when defending their nests and pose a risk of disease spread as they are carriers of Psittacine Beak and Feather Disease[89] (See Appendix 10).

Invertebrates

Two non-native invertebrate species were recorded in Shepherds Bush, the European Honey Bee (*Apis mellifera*) and Portuguese millipede (*Ommatoiulus moreletii*).

Portuguese millipedes were first recorded in Western Australia in 1986 and are now widespread in the south-west of the State. They feed on organic matter such as leaf litter and are not known to impact native flora or fauna. Portuguese millipedes can reach high population levels and be a domestic nuisance when they invade homes and gardens.[90] This species is known to be distasteful and therefore avoided by many predators. It plays a useful role in breaking down organic matter in the soil, however is considered a pest when it reaches high population levels.[88] This species has become widespread across the Perth metropolitan area in both bushland and suburban areas.[9]

Portuguese millipedes are attracted to lights at night and this is presumably why they invade homes. There are a number of biological, chemical and physical controls residents surrounding Shepherds Bush can implement to reduce the impact of portuguese millipedes around their home. These measures include limiting the amount of light released from the home at night (i.e. drawing curtains), reducing the amount of organic matter surrounding the home, such as moving compost piles and removing leaf litter away from the home and installing smooth barriers around the home, as the species cannot travel along smooth surfaces. Biological controls such as

[88] Birdlife Australia (no date (c))
[89] DAFWA cited in ELA (2016)
[90] Widmer (2006)

predation by other insects and chemical measures such as insecticides, can also be used to reduce portuguese millipede numbers surrounding residential properties.[91]

European honey bees are frequently observed at the site. The European honey bee (*Apis mellifera*) is common within the City's natural areas and may impact upon native flora and fauna through competing with native fauna (including native bees) for floral resources, disrupting natural pollination processes and displacing endemic wildlife from tree hollows. European honey bees are feral animals, however, European honey bees are important to Australian horticulture and agricultural industries with approximately 65% of agricultural production in Australia being dependent on pollination by European honey bees.[92]

Ecological Linkages

Naturally connected landscapes and ecosystems are generally healthier, protect a diversity of species, provide pathways for species movement and can store carbon more effectively than degraded landscapes.[93] In urban areas where there is engineered infrastructure dividing the landscape, it may be beneficial to provide wildlife crossings such as underpasses, tunnels, viaducts or overpasses to enable wildlife movement.

Shepherds Bush does not form a direct part of an ecological linkage, however it is situated between two north-south ecological corridors. There is a north-south ecological corridor of Yellagonga Regional Park and Neerabup National Park and a north-south ecological corridor of Lilburne Park, Hepburn Heights Conservation Area, Pinnaroo Valley Memorial Park, Craigie Bushland, Water Corporation land and Woodvale Nature Reserve. Both ecological corridors have main arterial roads dividing the landscape, as shown in Figure 21.

Shepherds Bush Reserve, although isolated from other bushland remnants, is situated proximally to other important local bushland reserves, namely Craigie Bushland and Pinnaroo Valley to the west, Yellagonga Regional Park to the east, and Warwick Open Space to the south-east. It provides habitat connectivity for many species, particularly woodland birds and this is important for the continued presence of a range of local bird species, including Carnaby's Black-Cockatoo. The occurrence of Carnaby's Black-Cockatoo and the Rainbow Bee-eater highlight the foraging and potential breeding value of the study area.[9]

Current Management Approach

The City of Joondalup is implementing a number of management actions to monitor native fauna and address the environmental impacts of domestic and pest animals within the City's natural areas. Monitoring of native fauna occurs through fauna surveys. Control of non-native fauna such as foxes and rabbits is undertaken annually within selected bushland, wetland and coastal areas. Fox and rabbit control methods employed include biological and chemical control, trapping, baiting and exclusion methods such as fencing. Fox control is conducted when fox warrens are identified on site, however fox control has not been conducted in Shepherds Bush.

The City's current management practices have greatly reduced the incidence of pest animal populations within the City. However, continued and coordinated action is required to ensure that populations remain at controllable numbers and that the impacts on natural areas remain acceptably low.

The City also promotes responsible pet ownership and encourages the community to ensure that domestic pets do not have a negative impact on the natural environment. Shepherds Bush is designated as a place where dogs must be on a lead at all times by Council resolution in accordance with the *Dog Act 1976*. Cats may be seized where they are found wandering in public areas, such as Shepherds Bush, in accordance with the *Cat Act 2011*.

Shepherds Bush Reserve

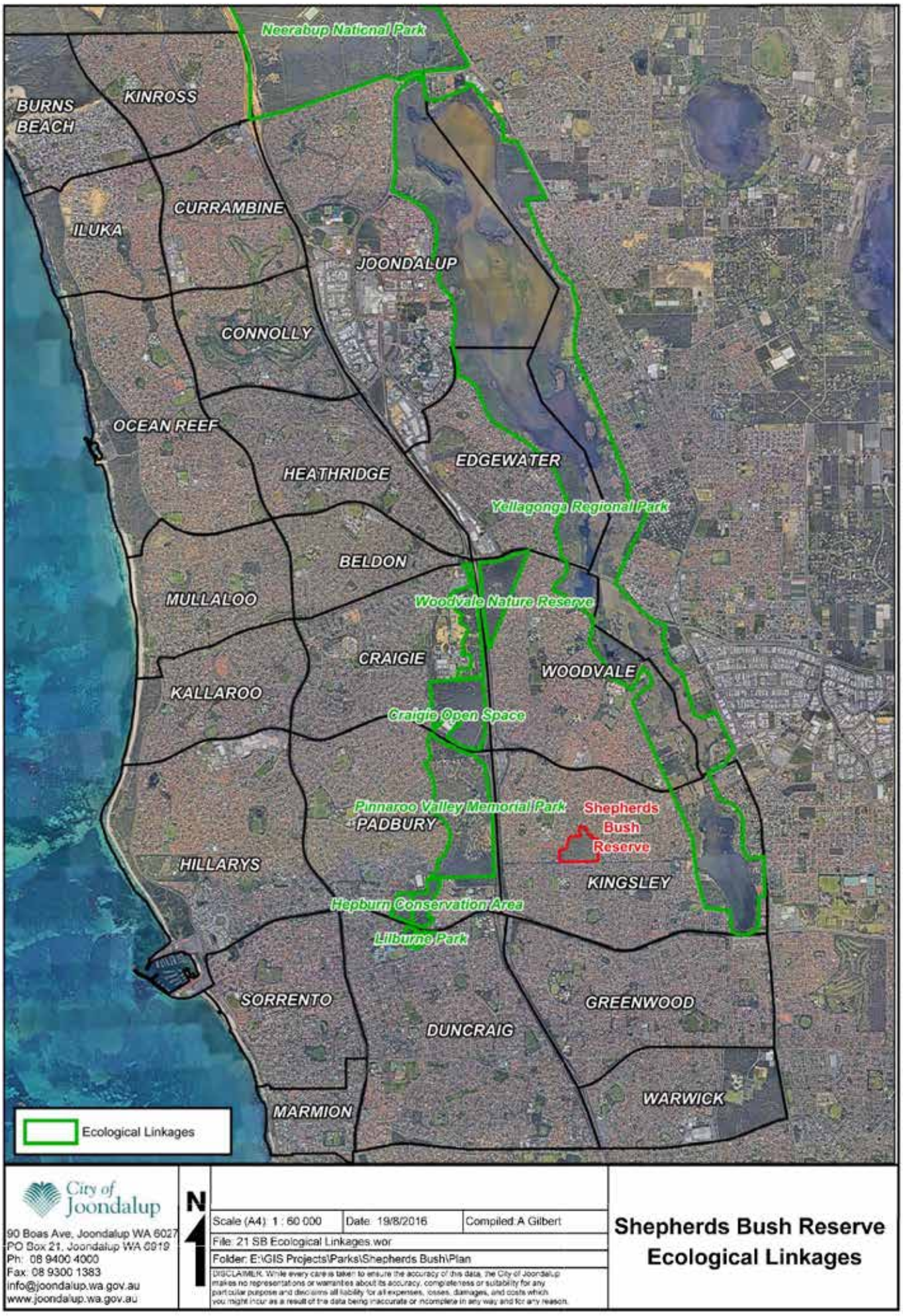
[91] DAFWA (2016a)
[92] Rural Industries Research and Development Corporation (no date)
[93] NWCPAG (2012)

Recommended Fauna Management Actions

To monitor and protect native fauna in Shepherds Bush, the following management actions are proposed:

Action	Details
Fauna survey	Undertake a follow up fauna survey, in mid-late spring to supplement previous fauna survey, within five years.
Fauna/Ecological Linkages investigations	During on ground maintenance tasks, investigate the access points utilised by kangaroos, in order to guide suitable management of these mammals within the reserve. Based on the findings, undertake an in house study aiming to improve ecological linkages between Pinnaroo Valley Memorial Park, Hepburn Heights, Yellagonga Regional Park and Craigie Bushland.
Bat survey	Undertake a one week remote monitoring bat survey in summer to supplement previous one night bat survey undertaken in spring.
Installation of bat boxes	Pending results of survey, consider installing bat boxes to encourage bats to roost.
Artificial hollows	Investigate installation of artificial hollows in trees such as Tuart or Marri to encourage Carnaby's Black-Cockatoos or Forest Red-tailed Black Cockatoos to nest.
Rainbow Bee-eater nesting sites	Monitor for Rainbow Bee-eater nesting sites through monthly inspections and install fencing and signage around exposed nesting sites to decrease trampling of nests by humans or dogs.
Invertebrates survey	Undertake targeted survey for invertebrates in spring to supplement previous opportunistic invertebrate survey undertaken, within five years.
Feral animal control	Monitor feral animal populations and implement regular control to reduce pressures on native fauna and flora. Remove feral beehives if they are identified on site and are accessible.
Patrols to ensure dogs are kept on leads and owners are cleaning up after their dogs	Patrols undertaken by City Rangers to ensure dogs are kept on leads and their droppings are collected.

Figure 21: Ecological Linkages near Shepherds Bush Reserve



Slender/Candlestick Banksia *(Banksia attenuata)*

3.5 Social and Built Environment

History and Heritage

Shepherds Bush is listed on the State Heritage Register (place number 9487) due to the social and ecological significance of the site. Shepherds Bush is not listed on any State or Federal Indigenous heritage inventory or register.

Social Value

Australians have reported they would be willing to pay an average of $35,000 more (approximately 7%, assuming a base value of $500,000) to live in a home in a 'green' neighbourhood, with a third of Australians willing to pay an extra $100,000 or more to live in a 'green' area. Approximately two thirds of Australians would prefer to buy a home in a nature-filled neighbourhood, even if it cost them more to do so. Living in a home with a 'green' neighbourhood is important to Australians, even more important than proximity to work, shops and public transport.[94]

Urban natural areas can provide social, psychological, physical and spiritual benefits and play a role in community health, wellbeing and quality of life. Some of the benefits of urban natural areas for the community include:

- Reduction of mental fatigue and stress;
- Provide opportunities for reflective thought, peace and quiet;
- Create opportunities for informal social interactions;
- Provide opportunities for activities that can increase physical health; and
- Assists to reduce the crime rate by relaxing people and encouraging people to be outdoors.[95]

The main uses of Shepherds Bush are for purposes such as walking, cycling (including use of BMX bicycles on the BMX track) or dog exercising. Shepherds Bush may also be used as a thoroughfare for people walking to and from Kingsley Village Shopping Centre and residential homes. User surveys would provide information on the reasons why people visit Shepherds Bush, the number of people and frequency of visits and enable a more targeted environmental education campaign regarding bushland management.

A former Friends of Shepherds Bush group was operational from 1999 to 2002. Recently there has been renewed interest in reforming a group to assist in maintaining the conservation values of the site.

Access and Infrastructure

Shepherds Bush contains power, lighting, water and sewerage utilities and infrastructure, such as fencing, paths and seating. A BMX track, playground, drinking fountain, picnic table and a BBQ facility are also located in the south eastern corner of the site.

In 2015 the City was awarded funding from the Western Australian Department of Transport as part of their 'Bike Boulevard Safe Active Streets' program to upgrade the Robertson Road Cycleway in 2016. The Robertson Road Cycleway is a 2.4km bicycle route that services residents within the suburb of Kingsley. The cycleway provides a direct link for pedestrians and bike riders from Lake Goollelal path networks in the east to the Mitchell Freeway Principal Share Path in the west. Shepherds Bush is located in the western end of the Robertson Road Cycleway and directly borders the Cycleway for 530m.

The 2016 Robertson Road Cycleway upgrade will include the installation of LED lighting, an asphalt bike skills track and a designated red asphalt cycle path for cyclists and concrete path for pedestrians. In conjunction with the cycleway the City will upgrade and improve infrastructure to Shepherds Bush with municipal funds in 2016. These works will include installation of a new picnic setting and shelter, a BBQ facility, a drinking fountain, bike parking, a park seat, a new bin and play space.

The asphalt bike skills track was installed as part of the Robertson Road Cycleway project to provide an educational tool to make children of all ages road and bike safety aware.

Robertson Road Cycleway

[94] Planet Ark (2014)
[95] Tarran (2006)

Utilities

Several public utilities operate within or surrounding Shepherds Bush, as shown in Figure 22, Figure 23 and Figure 24.

Power and Lighting

Shepherds Bush has power and lighting infrastructure surrounding the site, as shown in Figure 22.

Water

Figure 23 outlines the public hydrants and distribution mains surrounding Shepherds Bush. The public hydrants are owned, serviced and maintained by the DFES in conjunction with the Water Corporation.

Sewerage

Figure 24 shows the Water Corporation sewerage infrastructure in place surrounding Shepherds Bush. The Water Corporation maintain the sewerage infrastructure on an as required basis.

Wayfinding Signage

Figure 22: Shepherds Bush Reserve Power and Lighting Utilities

Figure 23: Shepherds Bush Reserve Water Utilities

Figure 24: Shepherds Bush Reserve Sewerage Utilities

Conservation Fencing

Conservation fencing is used to restrict access and protect areas of bushland. Timber post and plastic coated galvanized chain mesh fencing surrounds the outer perimeter of Shepherds Bush (see Figure 25). Fencing also surrounds the sump located in the north west of the site.

Fencing is inspected on a monthly basis and repairs are conducted as required.

Access Points

Access points allow people to enter natural areas that are fenced off and often give access to paths. There are numerous access points in Shepherds Bush, as shown in Figure 29.

Some of these access points are open with a bar in the middle or have vehicular gates, farm gates or chained gates. Access gates prevent unauthorised vehicle and motorbike access.

Paths and Trails

Paths in Shepherds Bush are used for pedestrian and cyclist access, fire access ways and bushland management and maintenance purposes. The paths in Shepherds Bush are mostly used by pedestrians, dog walkers and cyclists. In May 2016, all the formal limestone paths were converted to asphalt. The upgrade of these paths will result in increased longetivity of the path infrastructure and reduce maintenance tasks associated with runoff, compared to the limestone paths. These paths will also improve accessibility for people with prams and wheelchairs.

A number of informal tracks and BMX bike jumps also exist within the bushland. The use of informal tracks and the disturbance of soil through the construction of bike jumps, has the potential to spread and establish weeds and reduce healthy vegetation condition.

The City's *Walkability Plan 2013-2018* includes a recommendation to 'review bushland trail designs to include a network of short and long looped trails for visitors to natural bushland areas'.

The current gates are easy for cyclists or people with prams or wheelchairs to use, however gates that allow easy access on site also allow motorbikes to enter.

Paths in Shepherds Bush allow wheelchair access. The paths can be accessed from entries in the north and south of the site, with the southern entry points also connecting to the Robertson Road Cycleway.

The City's *Walkability Plan 2013-2018* also includes a recommendation to 'review access points to natural bushland areas utilising "crime prevention through

Figure 25: Conservation Fencing on the perimeter of Shepherds Bush Reserve

environmental design" principles'. The principles of "crime prevention through environmental design" rely on the ability to influence offender decisions that precede criminal acts by enhancing the perceived risk of being caught; and hence, deterring criminal activities.[96]

Access and Inclusion

In the Survey of Disability, Ageing and Carers conducted in 2012, 31,400 people, or 18.73% of the population in the City of Joondalup currently have a core activity limitation associated with communication, mobility or self-care, for which assistance is required. A further 5,800 or 3.4% of the population have a disability that restricts schooling or employment opportunities but does not limit their daily core activities.[97]

The City of Joondalup has an *Access and Inclusion Plan 2015-2017*, outlining that 'the City is committed to including people with disability through the continuous improvement of access to its information, facilities and services.'[97]

The *Walkability Plan 2013-2018* includes a recommendation to 'maintain existing internal and external trails to meet trail useability and accessibility standards'.[96] The upgrade of the limestone paths in May 2016 will improve accessibility for people using wheelchairs and prams, as asphalt generally provides a more even surface and less loose debris is present.

Signage

Signage is important to encourage appropriate use of the site and inform the community about the ecological values of Shepherds Bush. There are numerous signs at Shepherds Bush on the periphery of the site and near the main entrances, detailing information such as the name of the site and that the site is managed by City of Joondalup. Shepherds Bush is commonly referred to as 'Shepherds Bush Park', although there is large wooden signage at entry points referring to the site as 'Shepherds Bush Conservation Area' or 'Shepherds Bush Conservation Reserve'. This Plan promotes the use of the latter names, given the high conservation value of the Reserve.

There are also 'dogs must be on a lead' signs and signs raising awareness about the presence of Dieback (see Plant Diseases), at the main entrance points.

Directional signage uses maps to indicate trails, entrances and infrastructure. Interpretive signage increases awareness of the ecological values of the bushland. The City has developed a Signage Strategy to guide the provision of information and interpretive messages within the City's natural areas. As part of the City's *Walkability Plan 2013-2018*, three interpretive signs, five 'You Are Here' signs and four directional signs were installed during 2016/17. All signs were installed along designated pathways, see Figure 29.

Toilets

There are no toilet facilities on site due to the site mainly being used for short periods by walkers or cyclists.

Parking

There are no car parks on site at Shepherds Bush. Street parking is available along Shepherds Bush Drive, Newhaven Place and Barridale Drive.

Seating

Shepherds Bush contains one park bench seat in the south-eastern section of the bushland and one park bench seat and one platform bench located near the play space and other infrastructure in the southern area the bushland, adjacent to the Robertson Road Cycleway, as shown in Figure 26 and Figure 29.

Figure 26: Seating at Shepherds Bush Reserve

[96] City of Joondalup (2013b)
[97] City of Joondalup (2015)

Rubbish in Shepherds Bush

Antisocial Behaviour

There is a history of suspicious fire activities, dumping of garden refuse and cubby houses and bike jumps being built in Shepherds Bush, resulting in damage to surrounding vegetation and impacts to the healthy vegetation condition of the site. Monthly inspections are conducted and if cubbies are identified, they are dismantled by the City of Joondalup as required.

A new bike skills track has been installed within the recreation area of Shepherds Bush. During 2016/17 the existing BMX park in the south-east section of Shepherds Bush will also be upgraded, with the addition of a pump and jump track. It is anticipated that the provision of this upgraded infrastructure will provide better surveillance and deter anti-social behaviour occurring within the bushland, reducing the disturbance to the conservation values of the site. Additionally City Rangers conduct regular visits to Shepherds Bush Reserve as part of the City Rangers patrol regime, with their presence forming active surveillance of the bushland and adjoining recreational parkland.

It is expected more young people may utilise the new bike infrastructure at Shepherds Bush and their presence will result in the passive surveillance of antisocial behaviour.

Rubbish

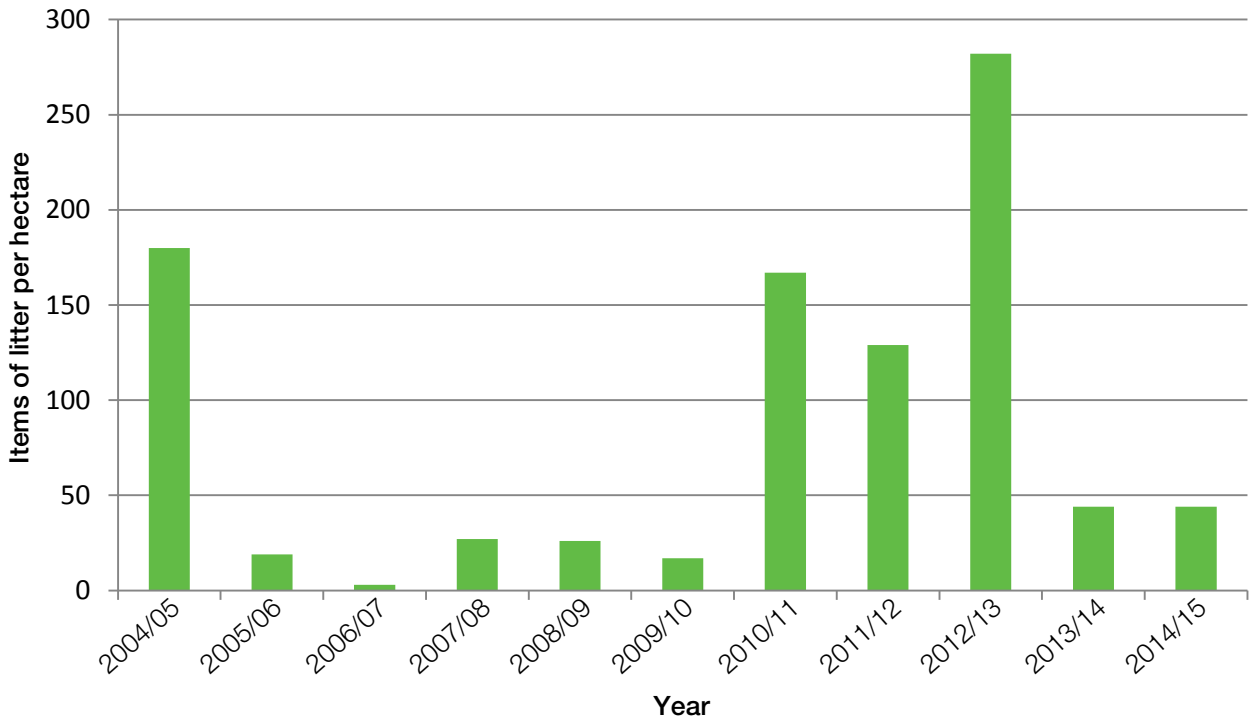
Rubbish bins are generally installed in locations where people gather to socialise or undertake recreational activities. Dog poo bins are generally installed in locations where people walk their dogs. There are dog poo bins located in the south-east corner and the south-west corner near paths and access points to the site (see Figure 29). These dog poo bins can also be used to dispose of general rubbish.

Since the upgrade and the installation of new infrastructure in the recreational parkland in 2016, residents have reported the occurrence of more litter due to an increase in the number of patrons using the facilities. The City will monitor this and investigate if the provision of additional bins or an increase in the frequency of litter collections in Shepherds Bush is required.

Litter can have negative impacts on flora and fauna. Litter is collected by the City on an as needed basis, sometimes in conjunction with hand weeding activities. Frequently litter is found when cubby houses are dismantled or in areas where bike jumps have been constructed.

The City monitors the amount of litter present in Shepherds Bush bushland on an annual basis, measured on three transects within the reserve. The amount of litter present in Shepherds Bush in 2014/15 is the same as in 2013/14, however the methodology for calculating the percentage cover of litter has been amended and therefore it is difficult to make direct comparisons. It is suggested the 2014/15 data be used as baseline information (see Figure 27).

Figure 27: Amount of Litter Present within Shepherds Bush Reserve



Water Sensitive Urban Design

A fenced off sump is located at Shepherds Bush on the Shepherds Bush Drive in the north-west of the site (see Figure 28). The sump in Shepherds Bush was assessed for the City's Sump Improvement Program but is unlikely to have works undertaken in the short or medium term due to its priority ranking. Landscaping works using local native species have been proposed along the sump edge on Shepherds Bush Drive.

There is also a swale located on Barridale Drive.

Figure 28: Fenced off Sump at Shepherds Bush Reserve

Recommended Social and Built Environment Management Actions

To enhance the social and built environment in Shepherds Bush, the following management actions are proposed:

Action	Details
User survey	Conduct user surveys, as required, to provide information on the reasons why people visit Shepherds Bush, the number of people and frequency of visits and enable a more targeted environmental education campaign regarding bushland management.
Maintain conservation fencing	Maintain conservation fencing on an as needed basis (informed by monthly inspections) to protect the native vegetation, flora and fauna from informal access.
Investigate closure and rehabilitation of informal tracks	Investigate closure and rehabilitation of informal tracks that are used infrequently to protect vegetation.
Implement *Walkability Plan 2013-2018*	Implement recommendations from the *Walkability Plan 2013-2018* that are applicable to the management of Shepherds Bush.
Monitor and report litter	Monitor and report the amount of litter present in Shepherds Bush bushland on an annual basis.
Dismantle cubby houses and BMX (and motorbike) tracks and jumps in the bushland.	Dismantle cubby houses and bike tracks and jumps as required to discourage vegetation degradation and littering in the surrounding area.
Patrols undertaken by City Rangers	Conduct regular visits to Shepherds Bush Reserve as part of the City Rangers patrol regime, as a form of active surveillance of the bushland and adjoining recreational parkland.
Investigate the provision of additional waste services	Monitor and investigate the provision of additional waste services to mitigate litter, as a result of increased public use and infrastructure upgrades in the active parkland.

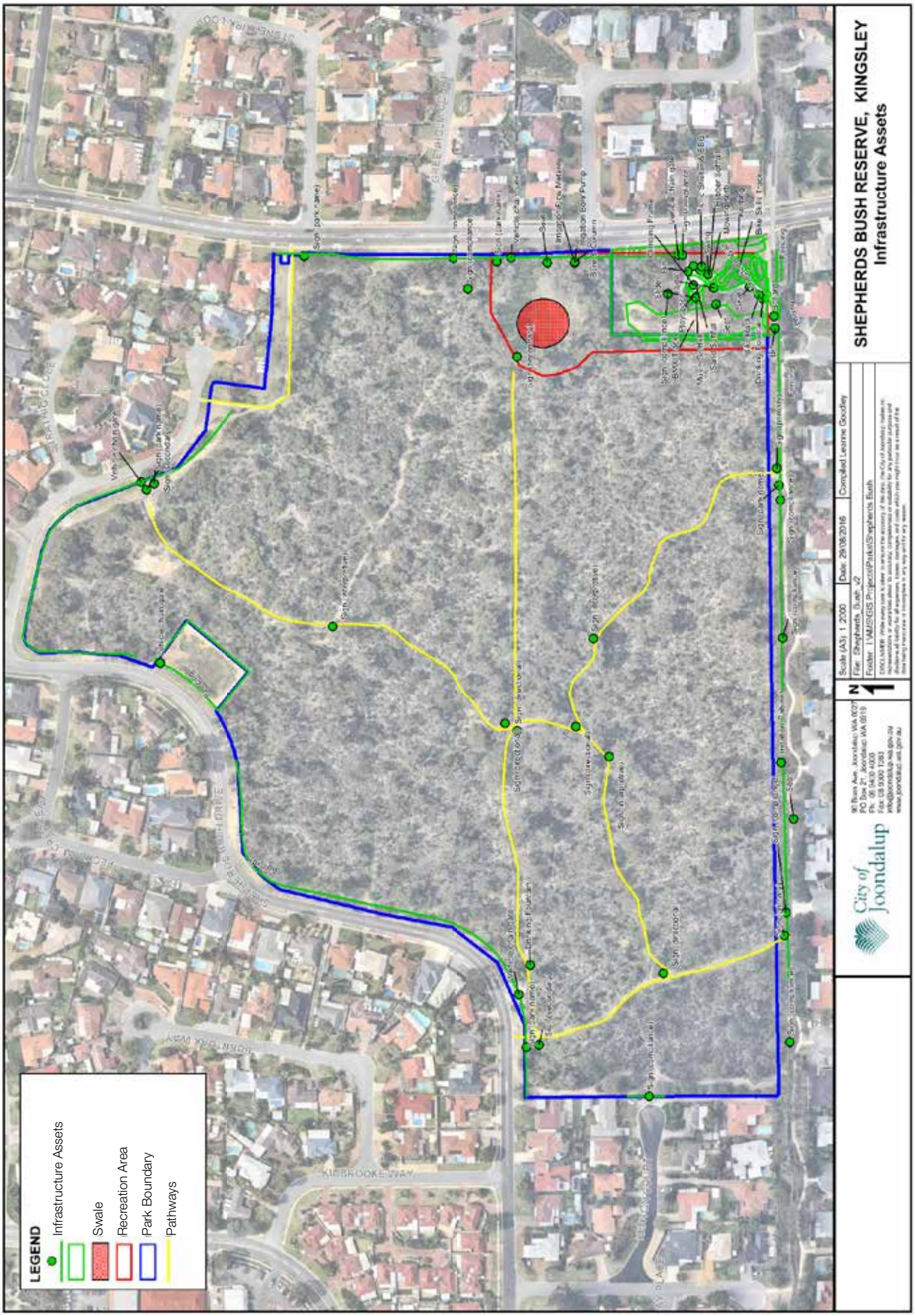


Figure 29: Infrastructure at Shepherds Bush Reserve

Marri 'honkey' nuts *(Corymbia calophylla)*

3.6 Fire Management

Fire is an important natural feature of the Western Australian landscape. Fire helps to shape the diversity of plant communities with many native plants having developed fire-related adaptations over time, for example fire expedites many species to flower or germinate.

Before Aboriginal people populated the Australian continent approximately 40,000 to 60,000 years ago, the major cause of fires would have been lightning. Aboriginal people learnt to harness the naturally recurring fire caused by lightning and other sources to their advantage, which resulted in skilful burning of landscapes for many different purposes, such as to gain access to difficult areas, promote the development of food plants, for cooking, warmth and signalling and attracting animals for hunting.[98]

Although there are benefits to fire, an increase of fire occurrences particularly in the same area over a short period of time, referred to as fire intervals or measured as time since last fire, has the potential to adversely impact flora and fauna populations.

Human activity such as accidents and arson have resulted in increased incidences of fire within many urban bushland reserves, which can encourage growth of highly flammable and invasive weeds.

The climate in the south-west of Western Australia has become warmer and drier and is likely to continue to dry, with lower winter rainfall and increased average temperatures resulting in a longer 'fire season' and a greater proportion of the landscape that is sufficiently dry enough to burn.[99, 100]

Bushfires are unplanned fires that can be caused by events such as lightning, unplanned effects from controlled burning operations, escape from industrial activities, damaged power transmission lines, discarded cigarette butts or deliberate arson. Bushfires can cause significant damage to people, property and the environment.[101] In 2015 the State Government released *State Planning Policy 3.7*, *Planning in Bushfire Prone Areas* and corresponding guidelines in response to several extreme fire events in Australia.

Under the *Bush Fires Act 1954*, local government have the responsibility of preventing and responding to bushfires, hence fire management of Shepherds Bush is the responsibility of the City of Joondalup. The City of Joondalup has a "duty of care" to take all reasonable precautions to prevent any bushfire from spreading onto neighbouring properties. The City of Joondalup does not currently have a prescribed burn management regime for the area.

The Department of Fire and Emergency Services (DFES) work with the community and local government to provide education on hazard risk management and to prevent, prepare for, respond to and recover from a diverse range of emergencies.[102, 103]

The DFES have developed a *Fire Pre-Plan for the Urban Bushland Area of Shepherds Bush Reserve* including site specific information on ecologically sensitive areas, risk management strategies, hazards, communications plan and fire suppression strategy and tactics. The Fire Pre-Plan is updated by the DFES annually in conjunction with key stakeholders including City of Joondalup.[104]

There are numerous public water hydrants located around Shepherds Bush which are installed and maintained by the Water Corporation and the DFES, as shown in Figure 23.

Undertaking fire management within Shepherds Bush will help to:

- Protect life, property and environment in Shepherds Bush and adjacent residential areas and privately owned buildings;
- Fulfil obligations under the *Bush Fires Act 1954*;
- Protect the ecological and amenity values of Shepherds Bush bushland;
- Protect landscape values (including flora and fauna) from uncontrolled fire and inappropriate suppression techniques;
- Reduce the frequency, impact and area of unplanned fires;
- Minimise the spread of disease and weeds during fire fighting operations and when establishing firebreaks; and
- Minimise impacts on air quality.

Fire Risk

A fire fuel load assessment was conducted at Shepherds Bush in October 2015 by the City of Joondalup which indicated the site has a very high fuel load of 21 tonnes/ha. The fuel load assessment was undertaken according to the methodology from the Fire and Emergency Services Australia (FESA) *Visual Fuel Load Guide for the Scrub Vegetation of the Swan Coastal Plain*.[105] Fuel load assessments are conducted annually at Shepherds Bush and the results used to inform fire management of the site.

98 DPaW (2013a)
99 DPaW (2013b)
100 City of Joondalup (2014)
101 EDOWA (2011)
102 DFES (2013)
103 DFES 2014
104 DFES (no date)
105 FESA (2007)

Fire Occurrences

There have been a substantial amount of fires at Shepherds Bush, the majority of which are believed to have been deliberately lit. The frequency of fires has lessened since 2007. This could be due to factors such as the DFES bushfire awareness campaigns.

Murdoch University (1989) recorded two fires in the three month period between November 1988 and January 1989 and stated through discussions with local residents that fires are 'a regular occurrence,' particularly in the degraded south east (the location of the current BMX track) and northern areas of Shepherds Bush.

Aerial photographs from 1974 assessed by Murdoch University (1989) indicated the 'absence of degraded areas and no apparent signs of fire.' Records of fire occurrences at Shepherds Bush are detailed in Table 4.

Monitoring of fire occurrences and detailing fire incidents and frequency through mapping and updating the City's Geographic Information System (GIS) layer could inform fire prevention actions.

Table 4: Fire Occurrences at Shepherds Bush Reserve (DFES 2016)
***1988-1989 Data sourced from Murdoch University (1989)**

Dates	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	*Nov 1988-Jan 1989
Fire Occurrences	1	1	0	1	2	3	0	1	3	9	0	10	8	16	2

Shepherds Bush Reserve

Fire Response

The closest Fire and Rescue Service Station is located on Hepburn Avenue in Duncraig and they are responsible for suppressing fires within Shepherds Bush. The Western Australia Police are responsible for the evacuation of residents and visitors, if required.

Fire Recovery

Weed control is revised after fire incidents to aid regrowth by selecting appropriate chemicals, targeting weeds if safe to do so for new seedlings, and spraying weedy grasses using targeted approaches.

Current Management Approach

The City of Joondalup implements a number of on ground measures to reduce the risk of fire, including undertaking:

- Controlled access;
- Weed (invasive) species management;
- Fuel load assessment and management; and
- Maintenance and installation of fire access tracks (fire access ways and strategic firebreaks).

Fuel load assessments are conducted annually at Shepherds Bush and the results used to inform fire management of the site.

Weed control and maintenance of fire access tracks are conducted in accordance with the City's Annual Bushland Schedule. A *Draft Bushfire Risk Management Plan* is being developed by the City of Joondalup. The Plan will outline the City's strategy for assessing fire risk, prevention, response and recovery.

The City has also developed *Fire Weed Management Guidelines* to mitigate the impact of weeds within the post fire environment of the City's natural areas. These Guidelines are implemented within the City's natural areas after a fire event.

Recommended Fire Management Actions

To prevent fire occurrences and minimise the environmental impact of fire occurrences in Shepherds Bush, the following management actions are proposed:

Action	Details
Assess fire fuel load	Annually assess and report fire fuel load using the *FESA Visual Fuel Load Guide* for the Scrub Vegetation of the Swan Coastal Plain to inform fire prevention actions.
Maintain fire access tracks and footpaths	Maintain fire access tracks and footpaths, including weed control and pruning of vegetation, by implementing the Annual Bushland Schedule.
Develop and implement *Bushfire Risk Management Plan*	Develop and implement a *Bushfire Risk Management Plan*, outlining the City's strategy for assessing fire risk, prevention, response and recovery.
Monitor fire occurrences	Monitor fire occurrences through mapping and updating Geographic Information System (GIS) layers detailing fire incidents and frequency to inform fire prevention actions.
Revise weed control after fire incidents	Revise weed control after fire incidents to aid regrowth by selecting appropriate chemicals, targeting weeds if safe to do so for new seedlings, and spraying weedy grasses using backpacks.
Implement *Fire Weed Management Guidelines*	Implement the *Fire Weed Management Guidelines*, when required, to reduce the infestation of weeds in natural areas after a fire.

3.7 Education and Training

An important objective of this Plan is to ensure that the local community, visitors to the City's natural areas and those that manage the City's natural areas have the necessary awareness, knowledge, motivation and behaviour to assist in protecting the City's natural areas.

Environmental objectives cannot be achieved through the actions of the City alone; the community can also affect the local environment in both positive and negative ways. Environmental outcomes require the support of an engaged community that is aware and participating in environmental activities.

The local community can protect and enhance Shepherds Bush through the following actions:

- Contact the City of Joondalup if they are interested in initiating or participating in an environmental volunteer group such as the Friends of Shepherds Bush to assist with bushland restoration and maintenance activities.
- Minimising access and disturbance to the site by staying on paths, not taking vehicles into natural areas, and not allowing dogs to run off-leads.
- Contain cats, particularly at night, and ensure they stay out of Shepherds Bush.
- Planting local, native species in gardens where possible.
- Avoid touching or feeding wildlife and picking wildflowers or native plants.
- Undertaking appropriate hygiene practices such as cleaning footwear when entering and leaving the site, removing any weed seeds attached to clothing and removing and disposing appropriately of dog excrement (may contain weed seed).
- Not dumping garden rubbish or littering on site. Litter could be collected from site when spotted, or people could organise or get involved with a Clean Up Australia Day event.

Schools are also an important avenue for raising awareness and interest in environmental issues and creating future community members that are aware of, appreciate and actively participate in local environmental management. There are a number of schools (Dalmain, Halidon, Creaney and Goollelal Primary Schoos) within close proximity to Shepherds Bush which creates possible bushland learning opportunities for students.

Yellow Buttercups *(Hibbetia hypericoides)*

Current Management Approach

The City implements an Annual Environmental Education Program to address key environmental issues and encourage greater environmental stewardship by the community. The Environmental Education Program includes a Think Green Biodiversity campaign, focussed on raising awareness of key environmental issues within the City and encouraging community participation in protecting the natural environment.

As part of the Environmental Education Program, the City has developed an Adopt a Bushland Program for students from years four to six to provide an interactive educational bushland management program. The Adopt a Bushland Program could be trialled with students from years four to six at the above mentioned schools.

In order to educate the community about how they can protect natural areas, the City has developed a number of key brochures titled 'Being WEEDwise: Garden Escapees in the City of Joondalup', 'Being WEEDwise: Environmental Weeds in the City of Joondalup' and 'Protecting our Natural Areas and Parks'.

The City of Joondalup Natural Areas Team currently conduct regular plant identification training, including weed management. New members in the Natural Areas Team undertake training for the management of pathogens.

The City's Friends Groups are instrumental in assisting to protect, preserve and enhance significant bushland areas within the City and may also benefit from training.

Recommended Education and Training Management Actions

To increase community awareness and training opportunities regarding natural areas management, the following actions are proposed:

Action	Details
Environmental Education Program	Implement initiatives of a 'Think Green Biodiversity' campaign (part of the Environmental Education Program) targeting environmental issues such as: • Pathogens; • Weeds; • Litter; • Fire; • Flora, fungi and fauna awareness; • Preventing hand feeding of wildlife; and • Responsible pet ownership.
Support establishment of 'Friends of Shepherds Bush'	Support the establishment of a 'Friends of Shepherds Bush' group and encourage community participation in the management of this natural area.
Adopt a Bushland program	Implement an Adopt a Bushland program for students to provide an interactive bushland management program.
Liaise with local schools	Liaise with nearby schools such as Dalmain, Halidon, Creaney and Goollelal Primary Schools to increase awareness of the bushland ecological values.
Natural Areas Team training	Conduct regular Natural Areas Team plant identification training, including weed management, to increase the effectiveness of weed control activities, as required.
Friends Groups training	Provide training including pathogen management and weed identification to community members interested in forming a 'Friends of Shepherds Bush.'

Shepherds Bush Reserve

4.0 Implementation Plan

To ensure the *Shepherds Bush Reserve Management Plan* is being implemented in an effective and timely manner the following steps will be undertaken:

- Monthly weed inspections;
- City of Joondalup Annual Report, Natural Area Key Performance Indicators;
- Scientific research;
- Field monitoring; and
- Review of the Management Plan.

4.1 Monthly Weed Inspections

Weed inspections of Shepherds Bush are conducted by the City of Joondalup once every four weeks.

4.2 Monitoring and Reporting

A review of the *Shepherds Bush Reserve Management Plan* will be undertaken annually through reporting against progress made in implementing recommended management actions.

Ongoing reporting against Council endorsed Natural Key Performance Indicators will also be undertaken to ascertain whether current management practices are leading to positive environmental outcomes. These indicators will be measured and reported on an annual, biennial and five yearly basis, as shown in Table 5.

Table 5: Natural Area Key Performance Indicators

Key Performance Indicator	Source	Reporting Period
Density of weeds per area – expressed as a percentage.	Density of weeds per area – expressed as a percentage.	Annual 2016/17- 2021/22
Waste present in natural areas – items per hectare	Waste present in natural areas – items per hectare	Annual 2016/17- 2021/22
Percentage of natural areas protected within City reserves	Areas (hectares) included in the City's proposed Conservation Reserves within the District/Local Planning Scheme (previously Schedule 5 and City of Joondalup Bush Forever sites).	Annual 2016/17- 2021/22
Overall change in vegetation vigour (condition) per area –expressed as an increase or decrease in the Vegetation Condition Index (VCI)	Source – Data obtained from analysis of remote multi spectral imagery. The imagery is currently obtained every two years.	Biennial (every two years) 2017/2018 2019/2020 2021/2022
Canopy Cover – expressed as a percentage per natural area	Source – Data obtained from analysis of remote multi spectral imagery. The imagery is currently obtained every two years.	Biennial (every two years) 2017/2018 2019/2020 2021/2022
Vegetation condition per area – expressed using the Keighery Scale* of vegetation condition, expressed as a percentage for each classification (pristine to degraded).	Data obtained through on site floristic survey undertaken to inform the review of the Management Plan, service provided by specialised consultants.	Five yearly 2021/2022

4.3 Scientific Research and Monitoring

A Natural Areas Initial Assessment is to be conducted on Shepherds Bush every five to ten years. The most recent assessment was conducted in 2014. The next assessment is to be conducted in 2020/21, prior to the review of the *Shepherds Bush Reserve Management Plan*.

Surveys in Shepherds Bush of flora, weeds, fungi, fauna, invertebrates and bats are to be conducted in 2020-2022. Comparisons to previous surveys will be made to assess site changes over time.

Fire fuel load assessments of Shepherds Bush are to be undertaken annually.

4.4 Management Plan Review

The *Shepherds Bush Reserve Management Plan* is to be reviewed every five years. The next review is due in 2021/22.

Shepherds Bush Reserve

4.5 Summary of Recommended Management Actions

Biodiversity Conservation Area	Recommended Management Action	Detail	Timeframe
Flora	Flora survey	Undertake a follow up flora survey in spring to supplement previous flora surveys, within five years. Make comparisons between flora surveys to assess site changes every five to seven years.	Within four or five years
	Weed survey	Undertake a follow up weed survey in winter to supplement previous weed surveys, within five years.	Within four or five years
	Investigate planting trees (and vegetation) for habitat	Investigate planting Tuart (*Eucalyptus gomphocephala*) and Marri (*Corymbia calophylla*) trees in Shepherds Bush to provide nesting and roosting habitat and a feeding resource in the long term for Carnaby's Black Cockatoos. Investigate planting other species of local trees and shrubs (such as Jarrah and *Hakea* species) to provide opportunities for nesting sites and shelter for fauna.	Within one or two years
	Revegetation	Support revegetation being conducted in degraded or completely degraded areas using local provenance species, as required.	On going
	Monthly weed inspections	Conduct monthly weed inspections to establish the extent of weeds and to identify priority weed species.	Ongoing
	Natural Areas Initial Assessment	Conduct five to ten yearly follow up of Natural Areas Initial Assessment to monitor ecological health of site.	Within four or five years
	Annual weed percentage cover monitoring and reporting	Monitor and report on the percentage cover of environmental weeds in Shepherds Bush on an annual basis, using three transects.	Ongoing
	Pathogen management	Undertake appropriate hygiene measures when conducting works within Shepherds Bush, as per the City of Joondalup *Pathogen Management Plan*.	Ongoing
	Weed control	Undertake a coordinated approach to regular weed control by implementing the Annual Bushland Schedule.	Ongoing
	Weed control on verges	Conduct weed management of weeds on verges within Shepherds Bush including mowing of verges to reduce seed spread, spraying of weeds and spreading of certified mulch, where required.	Ongoing
	Weed Management Plan	Implement the City of Joondalup *Weed Management Plan* to provide an ongoing strategic approach to the management of natural areas in order to reduce the incidence of weeds.	Within one or two years
Fungi	Fungi survey	Undertake a comprehensive fungi survey in autumn or winter after substantial rain, to supplement previous incidental fungi survey, within five years.	Within four or five years
Pathogens	Pathogen Management	Implement recommendations from the *Pathogen Management Plan* that are applicable to the management of Shepherds Bush Reserve.	Ongoing
	Hygiene Guidelines	Implement Pathogen and Weed Hygiene Guidelines and Purchasing of Landscaping Materials Guidelines to prevent the introduction or spread of weed or pathogens into Shepherds Bush Reserve.	Ongoing
	Education and Training	Investigate the installation of signage within Shepherds Bush Reserve to raise the awareness of the threats of pathogens within the site.	Within one or two years

Biodiversity Conservation Area	Recommended Management Action	Detail	Timeframe
Fauna	Fauna survey	Undertake a follow up fauna survey, in mid-late spring to supplement previous fauna survey, within five years.	Within four to five years
	Fauna/Ecological Linkage investigations	During on ground maintenance tasks, investigate the access points utilised by kangaroos, in order to guide suitable management of these mammals within the reserve. Based on the findings, undertake an in house study aiming to improve ecological linkages between Pinnaroo Valley Memorial Park, Hepburn Heights, Yellagonga Regional Park and Craigie Bushland.	Within one to two years
	Patrols undertaken by City Rangers	Patrols undertaken by City Rangers to ensure dogs are kept on leads and their droppings are collected.	Ongoing
	Bat survey	Undertake a one week remote monitoring bat survey in summer to supplement previous one night bat survey undertaken in spring.	Within four to five years
	Installation of bat boxes	If bat survey indicates presence of bats, consider installing bat boxes to encourage bats to roost.	Within four to five years
	Artificial hollows	Investigate installation of artificial hollows in trees such as Tuart or Marri to encourage Carnaby's Black-Cockatoos or Forest Red-tailed Black Cockatoos to nest.	Within four to five years
	Rainbow Bee-eater nesting sites	Monitor for Rainbow Bee-eater nesting sites through monthly inspections and install fencing and signage around exposed nesting sites to decrease trampling of nests by humans or dogs.	Ongoing
	Invertebrates survey	Undertake targeted survey for invertebrates in spring to supplement previous opportunistic invertebrate survey undertaken, within five years.	Within four to five years
	Feral animal control	Implement regular feral animal control to reduce pressures on native fauna and flora. Remove feral beehives if they are identified on site and are accessible.	Ongoing
Social and Built Environment	User survey	Conduct user surveys, as required, to provide information on the reasons why people visit Shepherds Bush, the number of people and frequency of visits and enable a more targeted environmental education campaign regarding bushland management.	Within four to five years
	Maintain conservation fencing	Maintain conservation fencing on an as needed basis (informed by monthly inspections) to protect the native vegetation, flora and fauna from informal access.	Ongoing
	Investigate closure and rehabilitation of informal tracks	Investigate closure and rehabilitation of informal tracks that are used infrequently to protect vegetation.	Ongoing
	Implement *Walkability Plan 2013-2018*	Implement recommendations from the *Walkability Plan 2013-2018* that are applicable to the management of Shepherds Bush.	Within one to two years
	Monitor and report litter	Monitor and report the amount of litter present in Shepherds Bush bushland on an annual basis.	Ongoing
	Dismantle cubby houses and BMX (and motorbike) tracks and jumps in the bushland.	Dismantle cubby houses and bike tracks and jumps as required to discourage vegetation degradation and littering in the surrounding area.	Ongoing

Biodiversity Conservation Area	Recommended Management Action	Detail	Timeframe
	Patrols undertaken by City Rangers	The City will continue to visit Shepherds Bush Reserve as part of the City Rangers patrol regime, as a form of active surveillance of the bushland and adjoining recreational parkland.	Ongoing
	Investigate the provision of additional waste services	Monitor and investigate the provision of additional waste services to mitigate litter, as a result of increased public use and infrastructure upgrades in the active parkland.	Ongoing
Fire Management	Assess fire fuel load	Annually assess and report fire fuel load using the FESA Visual Fuel Load Guide for the Scrub Vegetation of the Swan Coastal Plain to inform fire prevention actions.	Ongoing
	Maintain fire access tracks and footpaths	Maintain fire access tracks and footpaths, including weed control and pruning of vegetation, by implementing the Annual Bushland Schedule.	Ongoing
	Develop and implement Bushfire Risk Management Plan	Develop and implement a *Bushfire Risk Management Plan*, outlining the City's strategy for assessing fire risk, prevention, response and recovery.	Within one to two years
	Monitor fire occurrences	Monitor fire occurrences through mapping and updating Geographic Information System (GIS) layers detailing fire incidents and frequency to inform fire prevention actions.	Ongoing
	Revise weed control after fire incidents	Revise weed control after fire incidents to aid regrowth by selecting appropriate chemicals, targeting weeds if safe to do so for new seedlings, and spraying weedy grasses using backpacks.	Ongoing
	Implement Fire Weed Management Guidelines	Implement the Fire Weed Management Guidelines, when required, to reduce the infestation of weeds in natural areas after a fire.	Ongoing
Education and Training	Environmental Education Program	Implement initiatives of a 'Think Green Biodiversity' campaign (part of the Environmental Education Program) targeting environmental issues such as: • Pathogens; • Weeds; • Litter; • Fire; • Flora, fungi and fauna awareness; • Preventing hand feeding of wildlife; and • Responsible pet ownership.	Ongoing
	Support establishment of 'Friends of Shepherds Bush'	Support the establishment of a 'Friends of Shepherds Bush' group and encourage community participation in the management of this natural area.	Ongoing
	Implement Adopt a Bushland program	Implement an Adopt a Bushland Program for students to provide an interactive bushland management program.	Within one to two years
	Liaise with local schools	Liaise with nearby schools such as Dalmain, Halidon, Creaney and Goollelal Primary Schools to increase awareness of the bushland ecological values.	Within one to two years
	Natural Areas Team training	Conduct regular Natural Areas Team plant identification training, including weed management, to increase the effectiveness of weed control activities, as required.	Ongoing
	Friends Groups training	Provide training including pathogen management and weed identification to community members interested in forming a 'Friends of Shepherds Bush.'	Ongoing

City of Joondalup priority weed *(Gazania linearis)*

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Shepherds Bush Reserve

6.0 Appendices

Appendix 1 – Relevant Local, State and Federal Legislation, Policies, Plans and Strategies

Appendix 2 – Shepherds Bush Flora Species List

Appendix 3 – Shepherds Bush Key Flora Species

Appendix 4 - Conservation Codes for Western Australian Flora and Fauna

Appendix 5 – Keighery Scale Definitions

Appendix 6 – Examples of Priority Weed Species at Shepherds Bush

Appendix 7– Shepherds Bush High Priority Weed Species Management

Appendix 8 – Shepherds Bush Fauna Species List

Appendix 9 – Shepherds Bush Key Fauna Species

Appendix 10 – Shepherds Bush Introduced Fauna Species

Appendix 11 – Shepherds Bush Fungi Species List - Likely to Occur

Appendix 12 – Shepherds Bush Fungi Species - Likely to Occur - Photographs

Appendix 1 – Relevant Local, State and Federal Legislation, Policies, Plans and Strategies

Local Government

The purpose of the *Shepherds Bush Reserve Management Plan* aligns with the environmental aims and objectives of a number of City of Joondalup Plans including:

Strategic Community Plan

The City of Joondalup *Strategic Community Plan 2012-2022* highlights the focus on preservation, conservation and accessibility of the City's natural assets and the importance of engaging with the community and regional stakeholders.

Environment Plan

The City of Joondalup *Environment Plan 2014-2019* provides strategic direction in the delivery of environmental initiatives within the City of Joondalup.

Biodiversity Action Plan

The City of Joondalup *Biodiversity Action Plan 2009 – 2019* provides direction for the City's biodiversity management activities and details the development of individual Natural Areas Management Plans as an action.

City of Joondalup District Planning Scheme No. 2 Schedule 5

Planning for land use occurs under the District Planning Scheme No. 2. Schedule 5 (Clause 5.3.1) of the District Planning Scheme lists Places and Objects Having Significance for the Purpose of Protection of the Landscape or Environment.

Shepherds Bush is listed within Schedule 5 of the District Planning Scheme No 2.

City of Joondalup Pest Plant Local Law 2012

Under the *Biosecurity and Agriculture Management Act 2007* and the *Local Government Act 1995*, the Council of the City of Joondalup made the Pest Plant Local Law 2012 to require the owner or occupier of private land within the City of Joondalup district to destroy, eradicate or otherwise control pest plants within a specified time. Caltrop (*Tribulus terrestis*) is designated as a pest plant.

Caltrop was identified in Shepherds Bush in 2014 by the City of Joondalup.

Local Biodiversity Program (formerly Perth Biodiversity Project)

The City of Joondalup is one of 32 local governments participating in the Western Australian Local Government Association's (WALGA's) Local Biodiversity Program. The aim of the Local Biodiversity Program is to support local governments to effectively integrate biodiversity conservation into land use planning to protect and manage local natural areas.

As part of the Local Biodiversity Program, the City of Joondalup assessed all natural areas from 2004 onwards using the ecological criteria of the Natural Area Assessment process, resulting in a priority ranking of natural areas. The City of Joondalup assesses major conservation, high priority and medium priority natural areas approximately every five to seven years using this assessment tool.

Natural Area Assessments include a desktop assessment and field survey and document information such as:

- Vegetation complexes;
- Threatened or significant flora or ecological communities;
- Structural plant communities;
- Weed species;
- Vegetation condition assessment;
- Ecological criteria rankings;
- A viability estimate; and
- Fauna species observed.

Shepherds Bush is one of the City's five Major Conservation Areas due to the high biodiversity values of the area.

State Government

Relevant Legislation, Policies and Documents

Aboriginal Heritage Act 1972

The Act makes provision for the preservation on behalf of the community of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants.

Shepherds Bush is not listed on any State or Federal Indigenous heritage inventory or register.

Biosecurity and Agriculture Management Act 2007

The Act gives provision to control the entry, establishment, spread and impact of certain organisms that have or may have an adverse effect on other organisms, human beings, the environment, agricultural activities or related commercial activities. Pests, including plants, are declared under the Act as prohibited organisms.

Bushfires Act 1954

The Act makes provision for diminishing the dangers resulting from bush fires and for the prevention, control and extinguishment of bush fires.

Cat Act 2011

The Act makes provision for the control and management of cats and promotes and encourages the responsible ownership of cats.

Cats may be seized where they are found wandering in public areas, such as Shepherds Bush, in accordance with the *Cat Act 2011*.

Dog Act 1976

The Act makes provisions for the control of dogs in public and private spaces and promotes the responsible ownership of dogs.

Shepherds Bush is designated as a place where dogs must be on a leash at all times by Council resolution in accordance with the *Dog Act 1976*.

Environmental Protection Act 1986

The Act provides authority to the Environmental Protection Authority (EPA) for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment in Western Australia.

Heritage of Western Australia Act 1990

The Act provides for and encourages the conservation of places which have significance to the cultural heritage in the State.

Shepherds Bush is listed on the Register of the National Estate (place number 4522), a State cultural heritage register.

Wildlife Conservation Act 1950 (Department of Parks and Wildlife)

The Act provides the statute relating to conservation and legal protection of flora and fauna.

Two fauna species listed under the *Wildlife Conservation Act 1950* utilise Shepherds Bush the threatened Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and the migratory species Rainbow Bee-eater (*Merops ornatus*).

One priority flora species listed under the *Wildlife Conservation Act 1950* has been recorded at Shepherds Bush, *Jacksonia sericea*. The Department of Parks and Wildlife (DPaW) uses the International Union for Conservation of Nature for assigning species to threat categories. Under the DPaW Conservation Code, *Jacksonia sericea* is categorised as Priority Four (Rare, Near Threatened and other species in need of monitoring).

Government of Western Australia "Bush Forever" Strategy 2000

The Strategy identifies regionally significant bushland in the Perth Metropolitan Region to be retained, managed and protected forever.

Shepherds Bush is designated as a Bush Forever site (39).Two species identified in Shepherds Bush are listed as naturally occurring significant flora of the Perth Metropolitan Region, *Jacksonia sericea* and *Conostylis aculeata* subsp. *cygnorum*.

Perth and Peel Green Growth Plan for 3.5 million (draft) (Green Growth Plan)

The *Green Growth Plan* delivers a comprehensive environmental program for the protection of both Commonwealth matters of national environmental significance and State environmental values. The draft *Green Growth Plan* provides a comprehensive approach to the avoidance and mitigation of environmental impacts and a committed Conservation Program that will deliver significant improvements to the protection and management of the environment as the Perth and Peel regions grow to a population of 3.5 million people.

State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region

The *State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region* aims to provide direction and an implementation framework that will ensure bushland protection and management issues in the Perth Metropolitan Region are appropriately addressed and integrated with broader land use planning and decision-making.

DPaW Draft Weed Prioritisation Process 2013

The DPaW conducted a weed prioritisation process for weeds in each DPaW region, with the aim being to establish a species-led and an asset-protection-based approach to weed management, focussing on infestations of species which are considered to be high impact, rapidly invasive and still at a population size which is feasible to eradicate or contain to a manageable size. The weed prioritisation process is based on the Environmental Weed Census and Prioritisation, Swan Natural Resource Management Region project (Bettink and Keighery 2008) and the Environmental Weed Strategy of Western Australia (DPaW 1999). The assessment prioritises weeds using criteria of potential distribution, current distribution, ecological impact, invasiveness and feasibility of control to rate weeds as very high, high, medium, low, negligible, further assessment required or alert.

Shepherds Bush contains 26 high priority weeds rated as high priority due to their ecological impact in the DPaW Weed Prioritisation Process for the Swan Region 2013.

Federal Government

Relevant Legislation and Strategies

Environment Protection and Biodiversity Conservation Act 1999

The Act provides for the protection of the environment and the conservation of biodiversity, and for related purposes.

Two Environment Protection and Biodiversity Conservation (EPBC) Act 1999 listed species have been recorded in Shepherds Bush, the endangered Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and the migratory species Rainbow Bee-eater (*Merops ornatus*).

Australia's Biodiversity Conservation Strategy 2010-2030

The Strategy aims to protect biological diversity and maintain ecological processes and systems.

Weeds of National Significance (WONS) (1999 and 2012)

The Australian Government endorsed a list of 20 WONS in 1999 and a further 12 were added in 2012. The 32 Weeds of National Significance are identified as nationally agreed priority plant species for control and management based on the criteria of invasiveness and impact characteristics, potential and current area of spread and economic, environmental and social impacts.

Shepherds Bush contains no known Weeds of National Significance.

Threatened Species Strategy 2015

The long-term goal of the Australian Government's Threatened Species Strategy is to recover threatened plants and animals. The Strategy provides guidance into how the Australian community can work together to protect threatened animals and plants, both now and into the future.

The Strategy contains a a five-year Action Plan, which outlines on-ground actions and measurable targets to turn around the decline of threatened species. The Action Plan focuses on:

- Tackling feral cats.
- Creating safe havens for species most at risk.
- Improving habitat.
- Intervening in emergencies to avert extinctions.

International Conventions or Listings

International Union for Conservation of Nature (IUCN) Red List of Threatened Species

The IUCN Red List of Threatened Species™ provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria.

One endangered IUCN Red List species has been recorded in Shepherds Bush, Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*).

Pom Poms *(Ptilotus manglesii)*

Appendix 2

Shepherds Bush Flora Species List

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			EPBC ACT	WC Act/ Department of Parks and Wildlife	PMST	NatureMap	ELA 2015	The City's NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Agaricaceae	*Agaricus* sp.									+	
Aizoaceae	**Carpobrotus edulis*	Hottentot Fig					+	+		+	+
Aizoaceae	**Galenia pubescens* var. pubescens					•				+	
Aizoaceae	**Aptenia cordifolia*									+	
Aizoaceae	*Carpobrotus* sp. (sterile)									+	
Amaranthaceae	*Ptilotus drummondii*	Narrowleaf Mulla Mulla				+	+			+	
Amaranthaceae	*Ptilotus manglesii*	Pom Poms				+	+			+	+
Amaranthaceae	*Ptilotus polystachyus*	Prince of Wales Feather					+			+	+
Anarthriaceae	**Schinus terebinthifolius*	Japanese Pepper								+	
Anarthriaceae	*Lyginia barbata*					•					
Anarthriaceae	*Lyginia imberbis*					•				+	
Apiaceae	**Foeniculum vulgare*	Fennel								+	
Apiaceae	*Daucus glochidiatus*	Australian Carrot				•				+	+
Apiaceae	*Eryngium pinnatifidum* (formerly *E.rostratum)*	Blue Devils				+	+	+		+	+
Apiaceae	*Homalosciadium homalocarpum*					+	+			+	+
Apiaceae	*Xanthosia huegelii*					•				+	+
Araliaceae	*Hydrocotyle blepharocarpa*									+	
Araliaceae	*Trachymene coerulea* subsp. *coerulea*									+	
Araliaceae	*Trachymene pilosa*	Native Parsnip				+	+			+	+
Asparagaceae	**Agave americana*	Century Plant				+	+				
Asparagaceae	**Asparagus aethiopicus*				•						

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			EPBC ACT	WC Act/ Department of Parks and Wildlife	PMST	NatureMap	ELA 2015	The City's NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Asparagaceae	**Asparagus asparagoides*	Bridal Creeper			•						
Asparagaceae	**Asparagus declinatus*	Sprenger's Asparagus			•						
Asparagaceae	**Asparagus plumosus*	Common Asparagus Fern			•						
Asparagaceae	**Lachenalia reflexa*	Cape Cowslip/Yellow Soldier				•		+		+	
Asparagaceae	*Acanthocarpus preissi*					•				+	
Asparagaceae	*Dichopogon capillipes*						+				
Asparagaceae	*Laxmannia squarrosa*					•					
Asparagaceae	*Lomandra hermaphrodita*									+	
Asparagaceae	*Lomandra micrantha* subsp. *micrantha* (sterile)									+	
Asparagaceae	*Lomandra caespitosa*	Tufted Mat Rush				+	+			+	+
Asparagaceae	*Lomandra hermaphrodita*					•		+		+	
Asparagaceae	*Lomandra maritima*					•				+	
Asparagaceae	*Lomandra micrantha* subsp. *micrantha*									+	
Asparagaceae	*Lomandra preissii*					+	+				
Asparagaceae	*Lomandra* sp. (sterile)									+	+
Asparagaceae	*Lomandra* sp. *caespitosa/suaveolens* (sterile)									+	
Asparagaceae	*Lomandra suaveolens*					+	+			+	
Asparagaceae	*Sowerbaea laxiflora*	Purple Tassels				+	+			+	+
Asparagaceae	*Thysanotus arenarius*					+	+			+	
Asparagaceae	*Thysanotus manglesianus*	Fringed Lily					+			+	+
Asparagaceae	*Thysanotus* sp. (sterile)										+
Asparagaceae	*Thysanotus sparteus*					•				+	
Asparagaceae	*Thysanotus thyrsoideus*					•					
Asparagaceae	*Thysanotus triandrus*					•					

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			EPBC ACT	WC Act/ Department of Parks and Wildlife	PMST	NatureMap	ELA 2015	The City's NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Asphodelaceae	**Asphodelus fistulosus*						+				
Asphodelaceae	**Trachyandra divaricata*									+	+
Asteraceae	**Arctotheca calendula*	Cape Weed					+			+	+
Asteraceae	**Arctotheca populifolia*	Dune Arctotheca				•					
Asteraceae	**Chondrilla juncea*	Skeleton Weed				•					
Asteraceae	**Chrysanthemoides monilifera*	Bitou Bush			•						
Asteraceae	**Conyza bonariensis*	Flax leaf Fleabane				•		+		+	
Asteraceae	**Conyza parva*					•					
Asteraceae	**Conyza sumatrensis*					•					
Asteraceae	**Cotula turbinata*	Funnel Weed				+	+				+
Asteraceae	**Osteospermum ecklonis*						+			+	
Asteraceae	**Dittrichia viscosa*					•					
Asteraceae	**Galinsoga parviflora*	Potato Weed				•					
Asteraceae	**Gamochaeta coarctata*					•					
Asteraceae	**Gazania linearis*					+	+	+		+	+
Asteraceae	**Hedypnois rhagadioloides* subsp. *cretica*										+
Asteraceae	**Hypochaeris glabra*	Smooth Cats Ear				+	+	+		+	+
Asteraceae	**Hypochaeris radicata*	Flat Weed					+			+	
Asteraceae	**Lactuca serriola*	Prickly Lettuce								+	
Asteraceae	**Monoculus monstrosus* (formerly *Osteospermum clandestinum)*					•				+	+
Asteraceae	**Senecio vulgaris*	Common Groundsel				•					
Asteraceae	**Sonchus oleraceus*	Common Sowthistle				+	+			+	+
Asteraceae	**Taraxacum officinale*	Dandelion				•					
Asteraceae	**Urospermum picroides*	False Hawkbit					+	+		+	

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
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Asteraceae	**Ursinia anthemoides* subsp. *anthemoides*					+	+	+		+	+
Asteraceae	**Chrysanthemum* sp. (garden escapee)									+	
Asteraceae	*Asteridea pulverulenta*	Common Bristle Daisy				+	+				
Asteraceae	*Cotula australis*	Common Cortula								+	
Asteraceae	*Helichrysum luteoalbum*	Jersey Cudweed				•					
Asteraceae	*Lagenophora huegelii*						+			+	
Asteraceae	*Millotia tenuifolia*	Soft Millotia				•					
Asteraceae	*Olearia axillaris*	Coastal Daisybush				•				+	
Asteraceae	*Pithocarpa cordata*									+	
Asteraceae	*Podolepis gracilis*	Slender Podolepis				•				+	+
Asteraceae	*Podotheca angustifolia*	Sticky Longheads				•				+	
Asteraceae	*Podotheca chrysantha*	Yellow Podotheca				•				+	
Asteraceae	*Podotheca gnaphalioides*	Golden Longheads				+	+			+	+
Asteraceae	*Quinetia urvillei*									+	+
Asteraceae	*Senecio pinnatifolius var. latilobus*									+	
Asteraceae	*Senecio* sp. (unresolved taxonomy) (WAH)									+	
Asteraceae	*Waitzia suaveolens*	Fragrant Waitzia					+			+	
Asteraceae	*Xerochrysum bracteatum*					•					
Basellaceae	**Anredera cordifolia*	Madeira Vine			•						
Brassicaceae	**Brassica tournefortii*	Mediterranean Turnip				+	+			+	
Brassicaceae	**Cakile maritima*	Sea Rocket				•					
Brassicaceae	**Heliophila pusilla*					•	+			+	
Brassicaceae	**Lobularia maritima*	Sweet Alyssum				•					
Brassicaceae	**Raphanus raphanistrum*	Wild Radish				•					+

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
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Campanulaceae	**Wahlenbergia capensis*	Cape Bluebell				+	+			+	+
Campanulaceae	**Cuscuta epithymum*									+	
Campanulaceae	*Isotoma hypocrateriformis*	Woodbridge Poison				•					
Campanulaceae	*Wahlenbergia gracilenta*	Annual Bluebell				•				+	
Campanulaceae	*Wahlenbergia* sp.					•					
Campanulaceae	*Lobelia tenuior*	Slender Lobelia									+
Caprifoliaceae	**Centranthus macrosiphon*									+	+
Caryophyllaceae	**Cerastium glomeratum*	Mouse Ear Chickweed				+	+			+	
Caryophyllaceae	**Petrorhagia dubia* (formerly *P.velutina*)					+	+			+	+
Caryophyllaceae	**Sagina apetala*	Annual Pearlwort				•					
Caryophyllaceae	**Silene gallica* var. *gallica*					+	+			+	+
Caryophyllaceae	**Stellaria media*	Chickweed				•				+	
Casuarinaceae	*Allocasuarina fraseriana*	Sheoak				+	+	+	+	+	+
Casuarinaceae	*Allocasuarina humilis*	Dwarf Sheoak				+	+		+	+	+
Celastraceae	*Tripterococcus brunonis*									+	
Centrolepidaceae	*Centrolepis drummondiana*					•				+	+
Chenopodiaceae	**Chenopodium macrospermum*					•					
Chenopodiaceae	**Dysphania ambrosioides*	Mexican Tea				•					
Chenopodiaceae	*Rhagodia baccata* subsp. *baccata*	Berry Saltbush								+	
Colchicaceae	*Burchardia congesta* (formerly *Burchardia umbellata)*						+			+	+
Convolvulaceae	**Cuscuta epithymum*									+	
Convolvulaceae	**Dichondra micrantha*					•					
Crassulaceae	**Crassula alata*					•					
Crassulaceae	**Crassula glomerata*					+	+			+	

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
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Crassulaceae	*Crassula colorata*	Dense Stonecrop				•				+	+
Crassulaceae	*Crassula decumbens*									+	
Cupressaceae	*Callitris preissii*	Rottnest Island Pine				•				+	+
Cyperaceae	**Isolepis marginata*									+	
Cyperaceae	*Carex fascicularis*	Tassel Sedge				•					
Cyperaceae	*Ficinia nodosa*	Knotted Club Rush				•					
Cyperaceae	*Isolepis marginata*	Coarse Club Rush				•				+	+
Cyperaceae	*Lepidosperma angustatum*					•		+			
Cyperaceae	*Lepidosperma calcicola*					•				+	
Cyperaceae	*Lepidosperma costale*									+	
Cyperaceae	*Lepidosperma leptostachyum*						+			+	+
Cyperaceae	*Lepidosperma pubisquameum*					•					+
Cyperaceae	*Lepidosperma scabrum*									+	
Cyperaceae	*Lepidosperma* sp.					•					
Cyperaceae	*Lepidosperma squamatum*					+	+			+	
Cyperaceae	*Lepidosperma striatum*										+
Cyperaceae	*Mesomelaena pseudostygia*					+	+	+		+	+
Cyperaceae	*Schoenoplectus validus*	Lake Club Rush				•					
Cyperaceae	*Schoenus clandestinus*						+			+	
Cyperaceae	*Schoenus curvifolius*					•				+	+
Cyperaceae	*Schoenus grandiflorus*					+	+	+		+	+
Cyperaceae	*Tetraria octandra*					•				+	
Dasypogonaceae	*Calectasia narragara*					•					
Dasypogonaceae	*Dasypogon bromeliifolius*	Pineapple Bush				•					+
Dennstaedtiaceae	*Pteridium esculentum* subsp. *esculentum*					•					
Dilleniaceae	*Hibbertia aurea*					•					
Dilleniaceae	*Hibbertia crassifolia*					•					

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
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Dilleniaceae	*Hibbertia cuneiformis*	Cutleaf Hibbertia				•				+	
Dilleniaceae	*Hibbertia huegelii*					•					+
Dilleniaceae	*Hibbertia hypericoides*	Yellow Buttercups				+	+	+	+	+	+
Dilleniaceae	*Hibbertia racemosa*					+	+	+		+	+
Droseraceae	*Drosera erythrorhiza* subsp. *erythrorhiza*					+	+			+	+
Droseraceae	*Drosera glanduligera*	Pimpernel Sundew								+	
Droseraceae	*Drosera macrantha*					•				+	+
Droseraceae	*Drosera menziesii*					•			+		
Droseraceae	*Drosera paleacea*	Dwarf Sundew				•					
Droseraceae	*Drosera paleacea* subsp. *paleacea*					•					
Droseraceae	*Drosera pallida*	Pale Rainbow							+	+	+
Droseraceae	*Drosera platystigma*	Black-eyed Sundew									+
Epacridaceae	*Andersonia gracilis*		EN	VU	•						
Ericaceae	*Astroloma ciliatum*							+		+	
Ericaceae	*Astroloma pallidum*	Kick Bush				+	+	+		+	+
Ericaceae	*Conostephium minus*	Pink-tipped Pearl flower				•					
Ericaceae	*Conostephium pendulum*					•		+		+	+
Ericaceae	*Conostephium preissii*					•		+		+	
Ericaceae	*Leucopogon conostephioides*					•					
Ericaceae	*Leucopogon parviflorus*					•				+	
Ericaceae	*Leucopogon polymorphus*					•				+	
Ericaceae	*Leucopogon propinquus*					•				+	+
Ericaceae	*Leucopogon* sp.						+				
Ericaceae	*Lysinema ciliatum*	Curry Flower				•					

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			EPBC ACT	WC Act/ Department of Parks and Wildlife	PMST	NatureMap	ELA 2015	The City's NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Euphorbiaceae	**Euphorbia peplus*	Petty Spurge				+	+			+	+
Euphorbiaceae	**Euphorbia terracina*	Geraldton Carnation Weed				+	+	+		+	+
Euphorbiaceae	*Monotaxis grandiflora*	Diamond of the Desert				•					
Euphorbiaceae	*Monotaxis grandiflora* var. *grandiflora*					+	+			+	+
Euphorbiaceae	*Ricinocarpos glaucus*									+	+
Euphorbiaceae	*Ricinocarpos undulatus*					+	+				
Fabaceae	**Acacia dealbata*									+	
Fabaceae	**Acacia iteaphylla*							+		+	+
Fabaceae	**Acacia longifolia* subsp. *longifolia*					•					
Fabaceae	**Acacia longifolia* subsp. *sophorae*									+	
Fabaceae	**Genista* sp. x *Genista monspessulana*				•						
Fabaceae	**Lupinus cosentinii*						+			+	+
Fabaceae	**Medicago littoralis*						+				
Fabaceae	**Melilotus indicus*					•					
Fabaceae	**Ornithopus pinnatus*	Slender Serradella									+
Fabaceae	**Trifolium arvense*					+	+			+	
Fabaceae	**Trifolium campestre*	Hop Clover				+	+	+		+	+
Fabaceae	**Trifolium hirtum*	Rose Clover				•					
Fabaceae	**Trifolium subterraneum*	Subterranean Clover									+
Fabaceae	**Vicia sativa*					+	+			+	
Fabaceae	*Acacia benthamii*			P2		•				+	
Fabaceae	*Acacia cochlearis*					•				+	+
Fabaceae	*Acacia cyclops*	Coastal Wattle				+	+			+	+
Fabaceae	*Acacia huegelii*					•					

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Fabaceae	*Acacia lasiocarpa* var. *lasiocarpa*					•					
Fabaceae	*Acacia lasiocarpa* var. *sedifolia*					•					
Fabaceae	*Acacia pulchella*	Prickly Moses				•					
Fabaceae	*Acacia pulchella* var. *glaberrima*						+	+		+	+
Fabaceae	*Acacia rostellifera*						+			+	
Fabaceae	*Acacia saligna* subsp. *saligna*					+	+	+	+	+	+
Fabaceae	*Acacia stenoptera*										+
Fabaceae	*Acacia trigonophylla*										+
Fabaceae	*Acacia truncata*					•				+	
Fabaceae	*Acacia willdenowiana*						+	+		+	
Fabaceae	*Acacia xanthina*	White-stemmed Wattle				•					
Fabaceae	*Bossiaea eriocarpa*	Common Brown Pea				•			+	+	+
Fabaceae	*Daviesia divaricata*	Marno				•		+			+
Fabaceae	*Daviesia divaricata* subsp. *divaricata*					+	+			+	
Fabaceae	*Daviesia gracilis* (formerly *D.juncea)*								+		
Fabaceae	*Daviesia nudiflora*					+	+	+		+	+
Fabaceae	*Daviesia pedunculata*					•					
Fabaceae	*Daviesia triflora*					+	+	+		+	+
Fabaceae	*Euchilopsis linearis*	Swamp Pea				•					
Fabaceae	*Gastrolobium capitatum* (formerly *Nemcia capitata* and *Oxylobium capitatum)*					•				+	+
Fabaceae	*Gompholobium tomentosum*	Hairy Yellow Pea				+	+	+		+	+
Fabaceae	*Hardenbergia comptoniana*	Native Wisteria				+	+	+	+	+	+
Fabaceae	*Hovea pungens*	Devil's Pins								+	
Fabaceae	*Hovea trisperma*	Common Hovea				+	+	+		+	

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Fabaceae	*Isotropis cuneifolia*					•					+
Fabaceae	*Isotropis cuneifolia* subsp. *cuneifolia*									+	
Fabaceae	*Jacksonia calcicola*					•				+	
Fabaceae	*Jacksonia floribunda*	Holly Pea				•					
Fabaceae	*Jacksonia furcellata*	Grey Stinkwood					+			+	+
Fabaceae	*Jacksonia sericea*			P4		+	+	+			+
Fabaceae	*Jacksonia sternbergiana*	Stinkwood					+			+	
Fabaceae	*Kennedia coccinea*	Coral Vine				•					
Fabaceae	*Kennedia prostrata*	Scarlet Runner				+	+		+	+	+
Fabaceae	*Sphaerolobium medium*									+	
Fabaceae	*Templetonia retusa*									+	
Fabaceae	*Viminaria juncea*	Swishbush				•					
Geraniaceae	**Erodium botrys*	Long Storksbill					+			+	+
Geraniaceae	**Geranium molle*	Dove's Foot Cranesbill/Soft cranesbill							+		
Geraniaceae	**Pelargonium capitatum* (immat.)									+	
Geraniaceae	*Erodium cygnorum*	Blue Heronsbill									+
Geraniaceae	**Pelargonium capitatum*	Rose Pelargonium				+	+	+		+	+
Goodeniaceae	*Dampiera linearis*	Common Dampiera				•				+	+
Goodeniaceae	*Lechenaultia floribunda*	Free-flowering Leschenaultia				•					
Goodeniaceae	*Lechenaultia linarioides*					•				+	
Goodeniaceae	*Scaevola ?thesioides* subsp. *thesioides* (sterile)									+	
Goodeniaceae	*Scaevola canescens*	Grey Scaevola				+	+	+		+	+
Goodeniaceae	*Scaevola globulifera*					•					
Goodeniaceae	*Scaevola repens* var. *angustifolia*					•				+	+

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Goodeniaceae	*Scaevola repens* var. *repens*					+	+	+			
Goodeniaceae	*Scaevola thesioides* subsp. *thesioides*									+	
Gyrostemonaceae	*Tersonia cyathiflora*	Button Creeper								+	+
Haemodoraceae	*Anigozanthos humilis*	Catspaw				+	+			+	+
Haemodoraceae	*Anigozanthos manglesii*	Mangles Kangaroo Paw				•				+	+
Haemodoraceae	*Anigozanthos viridis* subsp. *terraspectans*	Dwarf Green Kangaroo Paw	VU	VU	•						
Haemodoraceae	*Conostylis aculeata*	Prickly Conostylis				•					
Haemodoraceae	*Conostylis aculeata* subsp. *cygnorum*					+	+	+		+	+
Haemodoraceae	*Conostylis candicans* subsp. *candicans*					•					
Haemodoraceae	*Conostylis setigera*					•			+		+
Haemodoraceae	*Haemodorum laxum*					+	+	+			
Haemodoraceae	*Haemodorum paniculatum*	Mardja				•				+	+
Haemodoraceae	*Haemodorum spicatum*							+		+	
Haemodoraceae	*Phlebocarya ciliata*					+	+				
Haloragaceae	*Glischrocaryon aureum*	Common Popflower								+	
Haloragaceae	*Gonocarpus pithyoides*					•					
Hemerocallidaceae	*Arnocrinum preissii*					•					
Hemerocallidaceae	*Caesia micrantha* (formerly *Caesia parviflora)*	Pale Grass-lily				+	+			+	+
Hemerocallidaceae	*Corynotheca micrantha*	Sand Lily				+	+	+		+	+
Hemerocallidaceae	*Dianella revoluta*	Blueberry Lily				•					
Hemerocallidaceae	*Dianella revoluta* var. *revoluta*					+	+			+	+
Hemerocallidaceae	*Tricoryne elatior*	Yellow Autumn Lily				•		+		+	+
Iridaceae	**Ferraria crispa*						+			+	
Iridaceae	**Freesia alba* x *leichtlinii*						+			+	+

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Iridaceae	**Gladiolus caryophyllaceus*	Wild Gladiolus				+	+	+		+	+
Iridaceae	**Hesperantha falcata*					•					
Iridaceae	**Ixia maculata*									+	
Iridaceae	**Moraea flaccida* (formerly *Homeria flaccida)*	One-leaf Cape Tulip				+	+	+		+	+
Iridaceae	**Romulea flava* var. *minor*					•					
Iridaceae	**Romulea rosea*	Guildford Grass				+	+			+	+
Iridaceae	**Sparaxis bulbifera*						+				
Iridaceae	**Sparaxis pillansii*	Harlequin Flower				•					
Iridaceae	*Watsonia meriana* var. *bulbillifera*	Watsonia						+			
Iridaceae	*Orthrosanthus laxus* var. *laxus*	Morning Iris				+	+	+		+	+
Iridaceae	*Patersonia occidentalis*	Purple Flag				•				+	+
Juncaceae	*Juncus pallidus*	Pale Rush				•					
Juncaceae	*Luzula meridionalis*	Field Woodrush				•				+	
Juncaginaceae	*Triglochin isingiana*									+	+
Lamiaceae	*Hemiandra linearis*	Speckled Snakebush				•					
Lamiaceae	*Hemiandra pungens*	Snakebush				•					
Lauraceae	*Cassytha flava*									+	
Lauraceae	*Cassytha pomiformis*									+	
Lauraceae	*Cassytha racemosa* var *racemosa* (no fruit)									+	
Loranthaceae	*Nuytsia floribunda*	Christmas Tree							+	+	+
Malvaceae	**Malva parviflora*	Marshmallow								+	+
Myrtaceae	**Agonis flexuosa*									+	
Myrtaceae	**Chamelaucium uncinatum*	Geraldton Wax				•	+	+		+	+
Myrtaceae	**Leptospermum laevigatum*	Coast Teatree									+

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Myrtaceae	**Melaleuca nesophila*					•				+	
Myrtaceae	*Agonis flexuosa*	Peppermint									+
Myrtaceae	*Baeckea* sp. Limestone (N. Gibson and M.N. Lyons 1425)			P1		•					
Myrtaceae	*Calothamnus quadrifidus*	One-sided Bottlebrush									+
Myrtaceae	*Calothamnus quadrifidus* subsp. *quadrifidus*						+			+	
Myrtaceae	*Calothamnus sanguineus*					•					
Myrtaceae	*Calytrix acutifolia*					•					
Myrtaceae	*Calytrix angulata*	Yellow Starflower				•					
Myrtaceae	*Calytrix flavescens*	Summer Starflower							+		
Myrtaceae	*Calytrix fraseri*	Pink Summer Calytrix				•					
Myrtaceae	*Corymbia calophylla* (formerly *Eucalyptus calophylla)*	Marri					+	+	+	+	+
Myrtaceae	*Darwinia foetida*		CR	EN	•						
Myrtaceae	*Eremaea pauciflora*							+			+
Myrtaceae	*Eremaea pauciflora var. pauciflora*					•					
Myrtaceae	*Eremaea purpurea*					•					
Myrtaceae	*Eucalyptus decipiens subsp. decipiens*					•				+	
Myrtaceae	*Eucalyptus foecunda*	Narrow-leaved Red Mallee				•					
Myrtaceae	*Eucalyptus gomphocephala*	Tuart				+	+	+	+	+	+
Myrtaceae	*Eucalyptus marginata* subsp. *marginata*	Jarrah				+	+	+	+	+	+
Myrtaceae	*Eucalyptus petrensis*					•					
Myrtaceae	*Eucalyptus rudis*	Flooded Gum				•					
Myrtaceae	*Hypocalymma robustum*	Swan River Myrtle				+	+	+		+	+
Myrtaceae	*Kunzea glabrescens*									+	
Myrtaceae	*Melaleuca cuticularis*	Saltwater Paperbark				•					

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Myrtaceae	*Melaleuca sp.*					•					
Myrtaceae	*Melaleuca systena* (formerly *M.acerosa)*					+	+			+	
Myrtaceae	*Regelia inops*					•					
Myrtaceae	*Verticordia huegelii*	Variegated Featherflower				•					
Myrtaceae	*Verticordia nitens*	Morrison Featherflower				•					
Oleaceae	**Olea europaea*				•	•		+		+	
Onagraceae	**Oenothera drummondii*	Beach Evening Primrose				•					
Onagraceae	**Oenothera stricta*	Common Evening Primrose				•					
Onagraceae	*Epilobium hirtigerum*	Hairy Willow Herb				•					
Orchidaceae	**Disa bracteata*					•					
Orchidaceae	*Caladenia arenicola*					+	+			+	+
Orchidaceae	*Caladenia discoidea*	Dancing Orchid				•					
Orchidaceae	*Caladenia flava*					•				+	+
Orchidaceae	*Caladenia huegelii*		EN	CR	•						
Orchidaceae	*Caladenia latifolia*	Pink Fairy Orchid								+	+
Orchidaceae	*Caladenia longicauda*	Common White Spider Orchid								+	+
Orchidaceae	*Diuris sp. Eneabba* (A.H. Burbidge 3941) (immat.)									+	
Orchidaceae	*Diuris corymbosa*						+				
Orchidaceae	*Diuris magnifica*					•				+	+
Orchidaceae	*Diuris micrantha*	Dwarf Bee-orchid	VU	VU	•						
Orchidaceae	*Diuris purdiei*	Purdie's Donkey-orchid	EN	EN	•						
Orchidaceae	*Drakaea elastic*	Glossy-leafed Hammer-orchid	EN	CR	•						
Orchidaceae	*Drakaea micrantha*	Dwarf Hammer-orchid	VU	EN	•						
Orchidaceae	*Elythranthera brunonis*	Purple Enamel Orchid				•					+

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Orchidaceae	*Microtis media* subsp. *media*					•				+	
Orchidaceae	*Prasophyllum hians*									+	
Orchidaceae	*Pterostylis* sp. 'short sepals' (W. Jackson BJ269) (senescent)									+	
Orchidaceae	*Pterostylis sanguinea*										+
Orchidaceae	*Pterostylis vittata*	Banded Greenhood								+	
Orchidaceae	*Pyrorchis nigricans*					+	+			+	+
Orchidaceae	*Thelymitra fuscolutea*	Leopard Orchid				•					
Orobanchaceae	**Orobanche minor*	Lesser Broomrape				+	+				
Oxalidaceae	**Oxalis pes-caprae*	Soursob					+	+		+	+
Oxalidaceae	**Oxalis purpurea*									+	
Papaveraceae	**Fumaria capreolata*	Whiteflower Fumitory					+	+		+	+
Phyllanthaceae	**Phyllanthus tenellus*					•					
Phyllanthaceae	*Phyllanthus calycinus*	False Boronia				+	+			+	+
Phyllanthaceae	*Poranthera microphylla*	Small Poranthera				+	+			+	+
Pinaceae	**Pinus radiate*	Radiata Pine			•						
Pittosporaceae	*Billardiera fraseri* (sterile)									+	
Pittosporaceae	*Pittosporum angustifolium*					•					
Pittosporaceae	*Pittosporum ligustrifolium*					•					
Poaceae	**Aira caryophyllea*	Silvery Hairgrass				+	+				
Poaceae	**Aira cupaniana*	Silvery Hairgrass									+
Poaceae	**Avena barbata*	Bearded Oat					+			+	+
Poaceae	**Avena fatua*	Wild Oat				•					
Poaceae	**Briza maxima*	Blowfly Grass				+	+	+		+	+
Poaceae	**Briza minor*	Shivery Grass				•				+	+

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Poaceae	**Bromus diandrus*	Great Brome				+	+			+	+
Poaceae	**Bromus madritensis*	Madrid Brome					+				
Poaceae	**Cenchrus ciliaris*	Buffel Grass			•	•					
Poaceae	**Cenchrus setaceus* (formerly *Pennisetum setaceum)*	Fountain Grass									+
Poaceae	**Cortaderia selloana*	Pampas Grass				•					
Poaceae	**Cynodon dactylon*	Couch					+	+		+	
Poaceae	**Ehrharta brevifolia* var. *cuspidata*					•					
Poaceae	**Ehrharta calycina*	Perennial Veldt Grass				+	+			+	+
Poaceae	**Ehrharta longiflora*	Annual Veldt Grass				+	+			+	+
Poaceae	**Eragrostis curvula*	African Lovegrass				•					
Poaceae	**Hordeum leporinum*	Barley Grass					+				+
Poaceae	**Lagurus ovatus*					+	+	+		+	
Poaceae	**Pentameris airoides* subsp. *airoides*					•				+	+
Poaceae	**Thinopyrum distichum*					•					
Poaceae	*Urochloa mutica* (formerly **Brachiaria mutica)*	Buffalo Grass			•						
Poaceae	**Vulpia muralis* (immat.)									+	
Poaceae	**Vulpia bromoides*	Squirrel Tail Fescue				•					
Poaceae	**Vulpia myuros*	Rat's Tail Fescue				•		+			+
Poaceae	*Amphipogon turbinatus*					•					+
Poaceae	*Austrostipa compressa*					•				+	
Poaceae	*Austrostipa elegantissima*									+	
Poaceae	*Austrostipa eremophila*					•					
Poaceae	*Austrostipa flavescens*					+	+	+		+	
Poaceae	*Austrostipa nitida*					•					

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Poaceae	*Austrostipa tenuifolia*					•					
Poaceae	*Eragrostis curvula*	African Lovegrass									+
Poaceae	*Heteropogon contortus*	Bunch Speargrass				•					
Poaceae	*Microlaena stipoides*	Weeping Grass				•				+	
Poaceae	*Poa drummondiana*									+	
Poaceae	*Poaceae* sp. (sterile)									+	
Poaceae	*Rytidosperma caespitosum* (formerly *Austrodanthonia caespitosa)*									+	
Poaceae	*Spinifex hirsutus*	Hairy Spinifex				•					
Polygonaceae	**Emex australis*	Doublegee					+			+	
Polygonaceae	*Persicaria decipiens*					•					
Portulacaceae	*Calandrinia corrigioloides*									+	
Portulacaceae	*Calandrinia granulifera*	Pygmy Purslane								+	+
Primulaceae	**Lysimachia arvensis* (formerly *Anagallis arvensis)*	Pimpernel					+			+	+
Proteaceae	*Banksia attenuata*	Slender Banksia				+	+	+	+	+	+
Proteaceae	*Banksia dallanneyi* var. *dallanneyi* (formerly *Dryandra lindleyana)*						+			+	+
Proteaceae	*Banksia grandis*	Bull Banksia					+	+			+
Proteaceae	*Banksia ilicifolia*	Holly-leaved Banksia				•					
Proteaceae	*Banksia menziesii*	Firewood Banksia				+	+		+	+	+
	Banksia nivea (formerly *Dryandra nivea)*										
Proteaceae	*Banksia prionotes*									+	+
Proteaceae	*Banksia sessilis* var. *cygnorum*						+			+	
Proteaceae	*Conospermum incurvum*	Plume Smokebush				•					
Proteaceae	*Conospermum stoechadis*	Common Smokebush				•					

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Proteaceae	*Conospermum triplinervium*	Tree Smokebush								+	
Proteaceae	*Grevillea preissii*									+	
Proteaceae	*Grevillea crithmifolia*									+	+
Proteaceae	*Grevillea preissii* subsp. *preissii*									+	
Proteaceae	*Grevillea* sp.					•					
Proteaceae	*Grevillea vestita* subsp. *vestita*					+	+	+		+	+
Proteaceae	*Hakea costata*	Ribbed Hakea				•					
Proteaceae	*Hakea lissocarpha*	Honey Bush				+	+	+		+	
Proteaceae	*Hakea prostrata*	Harsh Hakea				+	+	+	+	+	+
Proteaceae	*Hakea trifurcata*	Two-leaf Hakea				•					+
Proteaceae	*Persoonia saccata*									+	+
Proteaceae	*Petrophile brevifolia*					•				+	+
Proteaceae	*Petrophile linearis*	Pixie Mops				+	+	+		+	+
Proteaceae	*Petrophile macrostachya*					+	+			+	+
Proteaceae	*Petrophile media*									+	
Proteaceae	*Stirlingia latifolia*	Blueboy				•			+	+	+
Proteaceae	*Synaphea spinulosa* subsp. *spinulosa*					•				+	
Ranunculaceae	*Clematis pubescens*	Common Clematis				•					
Restionaceae	*Alexgeorgea arenicola*									+	
Restionaceae	*Alexgeorgea nitens*					•				+	+
Restionaceae	*Chordifex microcodon*					•					
Restionaceae	*Desmocladus fascicularis* (poor material)									+	
Restionaceae	*Desmocladus asper*					•				+	+
Restionaceae	*Desmocladus flexuosus*					+	+	+		+	+

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Restionaceae	*Hypolaena exsulca*					•					
Restionaceae	*Lepidobolus preissianus*										+
Rhamnaceae	*Spyridium globulosum* (formerly *Spyridium tridentatum)*	Basket Bush				•				+	+
Rhamnaceae	*Stenanthemum notiale* subsp. *chamelum*						+			+	
Rhamnaceae	*Stenanthemum tridentatum*							+			
Rubiaceae	**Galium murale*						+			+	
Rubiaceae	*Opercularia vaginata*	Dog Weed				+	+			+	+
Rutaceae	*Boronia purdieana* subsp. *purdieana*					•					
Rutaceae	*Diplolaena angustifolia*	Yanchep Rose				•					
Rutaceae	*Diplolaena dampieri*	Southern Diplolaena				•					+
Rutaceae	*Philotheca spicata*	Pepper and Salt								+	+
Rutaceae	*Rhadinothamnus anceps*					•					
Santalaceae	*Exocarpos sparteus*					•				+	
Santalaceae	*Leptomeria empetriformis*					•					
Santalaceae	*Leptomeria pauciflora*	Sparse-flowered Currant Bush				•					
Santalaceae	*Santalum acuminatum*	Quandong				•					
Sapindaceae	*Diplopeltis huegelii* subsp. *huegelii*					•					
Scrophulariaceae	**Dischisma arenarium*									+	
Scrophulariaceae	**Nemesia strumosa*					•					
Scrophulariaceae	*Eremophila glabra* subsp. *albicans*					•					
Scrophulariaceae	*Myoporum insulare*					•				+	
Solanaceae	**Lycium ferocissimum*				•	•					
Solanaceae	**Lycopersicon esculentum (Synonym *Lycopersicon lycopersicum)*					•					

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Solanaceae	**Solanum nigrum*	Black Berry Nightshade				+	+			+	+
Solanaceae	*Anthocercis littorea*									+	
Stylidiaceae	*Levenhookia pusilla*									+	
Stylidiaceae	*Stylidium androsaceum*									+	
Stylidiaceae	*Stylidium araeophyllum*						+				
Stylidiaceae	*Stylidium brunonianum*	Pink Fountain Triggerplant									+
Stylidiaceae	*Stylidium bulbiferum*	Circus Triggerplant				•					
Stylidiaceae	*Stylidium calcaratum*	Book Triggerplant				•					+
Stylidiaceae	*Stylidium crossocephalum*	Posy Triggerplant				•					
Stylidiaceae	*Stylidium hesperium* ms									+	
Stylidiaceae	*Stylidium maritimum*			P3		•					
Stylidiaceae	*Stylidium neurophyllum* ms									+	
Stylidiaceae	*Stylidium piliferum*	Common Butterfly Triggerplant				•					
Stylidiaceae	*Stylidium repens*	Matted Triggerplant					+			+	+
Stylidiaceae	*Stylidium rigidulum*									+	
Stylidiaceae	*Stylidium schoenoides*	Cow Kicks					+			+	
Tamaricaceae	**Tamarix aphylla*	Athel Pine			•						
Thymelaeaceae	*Pimelea sulphurea* (sterile)									+	
Thymelaeaceae	*Pimelea argentea*	Silvery Leaved Pimelea				•					
Thymelaeaceae	*Pimelea calcicola*			P3		•					
Thymelaeaceae	*Pimelea floribunda*					•					
Thymelaeaceae	*Pimelea leucantha*					+	+			+	+
Thymelaeaceae	*Pimelea sulphurea*	Yellow Banjine				•				+	+
Unknown	*Tree sp. (horticultural)									+	

Family	Latin name	Common name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			EPBC ACT	WC Act/ Department of Parks and Wildlife	PMST	NatureMap	ELA 2015	The City's NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Verbenaceae	*Lantana camara*				•						
Violaceae	*Hybanthus calycinus*	Wild Violet				+	+			+	+
Xanthorrhoeaceae	*Xanthorrhoea preissii*	Grass tree				+	+	+	+	+	+
Zamiaceae	*Macrozamia riedlei*	Zamia				+	+	+		+	+
Zygophyllaceae	**Tribulus terrestris*	Caltrop						+			

+ = recorded during survey.
• = listed within database search for respective survey but not recorded during that survey.
* = introduced species.
CR = listed as Critically Endangered under the EPBC Act, WC Act and the IUCN red list.
EN = listed as Endangered under the EPBC Act, WC Act and the IUCN red list.
VU = listed as Vulnerable under the EPBC Act, WC Act and the IUCN red list.
P1, P2, P3 = Taxa that may be threatened or near threatened, but are data deficient or have not yet been adequately surveyed to be listed under the Wildlife Conservation (Rare Flora) Notice
P4 = Taxa that are not currently threatened but could if present circumstances change. These taxa are usually represented on conservation lands.

Appendix 3

Shepherds Bush Key Flora Species

Priority and Significant Flora at Shepherds Bush

Name	Common Name	Conservation Code	Image
Jacksonia sericea	Waldjumi	Priority Four, *DPaW, Wildlife Conservation Act 1950*; Significant Flora of the Perth Metropolitan Region, Bush Forever Strategy (2000)	 Photo: ELA, Shepherds Bush, 2016
Conostylis aculeata subsp *cygnorum*	Prickly Conostylis	Significant Flora of the Perth Metropolitan Region, Bush Forever Strategy (2000)	 Photos: K.C. Richardson (WA Herbarium no date)

Note: For further explanations on Conservation Codes, refer to Appendix 4.

Appendix 4

Conservation Codes for Western Australian Flora and Fauna

IUCN categories and criteria (IUCN 2012)

Categories and criteria are also used for the Environment *Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Wildlife Conservation Act 1950 (WC Act)*.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa has not been recorded in its known and/or expected habitat at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (M)	Not an IUCN category. Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • The Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • The agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA); • The agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or • The agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).

The City of Joondalup has added a Category listed as Locally Significant to reflect locally significant native species within the City of Joondalup. Locally Significant species are defined below.

Category	Definition
Locally Significant (LS) - City of Joondalup	Taxa within the City of Joondalup who are at risk of predation or extinction from within the City due to a variety of environmental and external factors. These populations are in need of conservation and monitoring, thus are classed as Locally Significant species within the City of Joondalup.

Schedules under the State Wildlife Conservation Act 1950 (WC Act)

Schedule	Code	Conservation Status	Description
Schedule 1 Fauna and flora that are extant and considered likely to become extinct or rare as critically endangered species and therefore are in need of special protection.	S1 (CR)	Threatened Flora	Declared Rare Flora that is rare or likely to become extinct – Critically Endangered
		Threatened Fauna	Fauna that is rare or likely to become extinct – Critically Endangered
Schedule 2 Fauna and flora that are extant and considered likely to become extinct or rare as endangered species and therefore in need of special protection.	S3 (VU)	Threatened Flora	Declared Rare Flora that is rare or likely to become extinct – Vulnerable
		Threatened Fauna	Fauna that is rare or likely to become extinct – Vulnerable
Schedule 3 Fauna and flora that are extant and considered likely to become extinct or rare as vulnerable species and therefore in need of special protection.	S3 (VU)	Threatened Flora	Declared Rare Flora that is rare or likely to become extinct – Vulnerable
		Threatened Fauna	Fauna that is rare or likely to become extinct – Vulnerable
Schedule 4 Fauna and flora that is presumed to be extinct in the wild and therefore in need of special protection.	S4 (EX)	Presumed Extinct Fauna and Flora	
Schedule 5 Birds that are subject to international agreements relating to the protection of migratory birds, are declared to be that is in need of special protection.	S5 (IA)	Migratory	Birds protected under an international agreement
Schedule 6 Fauna that are of special conservation need being species dependent on ongoing conservation intervention, are declared to be fauna that is in need of special protection.	S6 (CD)	Conservation dependent	Ongoing conservation intervention required
Schedule 7 Fauna that is in need of special protection, otherwise than for the reasons mentioned in the above schedules.	S7 (OS)	Other specially protected	Other specially protected fauna

Priority flora and fauna categories used by the Parks and Wildlife (2015)

Schedule	Code	Description
Priority 1	P1	**Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	P2	**Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	P3	**Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	P4	**Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Appendix 5

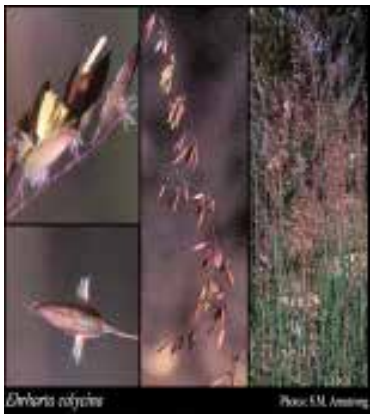
Keighery Scale Definitions

Vegetation Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
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 or shrubs.

(Sourced from Keighery 1994)

Appendix 6

Examples of Priority Weed Species at Shepherds Bush

Name	Common Name	Conservation Code	Image
Ehrharta calycina	Perennial Veldt Grass	High priority (DPaW Environmental Weed Strategy for WA)	 Photos: S.M. Armstrong (WA Herbarium no date)
Emex australis	Doublegee	Declared pest (BAM Act 2007)	 Photo: Department of Agriculture and Food (2016b)
Euphorbia terracina	Geraldton Carnation Weed	High priority (DPaW Swan Region), Priority (City of Joondalup)	 Photos: C.Hortin and K.C Richardson
Hypochaeris glabra	Smooth Cats ear	High priority (DPaW Swan Region), Priority (CoJ)	 Photos: C.Hortin and K.C Richardson

Name	Common Name	Conservation Code	Image
Lupinus cosentinii	Blue Lupin	High priority (DPaW Swan Region), Priority (City of Joondalup)	 Photos: J. Dodd and J.F. Smith (WA Herbarium no date)
Moraea flaccida	One-leaf Cape Tulip	Declared pest (BAM Act), High priority (DPaW Swan Region), Priority (City of Joondalup)	 Photos: R. Knox and K.C. Richardson (WA Herbarium no date)
Pelargonium capitatum	Rose Pelargonium	High priority (DPaW Swan Region), Priority (City of Joondalup)	 Photos: S.M Armstrong and K.C. Richardson (WA Herbarium no date)
Tribulus terrestris	Caltrop	City of Joondalup *Pest Plant Local Law (2012)*	 Photos: S.M. Armstrong, J. Dodd and R. Knox

Appendix 7

Shepherds Bush High Priority Weed Species Management

Name	Common Name	Type of Weed	Status/Notes	Treatment Type	Optimal Treatment Timing (WA Herbarium)
Acacia iteaphylla	Flinders Ranges Wattle	Trees and shrubs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, cut and paint stem	December to May
Arctotheca calendula	Capeweed	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate	June to November
Avena barbata	Bearded Oat	Grasses	High priority (DPaW Swan Region), Priority (City of Joondalup)	Quizalofop	July to October
Brassica tournefortii	Meditteranean Tulip	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Hand weeding	August to September
Bromus diandrus	Great Brome	Grasses	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, Quizalofop	June to August
Carpobrotus edulis	Hottentot Fig	Herbs	High priority (DPaW Swan Region)	Hand weeding	All year
Cynodon dactylon	Couch	Grasses	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, Quizalofop	November to February
Ehrharta calycina	Perennial Veldt Grass	Grasses	High priority (DPaW Swan Region), Priority (City of Joondalup)	Quizalofop	June to August
Emex australis	Doublegee	Herbs	Declared pest (BAM Act 2007)	Glyphosate	May to August
Euphorbia peplus	Petty Spurge	Herbs	Priority (City of Joondalup)	Glyphosate, Metsulfuron	May to November
Euphorbia terracina	Geraldton Carnation Weed	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Triasulfuron, Hand weeding	June to August spray, June to November hand weeding
Ferraria crispa	Black Flag	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Hand weeding, Glyphosate, Metsulfuron	August - September
Freesia alba x leichtlinii	Freesia	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Metsulfuron	July to August
Gazania linearis	Gazania	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, Hand weeding	June to December spray. All year hand weeding
Gladiolus caryophyllaceus	Wild Gladiolus	Herbs	High priority (DPaW Swan Region),	Hand weeding, hand wipe with Metsulfuron	July to September

Name	Common Name	Type of Weed	Status/Notes	Treatment Type	Optimal Treatment Timing (WA Herbarium)
Hordeum leporinum	Barley Grass	Grasses	High priority (DPaW Swan Region)	Hand weeding, Quizalofop	May to August
Hypochaeris glabra	Smooth Cats Ear	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, Hand weeding	May to October
Hypochaeris radicata	Flat Weed	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate	June to September
Lachenalia reflexa	Cape Cowslip	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Metsulfuron	June to August
Lagurus ovatus	Hare's Tail Grass	Grasses	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate	June to August
Lupinus cosentinii	Blue Lupin	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Hand weeding	June to September
Moraea flaccida	One-leaf Cape Tulip	Herbs	Declared pest (BAM Act), High priority (DPaW Swan Region), Priority (City of Joondalup)	Metsulfuron	July to August
Olea europea	Olive	Trees and Shrubs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Hand weeding, Glyphosate	October to June
Oxalis pes-caprae	Soursob	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, Metsulfuron	June to July
Pelargonium capitatum	Rose Pelargonium	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, Metsulfuron, Hand weeding	June to October
Sparaxis bulbifera		Herbs	High priority (DPaW Swan Region),	Metsulfuron	September
Tribulus terrestris	Caltrop	Herbs	Pest Plant (City of Joondalup)	Glyphosate, Hand weeding	January to December
Vulpia myuros	Rat's tail fescue	Grasses	High priority (DPaW Swan Region), Priority (City of Joondalup)	Hand weeding	July-September
Watsonia meriana var. bulbillifera	Watsonia	Herbs	High priority (DPaW Swan Region), Priority (City of Joondalup)	Glyphosate, Metsulfuron	September

Note: The Shepherds Bush High Priority Weed Species Management table was created using the following criteria:

- Weed species listed as a Weed of National Significance (WONS) in 1999 and 2012 by the Australian Government;
- The weed species is listed as a Declared Plant according to the *Biosecurity and Agriculture Management Act 2007;*
- The weed species is listed as High Priority in regards to its ecological impact according to the DPaW Draft Weed Prioritisation Process for the Swan Region (2013);
- The weed species is listed as a Pest Plant under the City's *Pest Plant Local Law 2012*;
- The City of Joondalup has determined that the weed species poses: a major threat to vegetation and the structure of vegetation communities or is likely to contribute to a high fuel load (e.g. grasses). These species are classed as High Priority weeds in the City of Joondalup.

Appendix 8

Shepherds Bush Fauna Species List

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Mammals											
Canidae	**Canis lupus*	Dog						+	+	+	
	**Vulpes vulpes*	European Red Fox			•				+	+	+
Dasyuridae	*Dasyurus geoffroii*	Chuditch	VU	VU							
Felidae	**Felis catus*	Cat			•				+	+	
Leporidae	**Oryctolagus cuniculus*	Rabbit			•			+	+	+	+
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo					+	+	+	+	+
	Macropus irma	Western Brush Wallaby		P4		•					
Molossidae	*Autonomous australis*	White-striped Free-tailed Bat								+	
Muridae	*Hydromys chrysogaster*	Water-rat		P4		•					
	**Mus musculus*	House Mouse							+	+	+
	Rattus fuscipes	Moodit or Southern Bush-Rat									
	**Rattus rattus*	Black Rat				•					
	**Rattus* sp.								+		
Peramelidae	*Isoodon obesulus* subsp. *fusciventer*	Quenda		P4		•					
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat				•	+			+	+
Birds											
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill				•					
	Acanthiza inornata	Western Thornbill				•					
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill				•					

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
	Gerygone fusca	Western Gerygone				•	+				+
	Sericornis frontalis	White-browed Scrub Wren				•					
	Smicrornis brevirostris	Weebill				•	+				+
Accipitridae	*Accipiter fasciatus*	Brown Goshawk				•	+				+
	Accipiter cirrocephalus	Collared Sparrowhawk				•					
	Aquila audax	Wedge-tailed Eagle									
	Circus approximans	Swamp Harrier				•					
	Elanus axillaris	Black-shouldered Kite									
	Haliaeetus leucogaster	White-bellied Sea Eagle	M		•						
	Haliastur sphenurus	Whistling Kite				•					+
Acrocephalidae	*Acrocephalus australis*	Australian Reed Warbler				•					
Aegothelidae	*Aegotheles cristatus*	Australian Owlet Nightjar									
	Anas gracilis	Grey Teal				•					
	Anas platyrhynchos	Mallard			•	•					
	Anas rhynchotis	Australasian Shoveler				•					
	Aythya australis	Hardhead				•					
	Anas superciliosa	Pacific Black Duck				•					+
	Biziura lobata	Musk Duck				•					
	Chenonetta jubata	Australian Wood Duck				•					
	Cygnus atratus	Black Swan				•					
	Malacorhynchus membranaceus	Pink-eared Duck				•					
	Oxyura australis	Blue-billed Duck				•					
	Stictonetta naevosa	Freckled Duck				•					
	Tadorna tadornoides	Australian Shelduck				•					

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Apodidae	*Apus pacificus*	Fork-tailed Swift	M	IA	•						
Ardeidae	*Ardea alba* subsp. *modesta*	Eastern Great Egret	M	IA							
	Ardea ibis	Cattle Egret	M	IA	•	•					
	Ardea ibis subsp. *coromanda*	Eastern Cattle Egret	M	IA		•					
	Ardea modesta	Great Egret	M	IA	•						
	Ardea pacifica	White-necked Heron				•					
	Nycticorax caledonicus	Nankeen Night Heron				•					
Artamidae	*Cracticus torquatus*	Grey Butcherbird				•	+		+	+	+
	Gymnorhina tibicen	Australian Magpie				•	+	+	+	+	+
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew				•					
Cacatuidae	*Calyptorhynchus baudinii*	Baudin's Cockatoo	VU	VU							
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	EN	EN	•	•	+			+	+
	Calyptorhynchus banksii subsp. *naso*	Forest Red-tailed Black Cockatoo	VU	VU							
	Cacatua galerita	Sulphur-crested Cockatoo				•					
	Cacatua pastinator	Western Long-billed Corella				•					
	Cacatua tenuirostris	Eastern Long-billed Corella				•					
	Cacatua sanguinea	Little Corella				•	+			+	+
	Eolophus roseicapillus	Galah					+		+	+	+
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike				•	+			+	+
	Lalage tricolor	White-winged Triller				•					
	Vanellus tricolor	Banded Lapwing				•					
Columbidae	**Columba livia*	Domestic Pigeon			•	•	+		+		
	Ocyphaps lophotes	Crested Pigeon				•					
	**Streptopelia chinensis*	Spotted Turtle-Dove			•	•	+			+	+

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
	**Streptopelia senegalensis*	Laughing Turtle-Dove			•	•	+		+	+	+
Columbidae	*Phaps chalcoptera*	Common Bronzewing							+		
Corvidae	*Corvus bennetti*	Little Crow				•					
	Corvus coronoides	Australian Raven				•	+	+	+	+	+
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo				•					
Dicruridae	*Grallina cyanoleuca*	Magpie-lark				•			+		
Estrildidae	*Lonchura castaneothorax*	Chestnut-breasted Mannikin				•					
Falconidae	*Falco berigora*	Brown Falcon								+	
	Falco cenchroides	Nankeen Kestrel				•			+		
	Falco longipennis	Australian Hobby				•					+
	Falco peregrinus	Peregrine Falcon								+	
Fringillidae	**Carduelis carduelis*	European Goldfinch			•	•					
Halcyonidae	**Dacelo novaeguineae*	Laughing Kookaburra				•	+			+	+
	Todiramphus sanctus	Sacred Kingfisher				•					
Hirundinidae	*Hirundo neoxena*	Welcome Swallow				•				+	
	Petrochelidon nigricans	Tree Martin								+	
Locustellidae	*Megalurus gramineus*	Little Grassbird				•					
Maluridae	*Malurus splendens*	Splendid Fairy Wren				•			+	+	
	Malurus lamberti	Variegated Fairy Wren				•					
Megapodiidae	*Leipoa ocellata*	Malleefowl	VU	VU	•						
Meliphagidae	*Anthochaera lunulata*	Western Wattlebird				•					+
	Anthochaera carunculata	Red Wattlebird				•	+	+	+	+	+
	Acanthorhynchus superciliosus	Western Spinebill				•					
	Epthianura albifrons	White-fronted Chat				•					

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
	Lichenostomus virescens	Singing Honeyeater				•	+			+	+
	Lichmera indistincta	Brown Honeyeater				•	+			+	+
	Manorina flavigula	Yellow-throated Miner				•	+	+			
	Phylidonyris novaehollandiae	New Holland Honeyeater				•			+	+	
Meropidae	*Merops ornatus*	Rainbow Bee-eater	M	IA	•	•	+			+	+
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella				•					
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler					+			+	
Pardalotidae	*Pardalotus striatus*	Striated Pardalote				•	+				+
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill								+	
	Acanthiza inornata	Western Thornbill								+	
	Gerygone fusca	Western Gerygone					+			+	
	Pardalotus striatus	Striated Pardalote					+			+	
	Smicrornis brevirostris	Weebill					+			+	
Passeridae	**Passer domesticus*	House Sparrow			•						
	**Passer montanus*	Eurasian Tree Sparrow			•						
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican				•					
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant				•					
	Phalacrocorax sulcirostris	Little Black Cormorant				•					
	Phalacrocorax varius	Australian Pied Cormorant				•					
Podargidae	*Podargus strigoides*	Tawny Frogmouth				•	+				
Podicipedidae	*Podiceps cristatus*	Great Crested Grebe				•					
	Tachybaptus novaehollandiae	Australasian Grebe				•					
	Poliocephalus poliocephalus	Hoary-headed Grebe				•					
Psittacidae	*Barnardius zonarius*	Australian ringneck								+	+

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
	Platycercus icterotis	Western Rosella				•					
	Platycercus zonarius	Twenty-eight Parrot					+	+			+
	Polytelis swainsonii	Superb Parrot								+	
	**Trichoglossus haematodus*	Rainbow Lorikeet				•	+	+		+	+
	Purpureicephalus spurius	Red-capped Parrot									+
Rallidae	*Fulica atra*	Eurasian Coot				•					
	Gallirallus philippensis	Buff-banded Rail				•					
	Gallinula tenebrosa	Dusky Moorhen				•					
	Porphyrio porphyrio	Purple Swamphen				•					
	Porzana tabuensis	Spotless Crake				•					
Recurvirostridae	*Cladorhynchus leucocephalus*	Banded Stilt				•					
	Himantopus himantopus	Black-winged Stilt				•					
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail				•			+	+	
	Rhipidura albiscapa	Grey Fantail									+
Rostratulidae	*Rostratula australis*	Painted Snipe	M	EN	•						
	Rostratula benghalensis australis	Australian Painted Snipe	M	EN	•						
	Tringa nebularia	Common Greenshank	M	IA		•					
Strigidae	*Ninox novaeseelandiae*	Southern Boobook Owl									+
Sturnidae	**Acridotheres tristis*	Common Myna, Indian Myna			•						
	**Sturnus vulgaris*	Common Starling			•						
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill				•					
	Platalea regia	Royal Spoonbill				•					
	Plegadis falcinellus	Glossy Ibis	M	IA		•					
	Threskiornis molucca	Australian White Ibis				•	+				

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	Threskiornis spinicollis	Straw-necked Ibis				•					
Turnicidae	*Turnix velox*	Little Buttonquail									+
Zosteropidae	*Zosterops lateralis*	Silvereye				•	+			+	
Reptiles											
Agamidae	*Pogona minor subsp. minor*	Western Bearded Dragon				•				+	
Chelidae	*Chelodina oblonga*	Oblong Turtle				•					
Elapidae	*Brachyurophis semifasciatus*	Southern Shovel-nosed Snake				•				+	
	Neelaps bimaculatus	Black-naped Snake				•					
	Neelaps calonotus	Black-striped Snake		P3		•					
	Notechis scutatus	Western Tiger Snake				•					
	Parasuta gouldii	Black-headed Snake				•					
	Pseudechis australis	Mulga Snake				•					
	Pseudonaja affinis subsp. *affinis*	Dugite				•			+	+	
	Simoselaps bertholdi	Jan's Banded Snake				•				+	
Gekkonidae	*Christinus marmoratus*	Marbled Gecko				•				+	+
	Diplodactylus polyophthalmus	Speckled Stone Gecko				•				+	
Pygopodidae	*Aprasia repens*	Sand-Plain Worm-Lizard				•				+	+
	Lialis burtonis	Burtons Legless Lizard				•	+			+	
Boidae	*Morelia spilota* subsp. *imbricata*	South-west Carpet Python				•					
Scincidae	*Acritoscincus trilineatum*	South-western Cool Skink				•					
	Cryptoblepharus buchananii	Snake-eyed Skink; Fence Skink				•	+			+	+
	Ctenotus australis	Western Limestone Ctenotus				•				+	
	Ctenotus fallens	West-coast Striped Skink				•	+				+
	Cyclodomorphus celatus	Western Slender Bluetongue								+	

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	Hemiergis quadrilineata	Two-toed Earless Skink				•	+			+	+
	Lerista elegans	Elegant Burrowing Skink				•				+	
	Lerista lineopunctulata	West Coast Line-spotted Lerista				•					
	Lerista praepedita	Worm Lerista				•				+	
	Menetia greyii	Common Dwarf Skink				•	+			+	+
	Morethia obscura	Shrubland Morethia Skink				•	+			+	+
	Tiliqua occipitalis	Western Bluetongue				•					
	Tiliqua rugosa subsp. *rugosa*	Bobtail					+	+	+	+	+
Typhlopidae	*Ramphotyphlops australis*	Southern Blind Snake				•				+	
Varanidae	*Varanus gouldii*	Gould's Sand Goanna				•			+	+	
	Varanus tristis	Black-tailed Tree Goanna				•			+		
Amphibians											
Hylidae	*Litoria adelaidensis*	Slender Tree Frog				•					
	Litoria moorei	Motorbike Frog				•					
Myobatrachidae	*Crinia insignifera*	Squelching Froglet				•					
	Crinia glauerti	Clicking Frog				•					
	Heleioporus eyrei	Moaning Frog				•					
	Limnodynastes dorsalis	Western Banjo Frog				•				+	
	Myobatrachus gouldii	Turtle Frog				•				+	+
Invertebrates											
(Acari)	Tick sp. 1	Kangaroo Tick					+				
	Tick sp. 2						+				
Acrididae	*Goniaea australasiae*	Gumleaf Grasshopper								+	+
(Araneae)	Spider sp. 1	Wolf Spider					+				

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
	Spider sp. 2	Wolf Spider					+				
	Spider sp. 3	Jumping Spider					+				
	Spider sp. 4	Christmas Tree Spider					+				
	Spider sp. 5	Orb Weaver					+				
Armadillidiidae	*Buddelundia TBC* sp. *TBC*	White-dashed Rolling Slater								+	
Blattidae	*Helea lata scavenger*	Beaten Bronze Paleleg Cockroach								+	
(Blattodea)	Cockroach sp. 1						+				
	Cockroach sp. 2						+				
	Cockroach sp. 3						+				
Bothriembryontidae	*Bothriembryon* sp. TBC	Snail								+	
Buthidae	*Lychas marmorata*	Marbled Scorpion								+	
Castniidae	*Synemon gratiosa*	Graceful Sun-Moth		P4		•				+	+
Cicadidae	*Pyropsalta melete*	Red Bandit									
(Coleoptera)	Beetle sp. 1	Stag Beetle					+				
	Beetle sp. 2	Weevil					+				
	Beetle sp. 3						+				
(Coleoptera)	Beetle sp. 4	Scarab					+				
	Beetle sp. 5	Borer					+				
Coreidae	*Mictis profana*	Crusader Bug								+	
(Dermaptera)		Earwig					+				
(Diptera)	Fly sp. 1	House Fly					+				
	Fly sp. 2	Bluebottle					+				
	Fly sp. 3	Flesh Fly					+				
Family TBC	Gen. sp. TBC	Centipede								+	

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Formicidae	*Camponotus terebrans*	Ant								+	
	Iridomyrmex sp.	Meat Ant								+	
Gryllacrididae	*Gen. nov. TBC sp. TBC*	Cricket								+	
	Paragryllacris TBC sp.	Cricket								+	
Helicidae	*Theba pisana*	Variable White Mediterranean snail								+	
(Hymenoptera)	Ant sp. 1						+				
	Ant sp. 2						+				
	Ant sp. 3						+				
	**Apis mellifera*	European Honey Bee					+	+		+	+
	Bee native sp.						+			+	
Ixodidae	*Amblyomma triguttatum*	Kangaroo Tick								+	
Julidae	**Ommatoiulus moreletii*	Portuguese Millipede					+				
(Julida)	-	Millipede					+				
(Lithobiomorpha)	Centipede sp. 2						+				
Lycaenidae	*Hypochrysops halyaetus*	Western Jewel Butterfly								+	+
Lycosidae	*'Lycosa' australicola*	Black-chevroned Spider								+	
	Tasmanicosa leuckartii	Lycosid Spider								+	
(Mantodea)	-	Praying Mantis					+				
Myrmeleontidae	Gen. sp. TBC	Larval Myrmlacewing								+	
Nephilidae	*Nephila edulis*	Southern Golden Orb spider								+	
	Nephila sp.	Golden Orb Weaver								+	
(Orthoptera)	Cricket sp. 1						+				
	Grasshopper sp. 1						+				
	Grasshopper sp. 2						+				
	Mole Cricket						+				

Family	Scientific Name	Common Name	Conservation status		Database searches		Shepherds Bush surveys			Other City of Joondalup natural areas	
			Conservation status	Database searches	Shepherds Bush surveys	Other City of Joondalup natural areas	ELA 2015	City of Joondalup NAIA Assessments (2004 and 2014)	Murdoch University (1989)	Hepburn Heights (City of Joondalup 2015)	WOS (ELA 2013)
Otostigmidae	*Ethmostigmus* sp. TBC	Centipede								+	
Paradoxosommatidae	*Antichiropus* sp. nov	Millipede								+	
Pentatomidae	*Poecilometis apicalis*	Bug								+	
Phasmatidae	*Arphax australis (imm.)*	Australian Arphax Stick-Insect								+	
	Gen. sp. TBC	Large Grey Stick-insect								+	
Pholcidae	*Pholcus phalangioides*	Cellar Spider								+	
(Polydesmida)	*Antichiropus* sp.	Millipede					+				
Porcellionidae?	*Porcellio scaber*	Slater/woodlice								+	
Scarabaeidae	*Colpochila* sp. TBC	Scarab Beetle								+	
	Gen. sp. TBC	Scarab Beetle								+	
	Gen. sp. TBC	Pygmy Brown Scarabeetle								+	
Scolopendrinae?	Gen. sp. unknown	Centipede								+	
(Scolopendromorpha)	Centipede sp. 1						+				
(Scorpiones)	Scorpion sp. 1	Marbled Scorpion					+				
Sparassidae	*Eodelena lapidicola*	Southern Blackfront Spider								+	
Tenebrionidae	*Helea perforatus*	Beetle								+	
Tettigoniidae	*Caedicia* sp. TBC	Katydid Grasshopper								+	
	Metaballus sp. TBC (imm.)	Katydid Grasshopper								+	
	Requena verticalis	Katydid Grasshopper								+	
Theridiidae	*Latrodectus hasselti*	Redback Spider								+	
(Thysanura)	Silverfish sp. 1						+				
Urodacidae	*Urodacus novaehollandiae*	Sand Scorpion								+	

+ = recorded during survey.

• = listed within database search for respective survey but not recorded during that survey.

* = introduced species.

EN = listed as Endangered under the EPBC Act, WC Act and/or the IUCN red list.

VU = listed as Vulnerable under the EPBC Act, WC Act and/or the IUCN red list.

LC = Least Concern under the IUCN red list.

M = listed as Migratory species under the EPBC Act.

IA = listed as Migratory under the WC Act.

P1 = Priority 1: poorly known species occurring on threatened land (land not managed for conservation)

P2 = Priority 2: poorly known species occurring on some conservation lands

P3 = Priority 3: known from few specimens or records and need urgent survey and evaluation of conservation status.

P4 = Priority 4: not currently threatened but could if present circumstances change. Usually found on conservation lands.

Carnaby's Black-Cockatoo (Calyptorhynchus latirostris)

Semaphore Sedge *(Mesomelaena pseudostygia)*

Appendix 9

Shepherds Bush Key Fauna Species

Conservation Significant Fauna at Shepherds Bush

Name	Common Name	Conservation Code	Image
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Schedule 2 (Wildlife Conservation Act), Endangered (IUCN, DPaW and EPBC)	 Photo: Gary Tate, Yellagonga Regional Park, 2012
Merops ornatus	Rainbow Bee-eater	Schedule 5 (Wildlife Conservation Act), Migratory (EPBC)	 Photo: BirdLife Australia, no date
Ninox novaeseelandiae	Southern Boobook Owl	Locally Significant – City of Joondalup	 Photo: Simon Cherriman, Shepherds Bush, 2015
Macropus fuliginosus	Western Grey Kangaroo	Locally Significant – City of Joondalup	 Photo: Gary Tate, Yellagonga Regional Park, 2016

Note: For further explanations on Conservation Codes, refer to Appendix 4.

Appendix 10

Shepherds Bush Introduced Fauna Species

Name	Common Name	Image
Apis mellifera	European Honey Bee	 Photo: Encyclopedia of Life (no date)
Dacelo novaeguineae	Laughing Kookaburra	 Photo: Chris Kershaw, Shepherds Bush, 2016
Felis catus	Feral Cat	 Photo: Gary Tate, Yellagonga Regional Park, 2016
Mus musculus	House Mouse	 Photo: Roar Solheim (IUCN 2012)

Name	Common Name	Image
Ommatoiulus moreleti	Portuguese Millipede	 Photo: Robert Mesibov (Australian Government no date)
Trichoglossus haematodus	Rainbow Lorikeet	 Photo: Chris Kershaw, Shepherds Bush, 2016
Vulpes vulpes	European Red Fox	 Photo: Centre for Fortean Zoology Australia (2010)

Appendix 11

Shepherds Bush Fungi Species List - Likely to Occur

Family	Species name	Previous surveys		
		WOS (PUBF 2005)	WOS (ELA 2012)	Hepburn Heights (Syrinx 2013)
Agaricaceae	*Lepiota* sp.	+		
Agaricaceae	*Agaricus* sp.			+
Agaricales (Order)	*Omphalina ericetorum*	+		
Amanitaceae	*Amanita* sp.	+		
Auriculariaceae	*Exidia* sp.	+		
Basidiomycetes	*Pycnoporus coccineus*		+	
Basidiomycetes	*Scleroderma cepa*		+	
Cortinariaceae	*Cortinarius* sp.	+		
Cortinariaceae	*Dermocybe clelandii*	+		
Crepidotaceae	*Crepidotus* sp.	+		
Dacrymycetaceae	*Calocera guepinioides*	+		
Diaporthales (Order)	*Harknessia uromycoidesjh*	+		+
Entolomataceae	*Entoloma* sp.	+		
Fomitopsidaceae	*Postia sp.*	+		
Gomphaceae	*Ramaria* sp.	+		
Helotiaceae	*Bisporella* sp.	+		
Hydnangiaceae	*Laccaria lateritia*			+
Hydnangiaceae	*Laccaria* sp.	+		
Hymenochaetaceae	*Coltricia cinnamomea*	+		
Hymenogastraceae	*Galerina* sp.	+		
Inocybaceae	*Inocybe* sp.	+		
Marasmiaceae	*Marasmius* sp.	+		
Marasmiaceae	*Omphalotus nidiformis*	+		
Marasmiaceae	*Rhodocollybia* sp.	+		
Meruliaceae	*Bjerkandera adusta*	+		
Mycenaceae	*Mycena* sp.	+		
Myxogastria (Class)	*Myxomycete* sp.	+		
Peniophoraceae	*Peniophora* sp.	+		
Pezizaceae	*Peziza* sp.			+
Pezizaceae	*Plicaria* sp.			+
Phallaceae	*Colus pusillus*	+		
Phanerochaetaceae	*Byssomerulius corium*	+		
Physaridae	*Physarum viride*	+		

Family	Species name	Previous surveys		
		WOS (PUBF 2005)	WOS (ELA 2012)	Hepburn Heights (Syrinx 2013)
Pluteaceae	*Volvariella speciosa*	+		
Polyporaceae	*Poria sp.*	+		
Polyporaceae	*Pycnoporus coccineus*			+
Psathyrellaceae	*Psathyrella* sp.			+
Sarcosomataceae	*Plectania* sp.	+		
Schizophyllaceae	*Schizophyllum commune*	+		
Schizoporaceae	*Schizopora* sp.	+		
Sclerodermataceae	*Pisolithus* sp.	+		+
Sclerodermataceae	*Scleroderma cepa*	+		
Sclerodermataceae	*Scleroderma* sp.			+
Stereaceae	*Aleurodiscus* sp.	+		
Stereaceae	*Stereum* sp.	+		
Strophariaceae	*Gymnopilus allantopus*	+		+
Strophariaceae	*Gymnopilus* sp.	+		
Strophariaceae	*Pholiota communis*	+	+	
Tremellaceae	*Tremella mesenterica* group			+
Tricholomataceae	*Clitocybe semiocculta*	+		
Tricholomataceae	*Clitocybe* sp.	+		+
Tricholomataceae	Fayodia sp.	+		
Tricholomataceae	*Resupinatus cinerascens*	+		
Tubariaceae	*Tubaria* sp.	+		
Unknown	Unknown 1 (Whitish Skin Fungus)			+
Unknown	Unknown 2 (Little brown mushroom)			+
Unknown	Unknown 3 *(Agaric)*	+		
Unknown	Unknown 4 *(Ascomycete)*	+		
Unknown	Unknown 5 *(Resupinate)*	+		

Grey Scaevola *(Scaevola canescens)*

Appendix 12

Shepherds Bush Fungi Species - Likely to Occur - Photographs

Name	Common Name	Image
Pholiota communis	Common Pholiota	 Photo: N.L. Bougher (Bougher 2009)
Gymnopilus allantopus	Golden Wood Fungus	 Photo: N.L. Bougher (Bougher 2009)
Harknessia uromycoides	Tuart Nut Fungus	 Photo: N.L. Bougher (Bougher 2009)
Scleroderma cepa	Earthballs	 Photo: Syrinx (2014) olden Wood Fungusnceence

City of Joondalup

T: 08 9400 4000
F: 08 9300 1383
Boas Avenue Joondalup WA 6027
PO Box 21 Joondalup WA 6919

joondalup.wa.gov.au

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