



Shire of Serpentine Jarrahdale

State of the Environment
Condition, Pressure, Response Reports

September 2019

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Appendices

Appendix A: Basic Summary of Records – Contaminated Sites
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Appendix D: Aboriginal Sites of Significance
Appendix E: List of Heritage Places

Abbreviated terms

Acronym	Description
Air NEPM	National Environment Protection (Ambient Air Quality) Measure
AQMS	Air quality monitoring station
ASS	Acid Sulfate Soils
BUWM	Better Urban Water Management
CCW	Conservation Category Wetland
CFC	Chlorofluorocarbons
CO	Carbon monoxide
CO ₂	Carbon dioxide
DBCA	Department of Biodiversity, Conservation and Attractions
DPaW	Department of Parks and Wildlife
DPIRD	Department of Primary Industries and Regional Development
DoT	Department of Transport
DSP	District Structure Plan
DWER	Department of Water and Environmental Regulation
DWMS	Drainage and Nutrient Management Plan
EPA	Environmental Protection Authority
GHG	Greenhouse Gas
GoWA	Government of Western Australia
LPP	Local Planning Policy
LSP	Local Structure Plan
MRS	Metropolitan Region Scheme
NEPM	National Environment Protection Measures
NO ₂	Nitrogen dioxide
O ₃	Ozone
P1	Priority 1
P2	Priority 2
P3	Priority 3

Acronym	Description
Pb	Lead
PDWSA	Public Drinking Water Source Area
PEC	Priority Ecological Community
PM _{2.5}	Particulate matter with an aerodynamic diameter of 2.5 microns or less
PM ₁₀	Particulate matter with an aerodynamic diameter of 10 microns or less
SO ₂	Sulphur dioxide
SOC	Soil organic carbon
SPP	State Planning Policy
TEC	Threatened Ecological Community
TN	Total Nitrogen
TP	Total Phosphorus
TPS2	Town Planning Scheme No.2
VOC	Volatile Organic Compounds

1. Introduction

1.1 Introduction

The Shire of Serpentine Jarrahdale is the fastest growing local government in Western Australia (Australian Bureau of Statistics, 2018). Through the extensive consultation and community consultation process associated with SJ2050, the Shire has embraced a strategic framework that aims to accommodate rapid growth whilst shaping the district in a manner that aligns with community values and aspirations. The Strategic Community Plan 2017-2027 incorporates these values and sets out the objectives and outcomes for the community over time (Figure 1-1).



Figure 1-1 Shire of Serpentine Jarrahdale Strategic Community Plan 2017-2027 - Objectives and outcomes

To ensure that the vision, aspirations and expectations established by SJ2050 are met - and the Shire of tomorrow is achieved in a way that recognises local character and identity - it is important to plan effectively for the future.

The community vision developed by Shire of Serpentine Jarrahdale highlights the importance of protecting the environment in the context of expected growth. The Shire needs to adapt to this growth by:

- Housing the expected increased population
- Encouraging economic and business growth
- Continuing to support local agriculture
- Preserving the rural character
- Achieving sustainable development outcomes

To enable the Shire to adapt to the expected growth, it is producing a State of the Environment report. To support this, six themed condition-pressure-response reports have been produced, aligned with the objectives and outcomes identified in the Strategic Community Plan.

1.2 Purpose of this report

The purpose of this report is to provide the Shire of Serpentine Jarrahdale with six condition-pressure-response reports relating to the key themes of the State of the Environmental Report. This report will be an appendix within an overarching State of the Environment Report, to be prepared by the Shire.

This report has been divided into independent sections, each covering one of six key themes.

- Atmosphere
- Land
- Inland Waters
- Biodiversity
- Human Settlements
- Heritage

Within each section, an overview of the current condition of that theme is provided, along with an outline of the key pressures impacting that particular theme and the suggested responses to manage the pressures.

1.3 Scope and limitations

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

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

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

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

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

GHD has not been involved in the preparation of the overarching State of the Environment Report and has had no contribution to, or review of the State of Environment Report other than in the preparation of the condition-pressure-response reports. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of the State of the Environment Report.

1.4 Assumptions

A representative concentration pathway of 4.5 (meaning it is assumed that global annual greenhouse gas emissions will peak around the year 2040 and begin to decline thereafter) has been assumed using the Climate Futures Tool from Climate Change in Australia (2019). This tool estimates an annual maximum daily temperatures of 0.5 °C to 1.5 °C by the year 2030. It is also estimated under the same assumption that rainfall will decrease by between 5 and 15 percent by the year 2030 (Climate Change in Australia 2019). A hotter, drier climate is assumed across all themes.

A photograph of a bright blue sky filled with numerous small, white, fluffy clouds. The clouds are scattered across the upper half of the frame, with some appearing as soft, rounded shapes and others as more wispy, elongated forms. The sky transitions from a deep blue at the top to a lighter blue at the bottom.

Theme One: Atmosphere

2. Theme One: Atmosphere

Aligning with the approach taken in the Australia State of the Environment 2016, the atmosphere theme is reported under two sub-themes of climate and ambient air quality.

This approach also allows an introduction and overview of climate change, which is a key pressure across the environmental themes captured by this report.

2.1 Overview – Climate

The greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases.

Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone and some artificial chemicals such as chlorofluorocarbons (CFCs). The absorbed energy warms the atmosphere and the surface of the Earth. This process maintains the Earth's temperature at around 33 °C warmer than it would otherwise be, allowing life on Earth to exist (Department of Environment and Energy, 2019).

Human activity, primarily the burning of fossil fuels during the past 250 years, has caused well-quantified increases in the concentrations of greenhouse gases in the atmosphere, resulting in significant increases in positive radiative forcing, which has a warming effect on climate.

2.1.1 Strategic alignment

Contributing to limiting human induced climate change may be defined as falling under several categories in the Shire of Serpentine Jarrahdale Strategic Community Plan, namely People, Place and Prosperity.

People – Limiting human induced climate change will contribute to a healthy community and a safe place to live by reducing the risk of health problems (heat stress) for all community members including the most vulnerable – children and the elderly.

Place – Responding to climate change contributes to the sustainability of the overall environment reducing the risks from drought and flooding and protecting ecosystems.

Prosperity – Promoting sustainability in businesses will help ensure they are sustainable in the long-term, reducing energy costs and limiting the impact of business on the wider environment.

2.2 Condition

Climate change is a global problem, requiring international cooperation to address. This has resulted in the Kyoto Protocol and the Paris Agreement where countries have agreed to limit the increases in global temperature to 2 °C above pre-industrial levels. This is essentially a commitment to reduce greenhouse gas emissions.

CSIRO observations show that global average concentrations of CO₂, methane, nitrous oxide and synthetic greenhouse gases continue to increase (Figure 2-1).

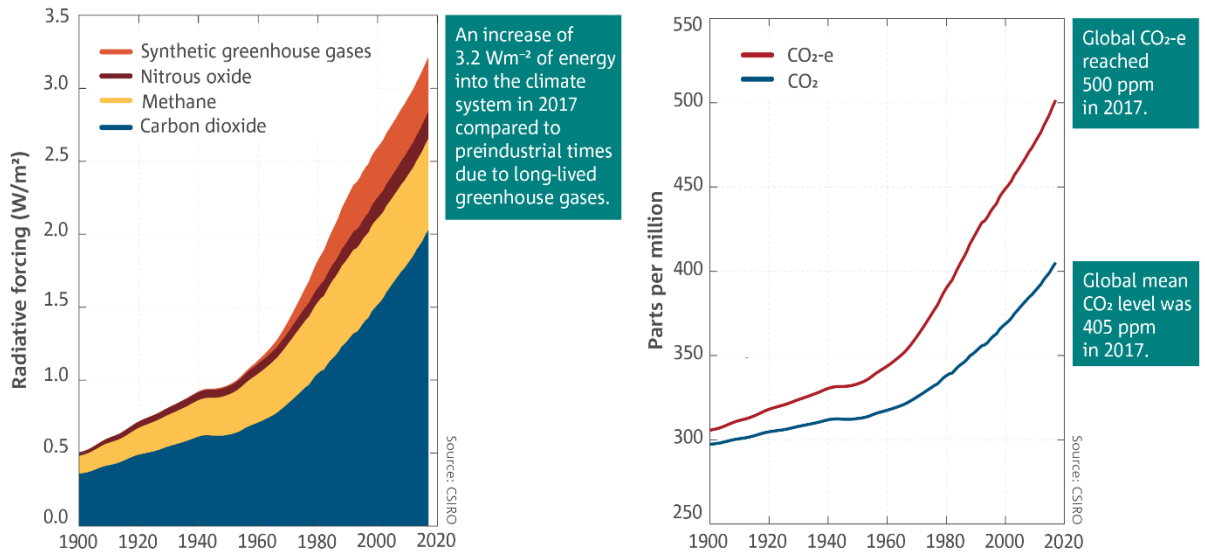


Figure 2-1 Radiative forcing relative to 1750 and Global mean greenhouse gas concentrations (CSIRO)

Australia has always been a land of extremes, experiencing heatwaves, floods, fire, cyclones and drought influenced by large scale drivers in the atmosphere and ocean, such as the El Nino-Southern Oscillation. However, this variability is now occurring against a background trend of increasing mean temperatures because of anthropogenic climate change (or the enhanced greenhouse effect). As the Australian climate continues to warm, droughts and flooding are projected to become more severe (Australia State of the Environment, 2016).

The Climate Futures Tool from Climate Change in Australia (2019) estimates climate change in the Southern and South-Western Flatlands (within which the Shire of Serpentine Jarrahdale is located) using results from several modelling studies. Assuming a representative concentration pathway of 4.5 (meaning it is assumed that global annual greenhouse gas emissions will peak around the year 2040 and begin to decline thereafter) it is estimated that annual maximum daily temperatures will increase by 0.5 °C to 1.5 °C by the year 2030. It is also estimated under the same assumption that rainfall will decrease by between 5 and 15 percent by the year 2030 (Climate Change in Australia 2019).

Observed temperature and rainfall data in the Shire since the early 1960s supports the prediction of a warmer, drier climate (Figure 2-2 and Figure 2-3).

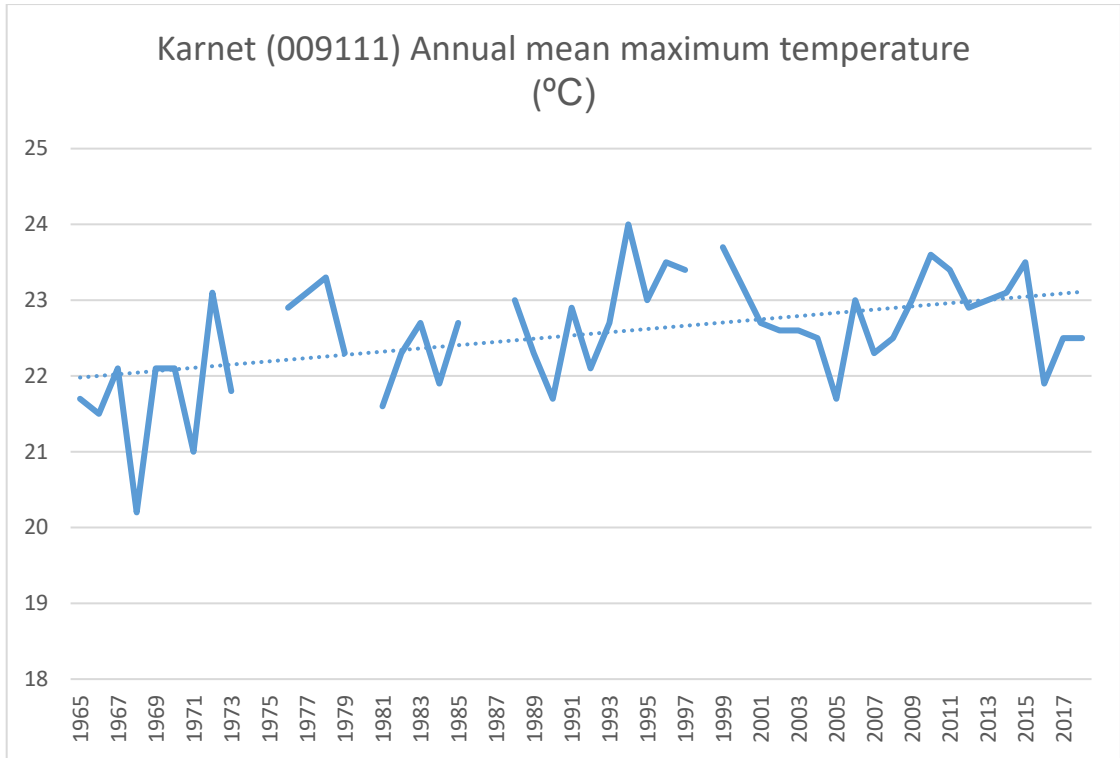


Figure 2-2 Annual mean maximum temperature (°C) (Bureau of Meteorology)

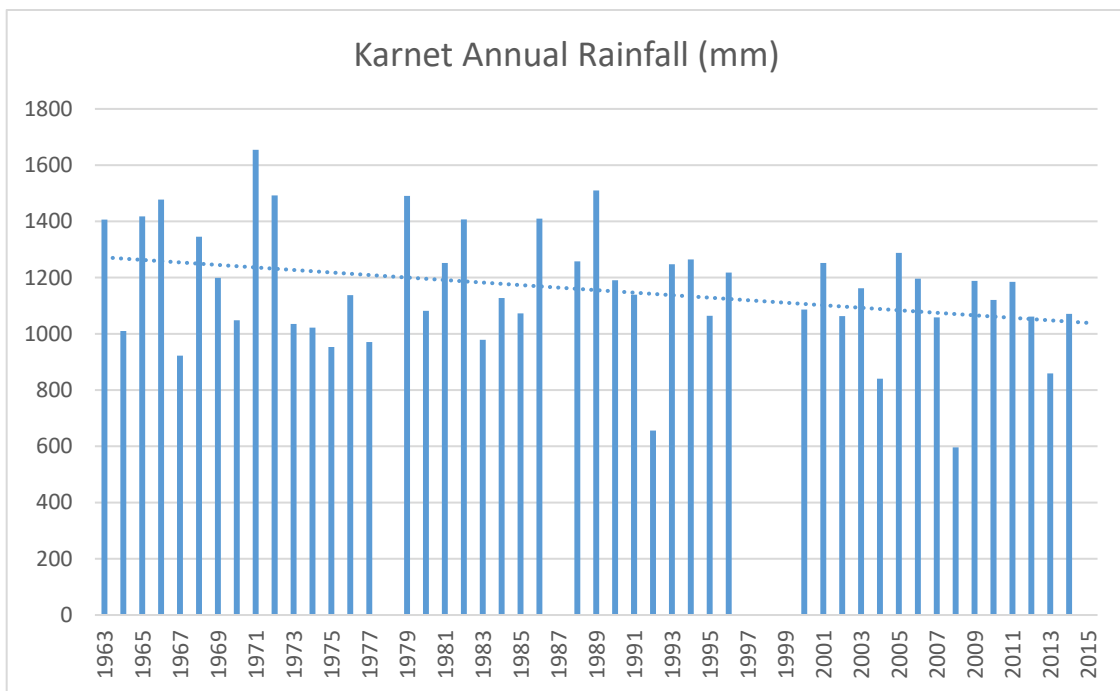


Figure 2-3 Karnet annual rainfall (mm) (Bureau of Meteorology)

2.2.1 Greenhouse gas emissions

The National Greenhouse Gas Inventory shows that overall greenhouse gas emissions from Western Australia are increasing (Figure 2-4).

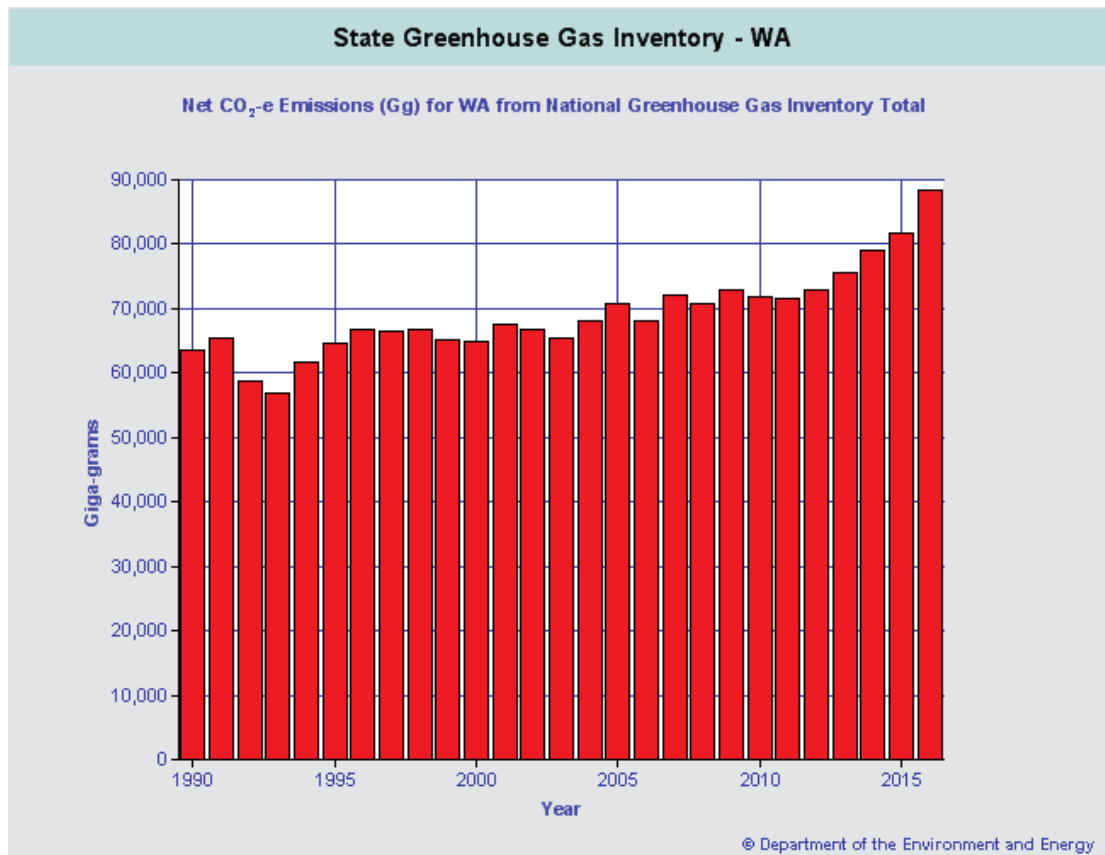


Figure 2-4 Western Australia Greenhouse Gas emissions trend

Emissions from the energy sector – including stationary energy, transport and fugitive processes – are the most significant contributor to overall emissions (Figure 2-5). In the Shire, household energy use and transport are therefore likely to be the highest contributors to greenhouse gas emissions. The Shire as the level of government most connected to the community has an opportunity to influence reductions in energy use within its residential population.

Significant emissions are also generated through waste and agriculture. The Shire has a role in reducing waste production, recycling waste generated and encouraging sustainable agricultural practices.

Overall greenhouse gas emissions across Australia are increasing; however, Australian per capita emissions are decreasing (Figure 2-6). Although reducing, per capita emissions remain high compared to other parts of the world (Figure 2-7). The decrease in per capita emissions is likely to be due to population increase.

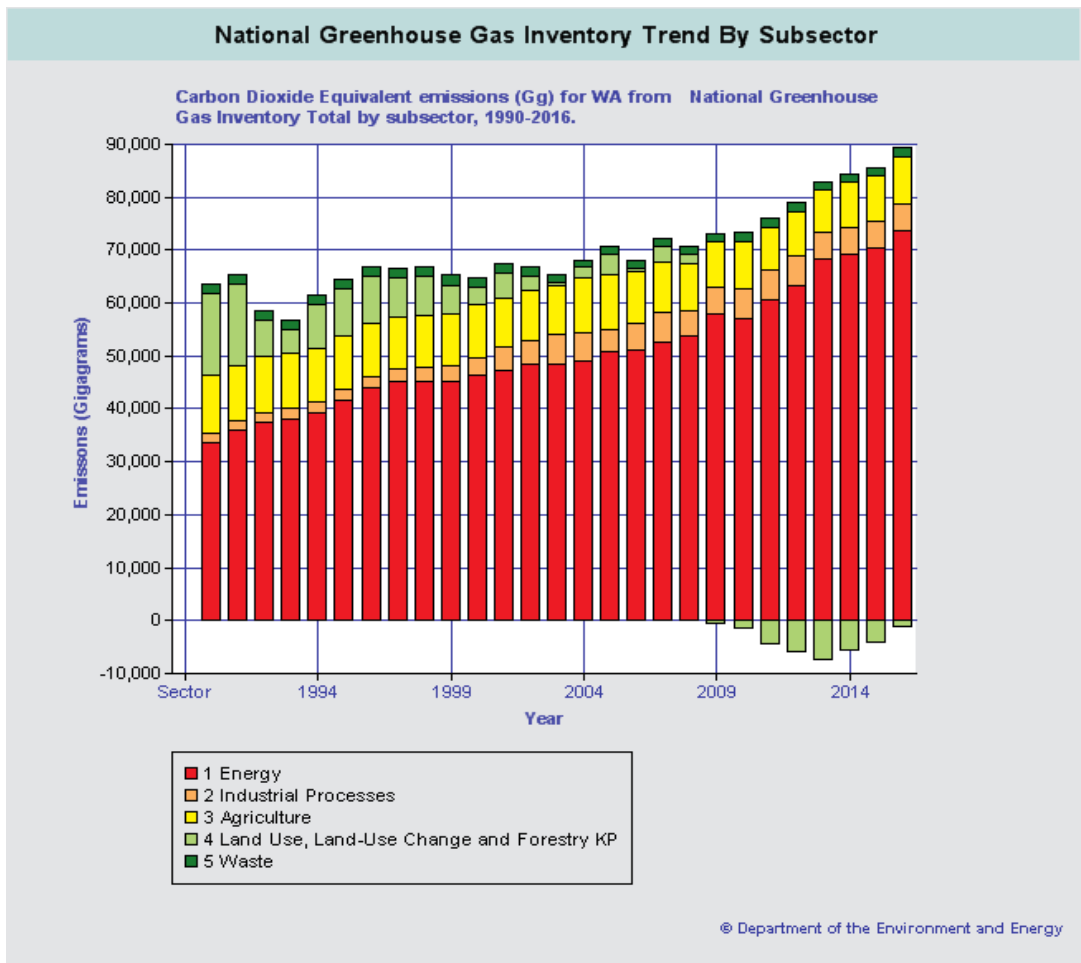


Figure 2-5 Greenhouse gas emission trend by industry (WA)

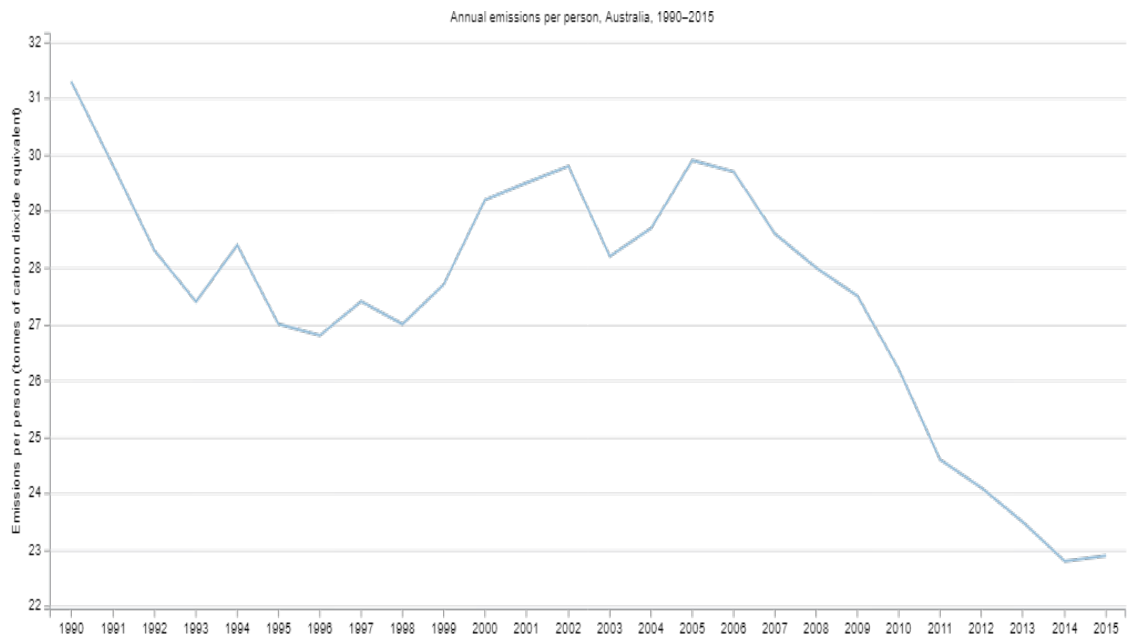


Figure 2-6 Australian per capita greenhouse gas emissions, State of the Environment Report 2016

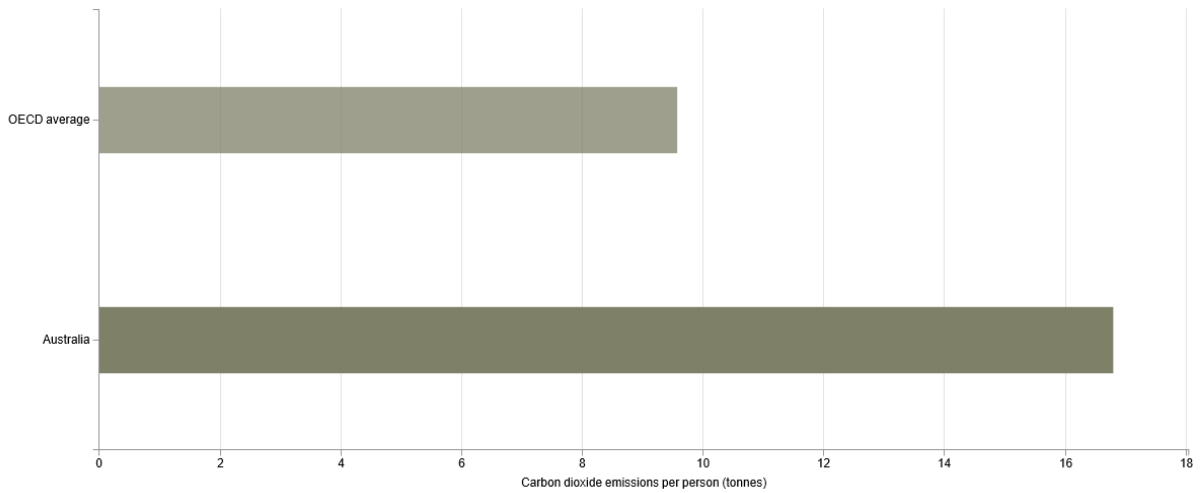


Figure 2-7 Global per capita emissions (State of the Environment 2016)

2.2.2 Shire greenhouse gas emissions

Energy consumption is the Shire’s main direct contribution to greenhouse gas emissions. Greenhouse gas emissions from Shire facilities and infrastructure is reducing over time, with overall emissions reducing by almost 21 percent in 2017-18 compared to 2005-06 (Figure 2-8).

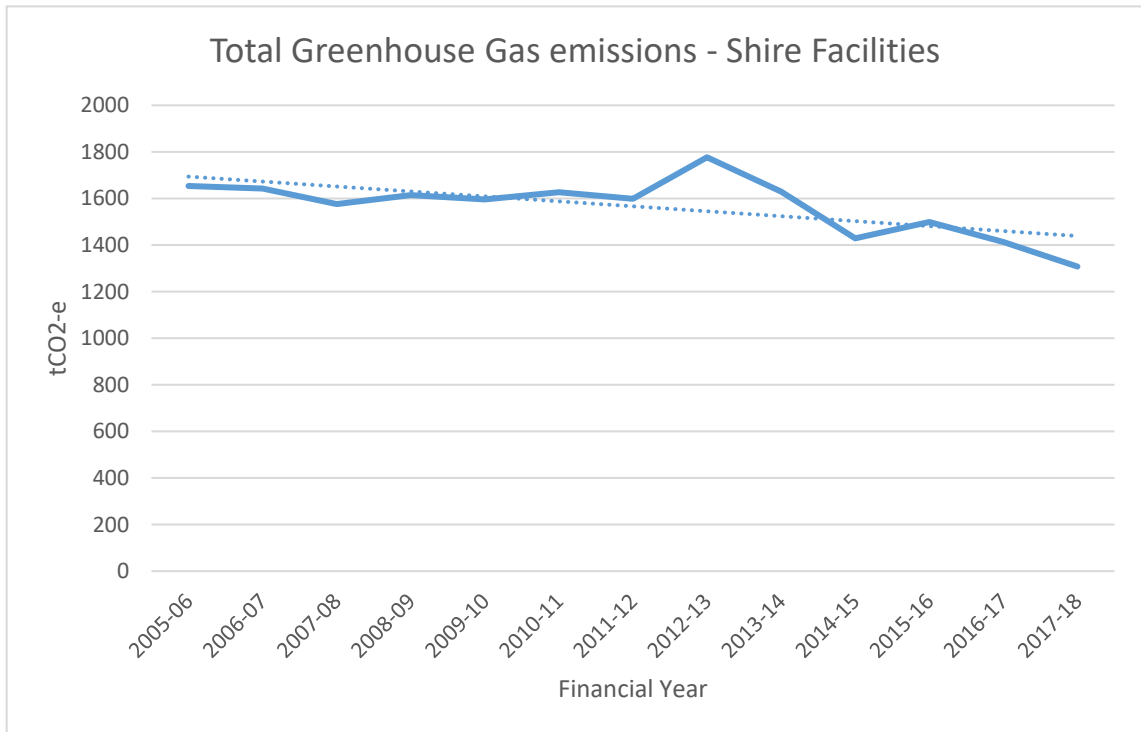


Figure 2-8 Shire greenhouse gas emission trend over time

Street lighting accounts for more than 50 percent of the Shire’s total greenhouse gas emissions (Figure 2-9). Emissions from street lighting peaked in 2012-2013; however, the overall trend for emissions from street lighting is a decrease over time, with emissions in

2017-2018 over 17 percent less than in 2005-2006. Emissions reductions have been achieved through new streetlight installations being CFL or LED rather than metal halide or halogen. Faulty heads are also replaced using CFL or LED.

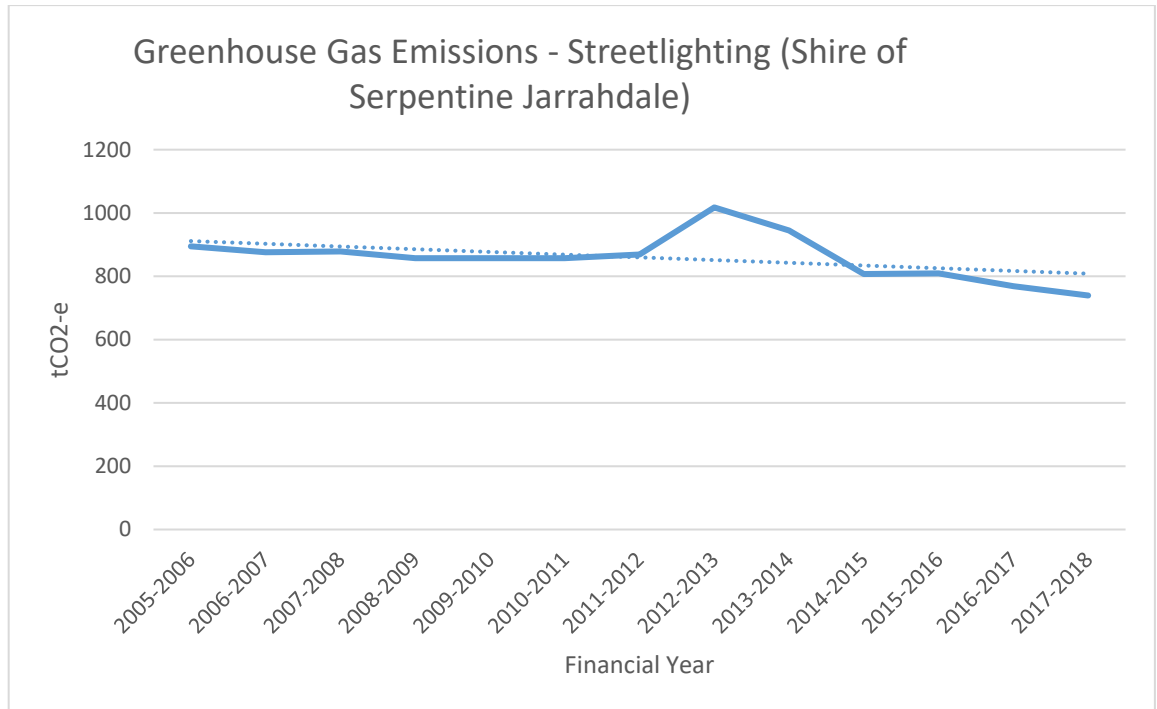


Figure 2-9 Emissions from street lighting in the Shire over time

The Serpentine Jarrahdale Community Recreation Centre (a multipurpose sports facility) is the Shire facility with the highest greenhouse gas emissions, contributing almost 19 percent of total emissions in 2017-2018. The Shire has installed solar panels; however, overall energy use and emissions has changed little since 2005.

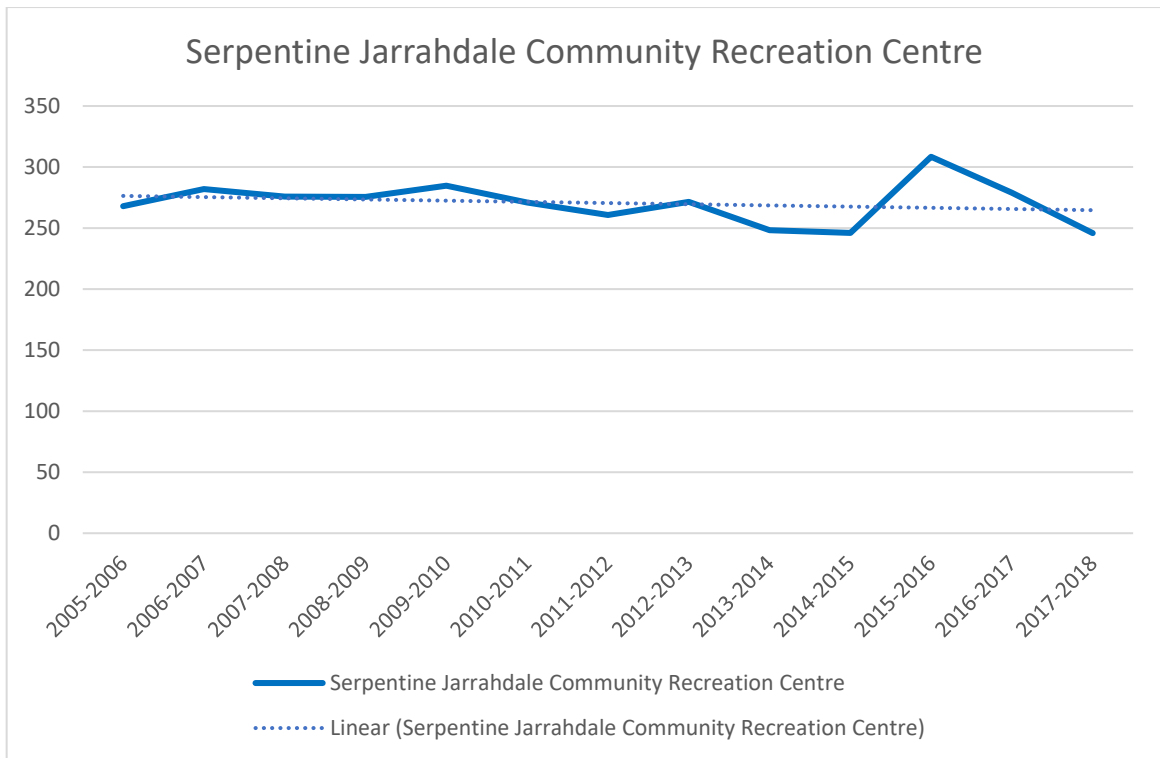


Figure 2-10 Emissions from the Serpentine Jarrahdale Community Recreation Centre over time

The Shire’s Administration Building is the second highest contributing facility to greenhouse gas emissions in the Shire, contributing over 10 percent of total Shire emissions in 2008-09. Around 2013, the Shire significantly reduced greenhouse gas emissions from the Administration Building and emissions are approximately 50 percent lower than the peak in 2008-09 and 25 percent lower than 2005-06. This reduction is likely to be due to the installation of solar panels which are producing energy when the building is most used, easily contributing to the reduction in emissions (Figure 2-11).

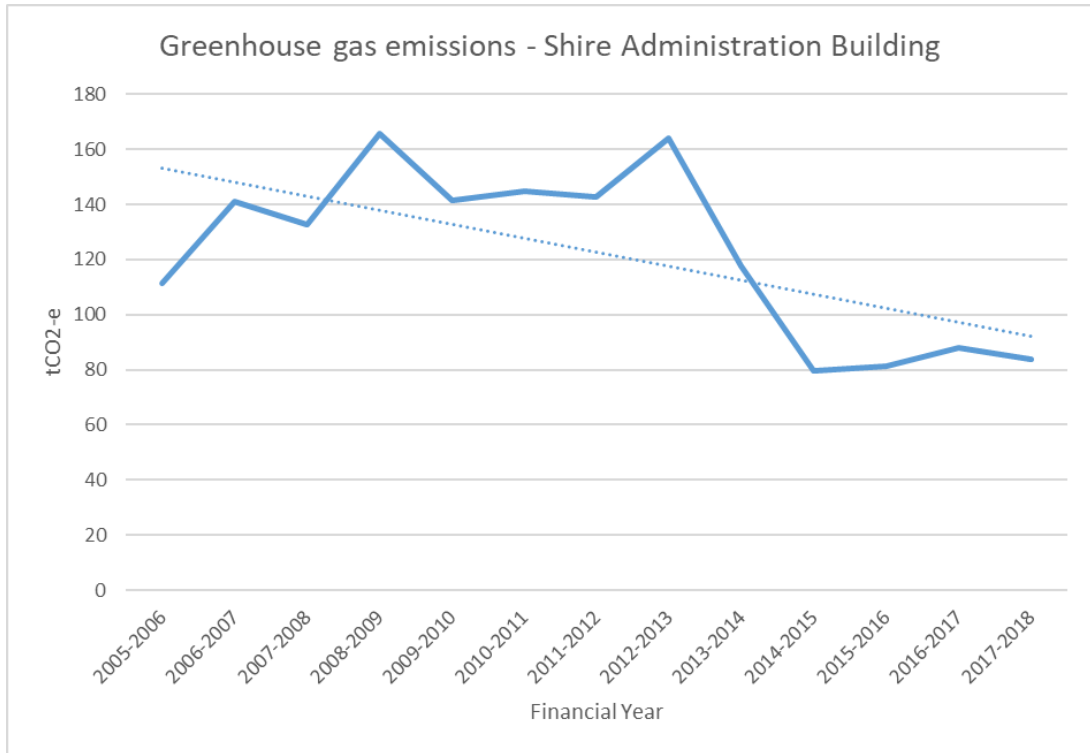


Figure 2-11 Emissions from the Shire of Serpentine Jarrahdale Administration Building over time

The Shire has installed solar PV systems on 14 of its facilities (including the Serpentine Jarrahdale Community Recreation Centre and the Council Administration Building) (Switch your Thinking Program pers. coms.). Emission reductions from these installations over time has been varied (Figure 2-12). In cases where the emission reductions have been limited, this may be due to the facility not being highly used during the day when the solar panels are creating energy that can be used. These panels will, however, be putting energy into the national power grid and are therefore still beneficial.

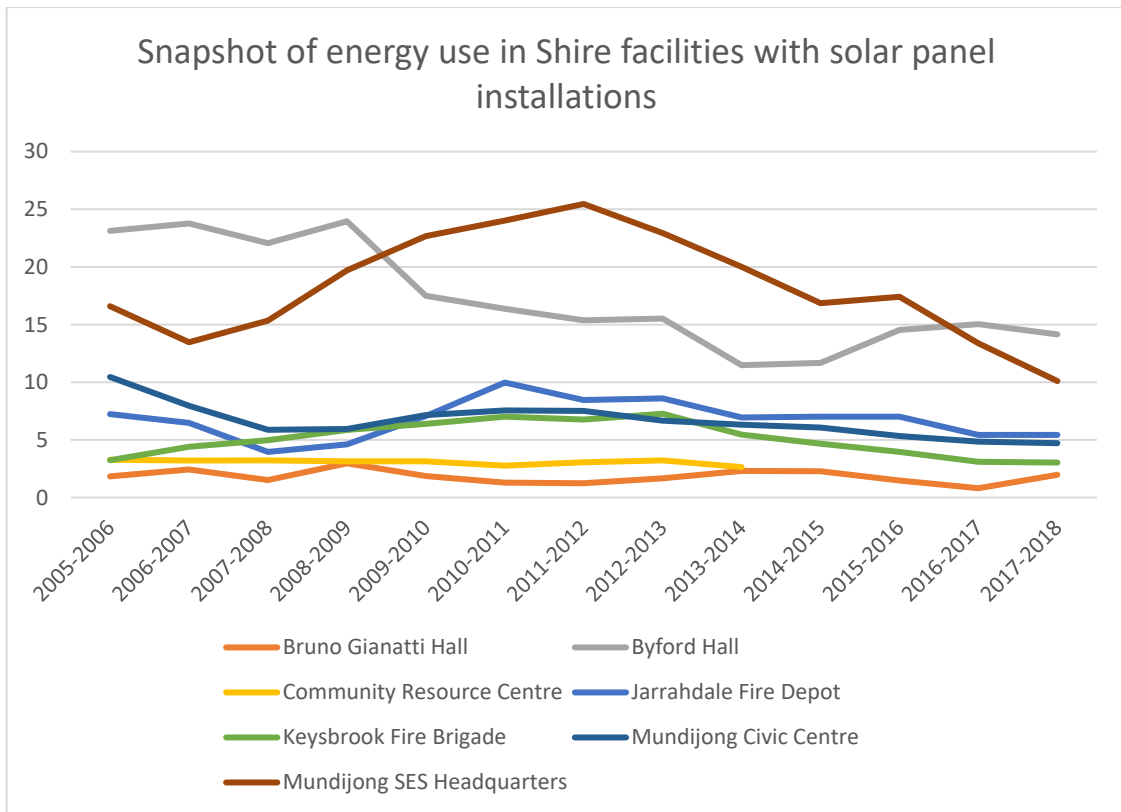


Figure 2-12 Emissions from Shire facilities that have installed solar panels

2.2.3 Household greenhouse gas emissions

Australian households generate a lot of greenhouse gases – mainly from transport, heating and cooling, appliances and wastes (in landfill) – accounting for at least one-fifth of Australia’s greenhouse gas generation. This is more than 18 tonnes per household each year on average, although annual greenhouse gas emissions can vary from as low as 3 tonnes up to 30 tonnes or more depending on lifestyle (Environmental Protection Agency, Victoria).

To enable residential greenhouse gas emissions reductions, the Shire’s Town Planning Scheme No.2 encourages the use of solar in the Townscape Precinct. The Shire has also started to receive development applications for more sustainable energy generation. A solar farm at Byford, for example, was approved by the Development Assessment Panel in 2016. This 30MW solar PV farm is expected to generate 80,000MWh of electricity annually, and whilst it will not reduce energy use, will help provide energy from renewable sources. The Shire may start to see more of this kind of application and for other developments such as wind farms.

According to Australia’s National Greenhouse Gas Inventory, decay of organic wastes in landfills generates 29 million tonnes of greenhouse gas each year. Around 30 percent of this is household food and garden waste – equivalent to around 1.5 tonnes of greenhouse gas per household each year.

In 2017/2018, the Shire collected:

- 676 tonnes of green waste
- 1,142 tonnes of hard waste

- 7,916 tonnes of general waste.

All collected green waste is mulched for garden use by the Shire and community, diverting this waste from landfill. The Shire helped residents to recycle 2461 tonnes of reusable waste in 2017/2018 and took 8,836 tonnes of waste to landfill (Shire of Serpentine Jarrahdale). Using the Carbon Neutral Carbon Calculator greenhouse gas emissions from residential waste to landfill in the Shire has been estimated as 12,370.4 tCO₂e for the 2017/18 financial year.

Per capita waste generation is steady within the Shire over the past 10 years (pers. coms Shire of Serpentine Jarrahdale).

2.3 Pressures

2.3.1 Population growth

In 2017, the population of the Shire of Serpentine Jarrahdale was estimated to be 29,566 (Australia Bureau of Statistics). Western Australia Tomorrow forecasts population in the Shire to be between 59,220 and 66,100 by 2031 (Department of Planning, Lands and Heritage).

Increased population will result in greater household energy usage, increased waste generation and increased transport. This will increase overall emissions from the Shire.

2.3.2 Urbanisation

As population grows, additional urban land is required, or existing land is used more intensely. In Perth, incorporating this growth is mostly concentrated in outer suburbs, in the inner city, in urban infill areas and along the coast.

The Shire's role in this process of urbanisation is to incorporate increased population in the urban centres of Byford and Mundijong. Depending on the current land-use, this often requires the clearing of native vegetation for development or the re-zoning of land from low-density residential/rural land to medium to high-density residential. This may reduce the capacity for urban greenery and green-spaces which help to combat the "heat island effect" common in highly developed areas. The "heat island effect" is the uncharacteristic local warming of an urban area due to lack of vegetation. In turn, this encourages the use of air-conditioning and results in increased GHG emissions (as residential energy is still largely supplied from gas fired power stations in the Perth area). The Shire's Urban and Rural Forest Strategy 2018-2028 recognises the benefits of maintaining urban tree canopy in reducing greenhouse gas emissions.

With 25 percent of greenhouse gas emissions produced by the construction, operation and maintenance of buildings (Architecture Australia), urbanisation is a significant contributor to greenhouse gas emissions.

2.3.3 Agriculture

Agriculture is important to the local economy, representing a \$33 million industry within the Shire. Nurseries and cut flowers, livestock slaughtering and vegetables are the highest value agricultural industries in the Shire (Australian Bureau of Statistics). Emissions from the nurseries, cut flower and vegetable industries are likely to largely result from transport of these commodities.

Livestock slaughtering, one of the highest value industries in the Shire, is likely to be a significant contributor to greenhouse gas emissions from the Shire. Whilst there is no

specific data for the Shire, in Australia direct livestock emissions account for about 70 percent of greenhouse gas emissions by the agriculture sector and 11 percent of the total national greenhouse gas emissions. This makes Australia's livestock the third largest source of greenhouse gas emissions after the energy and transport sectors. Livestock are the dominant source of methane and nitrous oxide, accounting for 56 percent and 73 percent respectively of Australia's emissions (Department of Primary Industries and Regional Development).

2.4 Responses

2.4.1 Shire greenhouse gas emissions reductions

The Shire has been investing in the installation of solar PV systems on its facilities, with 14 installed to date. There are likely to have been initiatives undertaken such as lighting retrofits that have contributed to overall reduction in energy usage. The Shire has also significantly reduced emissions from street lighting.

Given the advancement of solar technology in recent years and the significant reduction in costs to install, it may be worthwhile for the Shire to consider replacing existing solar panels with larger systems. Smaller systems could also be relocated to other facilities. Large solar systems on facilities such as the Administration building that have high electricity usage during the day may enable further reductions in overall energy usage.

There have also been recent improvements in battery storage technology and a decrease in associated costs. The use of battery storage could therefore be investigated to reduce greenhouse gas emissions at facilities with high energy use and where there has been minimal impact from solar panels, such as the Serpentine Jarrahdale Community Recreation Centre.

Small facility energy audits can also be carried out. Whilst only small reductions in energy usage may be achieved, there may be low cost initiatives that may be applied across multiple facilities that together add up to worthwhile emissions reductions.

Reducing energy usage is also likely to result in cost savings to the Shire. If well documented, this may provide leverage when budgets are allocated and assist in the continued funding for energy reduction activities.

2.4.2 Residential greenhouse gas emissions reductions

The Shire is a partner in the award-winning sustainability initiative 'Switch your thinking'. This program aims to reduce regional greenhouse gas emissions and inspire community action. Participation in this initiative provides access to advice, events and discounts on sustainable products to Shire residents. In 2018, the following free workshops were delivered by Switch your thinking in the Shire:

- Go Green House
- Wasteless Pantry
- From Garbage to Garden
- Upcycling the rag bag
- Coping with the plastic bag ban
- SJ Seniors Expo

- Nature Discovery Day Jarrahdale
- Prepping for change: Wild Edibles
- Lighting Farming with Dr Christine Jones
- SJ Community Fair
- Designing for Change
- Future proof your garden
- Future proofing the food bowl

Switch your thinking is also currently running a modern cloth nappy trial in which four families from the Shire are enrolled. 28 Shire residents receive free monthly energysmart tips via SMS. A total of 272 residents also subscribe to free monthly community and quarterly business and educator e-newsletters.

The Australian PV Institute estimates that 40.4 percent of dwellings in the Shire have solar PV installed, representing an installed capacity of 20,604kW (Figure 2-13). This is much higher than the Western Australian average of 27.6 percent of dwellings. The relatively high level of new house construction may have contributed to this increased uptake of solar PV. Participation in Switch your thinking may also have contributed to increased solar panel uptake although this is difficult to quantify.

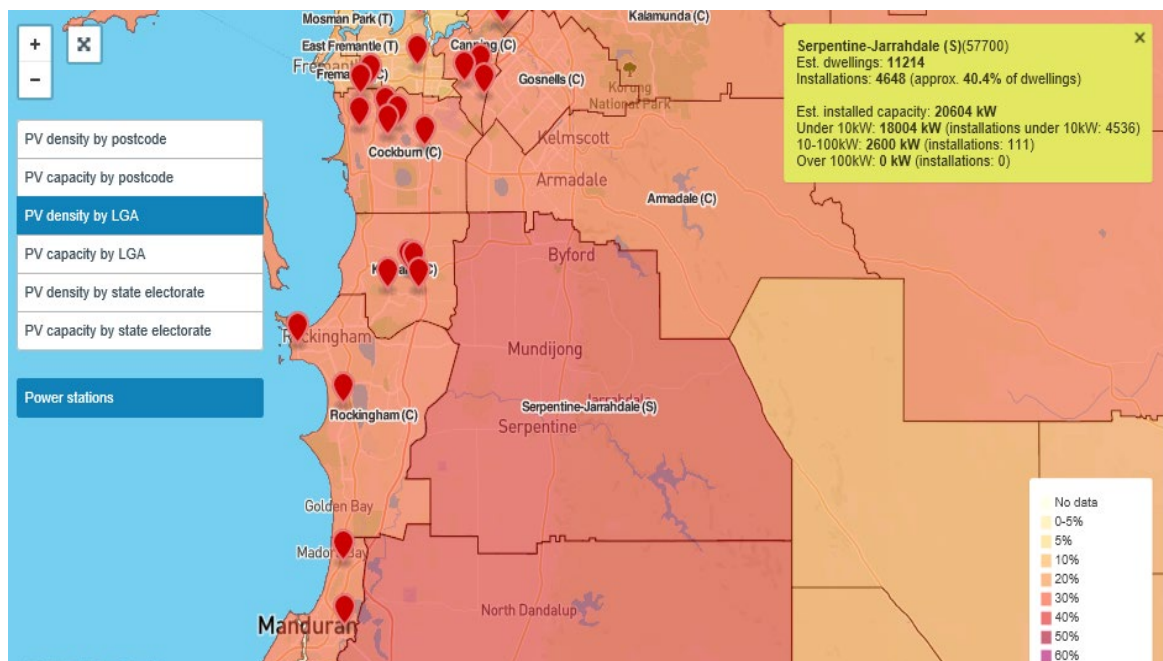


Figure 2-13 Snapshot from the Australian Photovoltaic installations mapping, March 2019

There are also trials using utility scale batteries as a part of the electricity power supply. This includes trials in new development areas (Alkimos Beach) and established areas (Meadow Springs) which may be considered within the Shire. The PowerBank trial provides 52 households access to 8kWh of virtual storage at the cost of \$1 per day to store their excess solar energy.

Alkimos Beach is the first community in Australia to trial large scale community battery storage. Every property in Alkimos Beach has a solar PV system size of 1.5KW or higher.

There is a 1.1MWh community scale Lithium Ion energy storage device, and people living in Alkimos are charged for electricity use based on the time of day they use it. The Peak Demand plan allows customers to make the most of the solar PV system by virtually storing excess energy.

These initiatives have the potential to be rolled out in new and existing developments within the Shire.

The Shire manages residential waste collection; this includes collecting:

- General waste weekly
- Recycling fortnightly
- Hard waste verge collection once per financial year
- Green waste collection twice per financial year

To encourage reductions in waste and responsible waste treatment, the Shire includes information regarding what can and cannot be recycled on its website. Participation in Switch your thinking also contributes to community education and encourages reduction in waste and activities such as composting.

To increase recycling rates, the Shire is introducing a program in 2019/2020 to sort hard waste. Historically only metal from hard waste collection has been recycled; however, this will allow a much greater volume of hard waste to be reused.

As population increases, there will be increased emissions from private vehicle use. Responses to this are discussed in Section 2.8.1.

2.4.3 Sustainable built form

In order to reduce effects of land clearing and land-use change, several responses can be considered. When designing residential areas, designate green-spaces and attempt to retain native vegetation to reduce the “heat island effect” and act as an air filter. As an additional benefit, green-spaces also increase the aesthetics of a residential area, and by retaining the native vegetation, require less irrigation than European vegetation. Green-spaces can also act as “stepping stones” for local wildlife, as native habitat can become discontinuous due to clearing and threaten local species.

Energy efficient urban design, particularly shading of residential buildings, can reduce the need for air conditioning, reducing energy use. Careful building design and strategically planted trees can easily achieve internal temperatures 5°C warmer in winter and 10°C cooler in summer than in typical, poorly designed homes (Town of Bassendean, 2016). The Shire has recognised the benefit of maintaining an urban tree canopy in its Urban and Rural Forest Strategy 2018-2028 and identified urban areas as under significant threat of canopy loss if current development practices, involving clearing lots of all vegetation, are employed.

Achievement of Goal 1 “Retain current level of canopy cover, and increase where possible” of the Shire’s Urban and Rural Forest Strategy 2018-2028 will help maintain and improve shading from trees in urban areas. This will help reduce residential greenhouse gas emissions from heating and cooling.

Additionally, sustainable built form is included in the design principles established by State Planning Policy 7.0: Design of the Built Environment (WAPC, 2019). This policy sets out the objectives, measures, principles and processes which apply to the design and

assessment of built environment proposals through the planning system. Well-designed buildings respond to local climate and site conditions by providing optimal orientation, shading, thermal performance and natural ventilation. Reducing reliance on technology for heating and cooling minimises energy use, resource consumption and operating costs over the life-cycle of the project.

Proposed residential areas should therefore be subject to sustainable design principles. This may include appropriate building orientation (to reduce the need for heating and cooling), light coloured roofs (to reduce the “heat island effect”), high energy rating appliances and double glazed windows. Solar panel systems should also be encouraged.

Sustainable design also includes the use of sustainable construction materials, recycling, good waste management practices, re-use of materials and existing structures, harnessing of renewable energy sources, and total water cycle management.

If the desired built form is not being achieved in the Shire, the preparation of more detailed design guidelines to complement SPP 7.0 and Design WA but tailored to the local conditions can be considered. Alternatively, recommendations to achieve certain principles and objectives relating to the area’s structure and form can be included in structure plans. The Mundijong/Whitby District Structure Plan, for example, includes a Climate-Responsive Design and Energy principle which sets out recommended strategies for future planning and development including:

- Development guidelines which aim to minimise community energy and water use
- Commercial, industrial and public buildings to meet 5 Green Star design or above
- Developments encouraged to sign up to Green Energy from Synergy
- Use of solar panels within public open space e.g. on amenities blocks or pergolas in parks etc. to assist running BBQs or street lighting
- Street lights to be energy efficient and solar powered where possible
- Promote the investigation of renewable energy sources at local structure plan stages for commercial development (Shire of Serpentine Jarrahdale 2010).

The Local Planning Policy 2.3: Development Standards for Development Applications (LPP 2.3) adopted by the Shire of Serpentine Jarrahdale on 23 July 2018 “establish[es] minimum standard[s] for development to maintain and enhance the amenity and natural environment” (Shire of Serpentine Jarrahdale 2019d). LPP 2.3 addresses objective 2.1 - “A diverse, well planned built environment” from the Strategic Community Plan 2017-2027. LPP 2.3 sets forth standards to which building developments will be subject. An example of the standards includes mandatory revegetation of mature vegetation to be lost as a result of any development/planning application throughout the Shire. Another standard is the consideration of the climate when landscaping is proposed – “evergreen trees such as native trees should be planted along the eastern and western elevations to provide shade to indoor and outdoor living areas, and to reduce the heating of masonry walls and paving. Deciduous trees may be planted along the northern elevation of buildings to allow winter sunlight to indoor and outdoor areas” (Shire of Serpentine Jarrahdale 2019d).

2.4.4 Schools greenhouse gas emission reductions

ClimateClever is a new engaging, data-driven program underpinned by a set of innovative online tools designed to help schools measure, monitor, compare and reduce their carbon footprint, to become leaders in sustainability and climate action.

Switch your thinking offers a 50 percent subsidy for schools in the Shire of Serpentine Jarrahdale to participate in ClimateClever. The offer is available to primary schools, high schools and early years learning centres, although places are limited and shared with the Cities of Armadale and Gosnells.

Jarrahdale Primary School was recognised as a Switched on School in 2015. Activities to reduce greenhouse gas emissions include waste reduction activities:

- Feeding school scraps to school chickens
- Worm farming
- Four bin system
- Hosting nude food days

The Waste Wise Schools program targets schools in Western Australia with educational strategies for reducing waste to landfill by implementing the 3Rs, reduce, reuse, recycle - while developing positive environmental values in students and the whole school community. Mundijong Primary School is a Waste Wise Schools participant.

2.4.5 Business greenhouse gas emission reductions

To help businesses reduce their greenhouse gas emissions, Switch your thinking includes rewards providing discounts on products to cut waste and reduce energy and water use.

Switch your thinking has also negotiated a partnership for the Shire with The Last Straw (a campaign aimed to reduce plastic straw usage in local businesses) – 11 local businesses have been contacted so far (Switch your thinking pers. coms) although no pledges from Shire businesses have been received as part of the campaign (Last Straw).

2.4.6 Renewable energy production

Western Australia currently has nine solar photovoltaic facilities and 18 wind turbine facilities (Department of Planning, Lands and Heritage). The Shire has received one solar farm application which is approved for development. Across Western Australia, there are currently three renewable energy applications with the Development Assessment Panel for consideration: two solar farms and one wind farm.

In response to this trend the Department of Planning, Lands and Heritage (DPLH) has produced the Draft Position Statement on Renewable Energy Facilities which aims to facilitate appropriate development of renewable energy facilities while minimising any potential impact upon the environment and valued landscapes. It also encourages informed public engagement early in the renewable energy facility planning process.

The Shire is well positioned to support the expansion of the renewable energy industry in Western Australia. The DPLH position paper can be utilised to guide assessment of applications received and includes information relating to the key planning considerations – environmental impact, visual and landscape impact, noise impacts, construction impact, public and aviation safety, cultural heritage and community consultation.

Encouraging developments to utilise renewable energy sources is a strategy in the Shire's draft Local Planning Strategy. The Draft Position Statement on Renewable Energy Facilities recommends that local government address renewable energy in their local planning frameworks to:

- Identify suitable locations for renewable energy facilities (subject to detailed evaluation)
- Consider competing rural land uses
- Incorporate renewable energy facilities into the local planning scheme
- Consider development of a local planning policy relating to renewable energy facilities

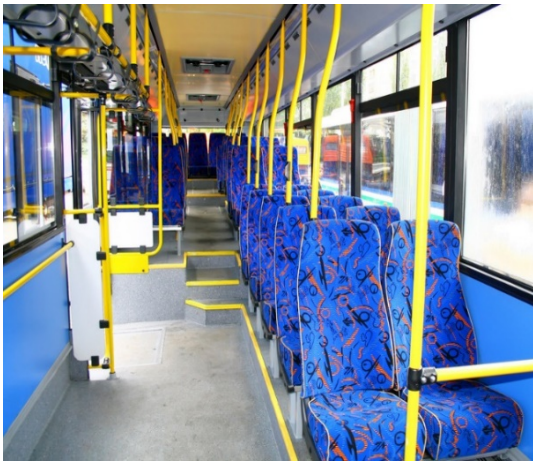
As the Shire has received an application for a solar farm, and it may be expected to receive more, the Shire should consider improving how this development and land use is addressed and incorporated into the local planning framework.

2.4.7 Agriculture

There are four main approaches to mitigating livestock greenhouse gas emissions:

- Husbandry (animal breeding, feed supplements, improved pastures)
- Management systems (stocking rates, biological control)
- Numbers of livestock
- Manure management.

Keeping of livestock is likely considered a rural use under the Shire's Town Planning Scheme No. 2 and does not require development approval. The Shire has limited opportunity to influence the number of livestock and management systems employed. This may be more appropriately encouraged by the Department of Primary Industries and Regional Development.



2.5 Overview – Ambient air quality

One of the most important aspects of the atmosphere is air quality, which is quite simply a measure of the cleanliness of the surrounding air. It can be affected by air pollutants (anthropogenic (human made) or naturally occurring) which have the ability to accumulate in the air and cause significant effects to people, flora, fauna and infrastructure. Air quality is an important contributor to quality of life, and plays a role in the liveability of our towns, cities and environment.

This section will discuss the current condition of the Shire of Serpentine Jarrahdale atmosphere in terms of air quality.

2.5.1 Strategic alignment

The atmosphere may be defined as falling under several categories in the Shire of Serpentine Jarrahdale Strategic Community Plan, namely People, Place and Prosperity.

People – Maintaining good air quality will contribute to a healthy community and a safe place to live by ensuring clean air for all community members including the most vulnerable – children, people with existing cardio-pulmonary and cardio-respiratory conditions, and the elderly.

Place – A clean atmosphere contributes to the sustainability of the overall environment by providing an acceptable level of air quality for the existing population but also allowing for population and economic growth in the future.

Prosperity – Sustainably clean air that allows for the growth of business will ensure a prosperous economy. Additionally, a clean atmosphere assists to attract tourism, which will in turn contribute to the local economy.

2.6 Condition

2.6.1 Overview of air quality monitoring stations

Ambient air quality is determined by the types and amounts of pollutants emitted into the atmosphere, and the processes associated with their transport, transformation, mixing, and removal from the atmosphere. Many different pollutants exist in our atmosphere, including gases (e.g. carbon monoxide, nitrogen dioxide, sulphur dioxide, ozone, and volatile organic compounds (VOCs) such as benzene and formaldehyde) and particulate matter (PM, including particulate matter less than 10 microns in size [PM₁₀] and particulate matter less than 2.5 microns in size [PM_{2.5}]) (Australia State of the Environment 2016).

Under the *National Environment Protection (Ambient Air Quality) Measure* (Air NEPM), WA is required to carry out ambient air quality monitoring across the state. The Department of Water and Environmental Regulation (DWER) is responsible for the operation and maintenance of the 13 ambient air quality monitoring stations (AQMS) situated in the Perth metropolitan region and regional locations. Although there is no monitoring site in the Shire of Serpentine Jarrahdale, the closest representative^[1] sites were agreed upon with the Shire and data from these sites were used to provide an indication of existing air quality. The 2017 Western Australia air monitoring report (DWER 2017) was also used to determine trends in air quality over time.

¹ There are closer AQMS, however these are located in industrial areas and do not provide a measure of ambient air quality typically experienced by predominantly residential suburbs, such as those located within the Shire of Serpentine Jarrahdale.

The closest DWER operated AQMS to the Shire of Serpentine Jarrahdale are Caversham and South Lake. Caversham is located approximately 51 km north of the Shire and monitors carbon monoxide (CO), ozone (O₃), nitrogen dioxide (NO₂), particulate matter with an aerodynamic diameter of 10 microns or less (PM₁₀) and particulate matter with an aerodynamic diameter of 2.5 microns or less (PM_{2.5}). South Lake is located approximately 30 km north-west of the Shire and monitors CO, O₃, NO₂, sulphur dioxide (SO₂), PM₁₀ and PM_{2.5}. The location of the AQMSs are shown in Figure 2-14.

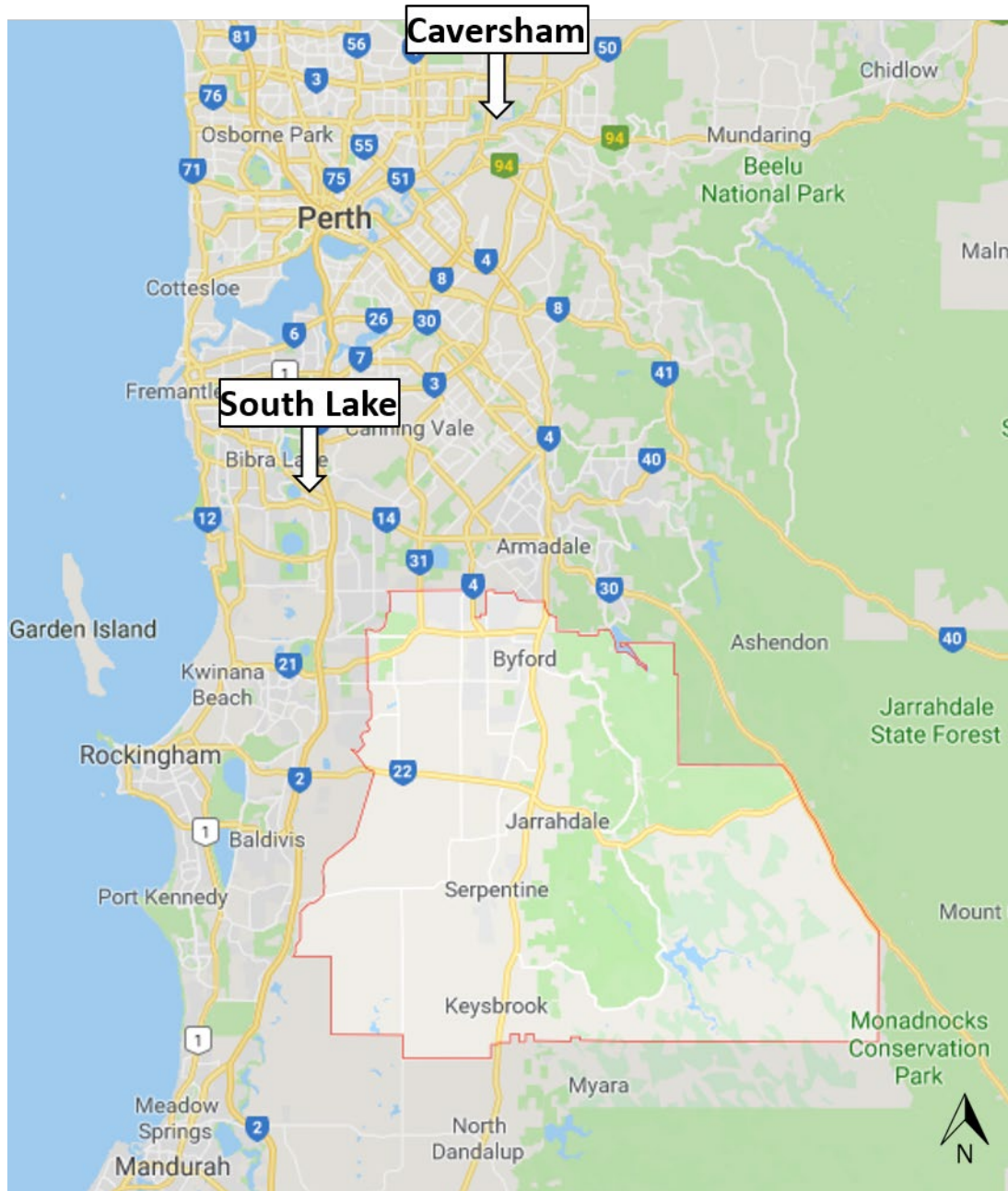


Figure 2-14 AQMS locations

In the 2017 Western Australia air monitoring report (DWER 2017), DWER provide the following descriptions for each AQMS:

- Caversham – “Semi-rural north-east metropolitan suburb located in the Swan Valley - a grape growing region next to Perth foothills - 14 km north-east of the Perth CBD. The

region mainly comprises low density housing and paddocks. Some brick manufacturing occurs in the region.”

- South Lake – “South-east metropolitan site located 17 km south of Perth with moderate/high density housing and moderate to high traffic flow. The site is located 1.6 km west of the Kwinana Freeway, a main north-south arterial road carrying approximately 87,000 vehicles daily and is 4 km north-east of the northern border of the Kwinana Industrial Area.”

AQMS parameters for Caversham and South Lake are shown in Table 2-1.

Table 2-1 AQMS parameters

AQMS	Approximate location		Distance from Shire (km)	Pollutants monitored	Data available for period:
	E (m UTM)	S (m UTM)			
Caversham	403104	6471775	51	CO	1993 to present
				O ₃	1989 to present
				NO ₂	1990 to present
				PM ₁₀	2004 to present
				PM _{2.5}	1994 to present
South Lake	390708	6446106	30	CO	2000 to present
				O ₃	2000 to present
				SO ₂	2000 to present
				NO ₂	2000 to present
				PM ₁₀	2000 to present
				PM _{2.5}	2006 to present

Caversham is located further from the Shire than South Lake; however, due to the overall surrounding land use at Caversham (grape-growing, paddocks and low density housing), it may be considered representative of the Shire of Serpentine Jarrahdale in terms of existing air emissions for the purpose of this assessment.

South Lake is located closer to the Shire than Caversham, however is more densely populated and represents a more urbanised region compared to the Shire. As both location and surrounding land-use are important in characterising the dispersion of pollutants, both Caversham and South Lake AQMSs will be included in this assessment.

2.6.2 Assessment criteria

In order to assess the condition of air quality monitored at these two sites, assessment criteria from the Air NEPM have been adopted. The Air NEPM was developed to provide benchmark standards for ambient air quality to allow for the adequate protection of human health and well-being. Air NEPM standards are implemented across Australia. The criteria are shown in Table 2-2.

Table 2-2 Air NEPM criteria

Pollutant	Averaging period	Max. concentration standard ($\mu\text{g}/\text{m}^3$)	Max. concentration standard (ppm)
CO	8-hour	-	9.0
NO ₂	1-hour	-	0.12
	Annual	-	0.03
Photochemical oxidants (as O ₃)	1-hour	-	0.10
	4-hour	-	0.08
SO ₂	1-hour	-	0.20
	24-hour	-	0.08
	Annual	-	0.02
Pb	Annual	0.5	-
PM ₁₀	24-hour	50	-
	Annual	25	-
PM _{2.5}	24-hour	25	-
	Annual	8	-

2.6.3 Ambient air quality

The following section describes the baseline environment in terms of ambient air quality recorded at Caversham and South Lake AQMS. Data was taken from the 2017 Western Australia air monitoring report (DWER 2017).

The maximum concentration and percentiles recorded at the Caversham AQMS are shown in Table 2-3. Exceedances of the relevant criteria are shown in red. From Table 2-3, it is clear that the monitored gaseous pollutants complied with the Air NEPM criteria. However, the PM₁₀ and PM_{2.5} data show exceedances of the Air NEPM criteria.

Table 2-3 2017 percentiles of monitored pollutant concentrations at Caversham AQMS

Pollutant	Averaging period	Data availability (%)	Max conc. Stand.	Max conc.	99 th %ile	98 th %ile	95 th %ile	90 th %ile	75 th %ile	50 th %ile
CO (ppm)	8-hour	97.5	9.0	2.9	1.1	0.8	0.5	0.4	0.2	0.1
NO ₂ (ppm)	1-hour	95.3	0.12	0.042	0.032	0.031	0.028	0.025	0.019	0.014
O ₃ (ppm)	1-hour	98.7	0.1	0.099	0.077	0.069	0.059	0.049	0.037	0.031
	4-hour	98.7	0.08	0.077	0.068	0.06	0.06	0.044	0.034	0.029
SO ₂ (ppm)	1-hour	-	0.20	-	-	-	-	-	-	-
	24-hour	-	0.08	-	-	-	-	-	-	-
PM ₁₀ ($\mu\text{g}/\text{m}^3$)	24-hour	98.6	50	79.2	43.3	32.6	27.8	25	19.6	14.8
PM _{2.5} ($\mu\text{g}/\text{m}^3$)	24-hour	98.7	25	65.9	31.3	21.8	15.7	11.8	9.3	7.5

Similarly, the maximum concentration and percentiles recorded at the South Lake AQMS are shown in Table 2-4. Exceedances of the relevant criteria are shown in red. It is clear that the monitored gaseous pollutants complied with the Air NEPM criteria. The PM₁₀ data also complied with the Air NEPM criteria. However, the maximum recorded concentration of PM_{2.5} shows an exceedance of the Air NEPM criteria. A comparison of percentiles of monitored pollutant concentrations for Caversham and South Lake are shown in Table 2-3 and Table 2-4.

Table 2-4 2017 percentiles of monitored pollutant concentrations at South Lake AQMS

Pollutant	Averaging period	Data availability (%)	Max conc.	99 th %ile	98 th %ile	95 th %ile	90 th %ile	75 th %ile	50 th %ile
CO (ppm)	8-hour	98.6	1.9	1.4	1.3	1	0.7	0.5	0.4
NO ₂ (ppm)	1-hour	97.3	0.045	0.034	0.03	0.028	0.026	0.021	0.016
O ₃ (ppm)	1-hour	98.5	0.074	0.061	0.058	0.05	0.043	0.035	0.031
	4-hour	98.5	0.067	0.055	0.052	0.045	0.038	0.033	0.029
SO ₂ (ppm)	1-hour	95.2	0.037	0.023	0.019	0.017	0.013	0.006	0.004
	24-hour	95.2	0.009	0.008	0.008	0.006	0.005	0.003	0.002
PM ₁₀ (µg/m ³)	24-hour	98.2	49.6	37.7	31.3	28.6	26.2	20.6	15.9
PM _{2.5} (µg/m ³)	24-hour	98.4	46.6	24.2	19.8	14.5	12.8	10.1	7.8

A summary of the likely causes of the above exceedances are provided in the Western Australia air monitoring report (DWER 2017) and detailed in Table 2-5. DWER reported exceedances of the PM₁₀ and PM_{2.5} Air NEPM criteria as being caused by nearby controlled burning in all instances.

Table 2-5 Summary of criteria exceedances for 2017 at Caversham and South Lake AQMS

Date	AQMS	Criteria exceeded	Concentration recorded ($\mu\text{g}/\text{m}^3$)	Description (DWER 2017)
5 April 2017	Caversham	24-hour $\text{PM}_{2.5}$	26.6	A number of Shire burn-offs and fires were current within the metropolitan area resulting in elevated particle levels throughout the day.
	South Lake		26.1	
13 May 2017	Caversham	24-hour PM_{10}	53.4	Department of Parks and Wildlife (DPaW) issued a smoke alert for the Perth metropolitan area, Perth Hills and southern suburbs to Mandurah for this event. The smoke was the result of a number of burns by DPaW, including a burn 10 km south-east of Mundaring and a burn 30 km south-east of Jarrahdale. Low wind speeds and variable wind directions were prevalent throughout the day.
		24-hour $\text{PM}_{2.5}$	44.2	
	South Lake	24-hour $\text{PM}_{2.5}$	33.8	
1 Jun 2017	Caversham	24-hour PM_{10}	79.2	A number of burns were underway throughout the south-west but due to the localised effect at Caversham, the exceedance was most likely cause by a local burn-off at Bellevue in the City of Swan.
		24-hour $\text{PM}_{2.5}$	65.9	
2 Jun 2017	Caversham	24-hour $\text{PM}_{2.5}$	37.9	A number of burns were underway throughout the south-west but due to the localised effect at Caversham, the exceedance was most likely cause by a local burn-off at Bellevue in the City of Swan.
7 Jun 2017	Caversham	24-hour PM_{10}	79.1	A number of bushfires and controlled burns conducted by DPaW and a number of burn-offs in various locations contributed to the smoke haze. The exceedance was most likely caused by prescribed burns in the region.
		24-hour $\text{PM}_{2.5}$	65.2	
6 Oct 2017	South Lake	24-hour $\text{PM}_{2.5}$	46.6	Smoke was caused by Department of Biodiversity, Conservation and Attractions managed prescribed burn.

2.6.4 Long-term air quality

A review of the long-term trends of the above pollutants is shown below. These graphs were sourced from the Western Australia air monitoring report and include data from 2008 to 2017 recorded at Caversham and South Lake AQMSs (DWER 2017).

Carbon monoxide (CO)

Figure 2-15 and Figure 2-16 show the long term 8-hour CO trends at Caversham and South Lake respectively. 90th percentile concentrations at Caversham are steady over the 10 year period, while maximum concentrations vary somewhat, particularly in 2017. There is no overall increasing or decreasing trend. Similarly, percentiles of CO recorded at South Lake vary from year-to-year with no discernible trend. Overall, concentrations appear higher at South Lake than Caversham, with the exception of a peak in maximum concentration at Caversham in 2017. Comfortable compliance with the Air NEPM maximum concentration criterion of 9.0 ppm is demonstrated.

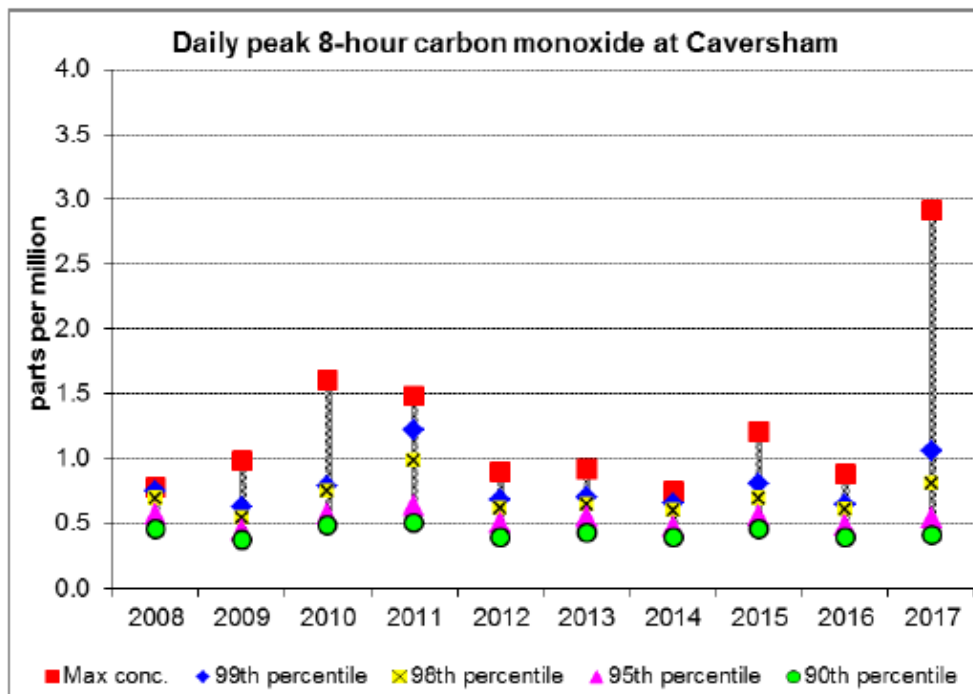


Figure 2-15 Long term 8-hour CO concentration percentiles at Caversham

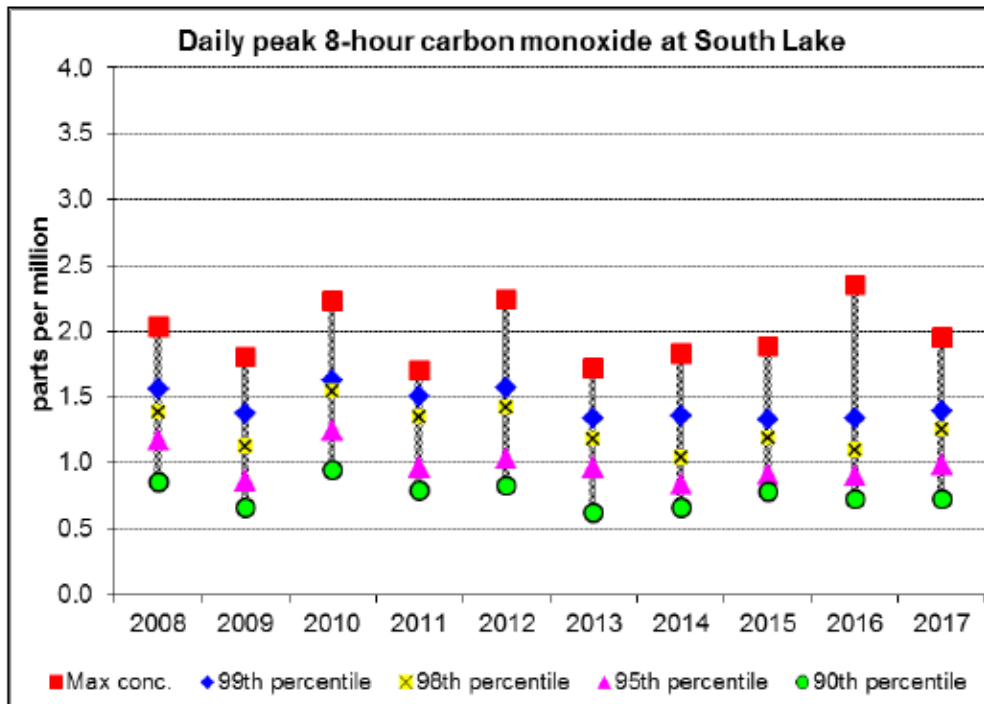


Figure 2-16 Long term 8-hour CO concentration percentiles at South Lake

Nitrogen dioxide (NO₂)

Figure 2-17 and Figure 2-18 show the long term 1-hour NO₂ trends at Caversham and South Lake respectively. At both sites, the 90th percentile concentrations appear steady over the 10 year period, while maximum concentrations vary somewhat. Both locations follow the same pattern in peaks and lows of NO₂ concentrations, however do not show an overall increasing or decreasing trend. The highest maximum of NO₂ for both locations was recorded in 2010. Comfortable compliance with the Air NEPM maximum concentration criterion of 0.12 ppm is demonstrated.

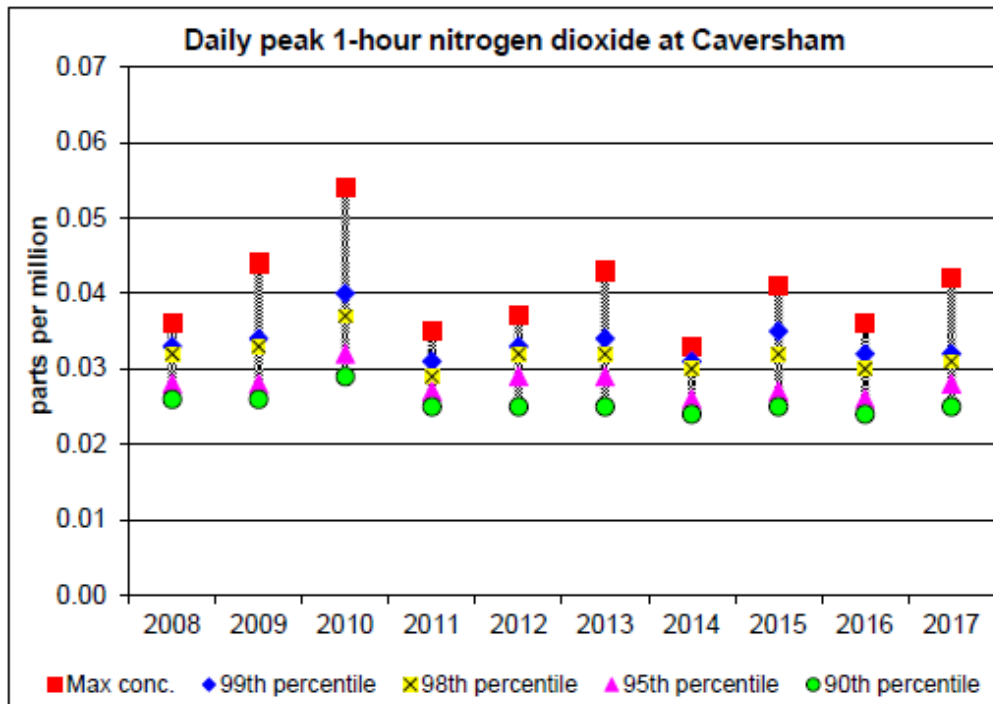


Figure 2-17 Long term 1-hour NO₂ concentration percentiles at Caversham

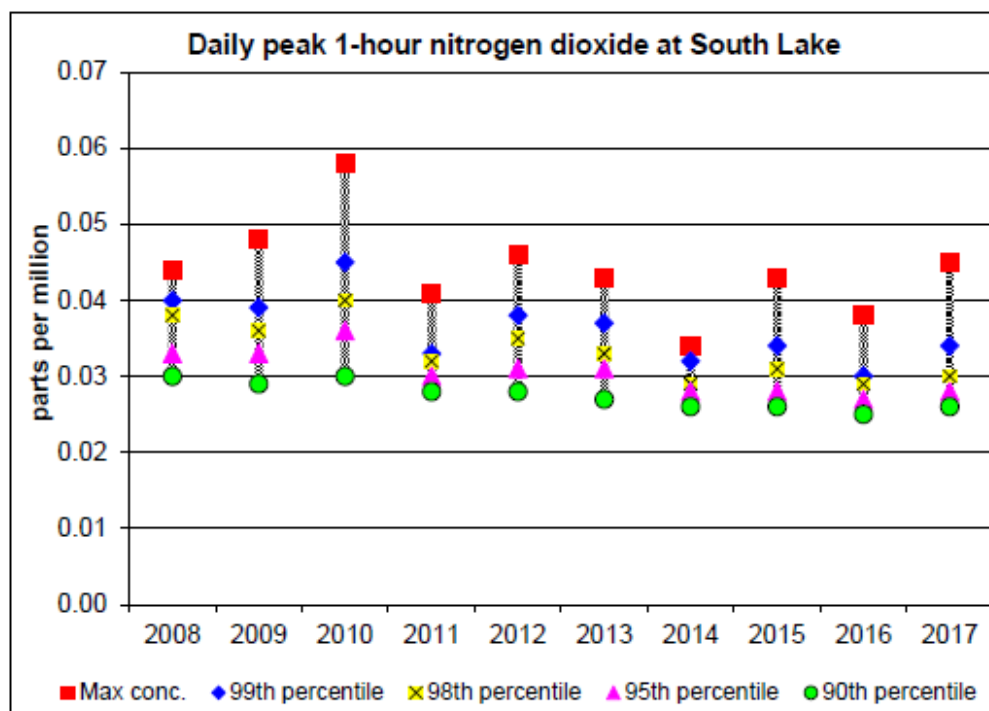


Figure 2-18 Long term 1-hour NO₂ concentration percentiles at South Lake

Ozone (O₃)

Figure 2-19 and Figure 2-20 show the long term 1-hour O₃ trends at Caversham and South Lake respectively. The spread of recorded concentrations at Caversham is larger than those of South Lake, with the maximum concentrations at Caversham recorded as

significantly higher than the 99th percentiles. This large spread recorded at Caversham suggests a higher variability in O₃ levels throughout the 10-year period compared to South Lake. Overall, O₃ concentrations recorded at Caversham appear higher than at South Lake, however neither location shows a discernible trend of O₃ concentrations over time. Compliance with the Air NEPM maximum concentration criterion of 0.10 ppm is demonstrated at South Lake but not Caversham.

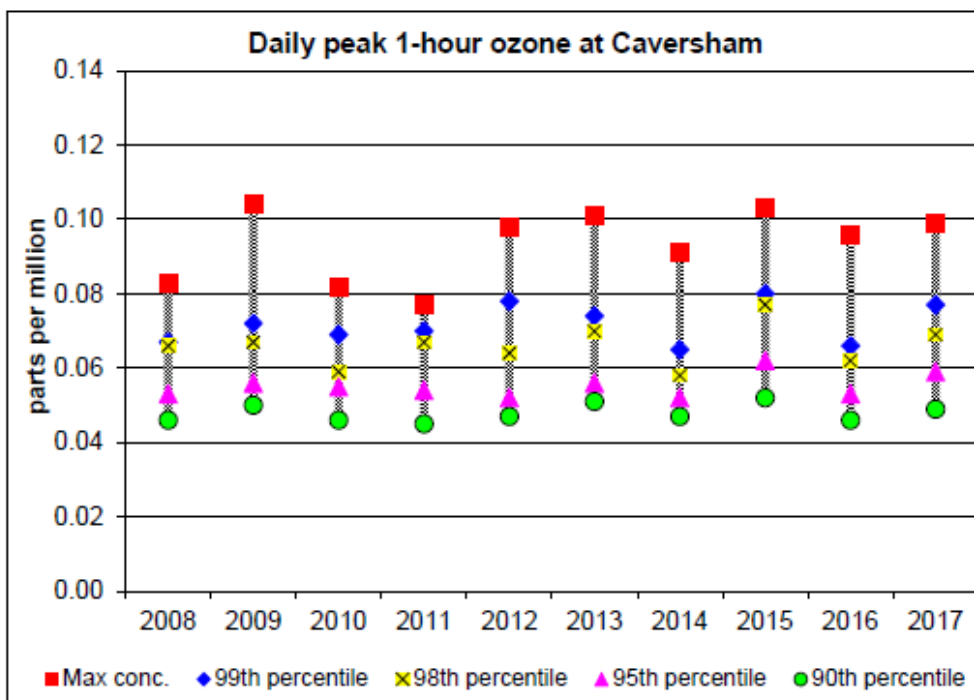


Figure 2-19 Long term 1-hour O₃ concentration percentiles at Caversham

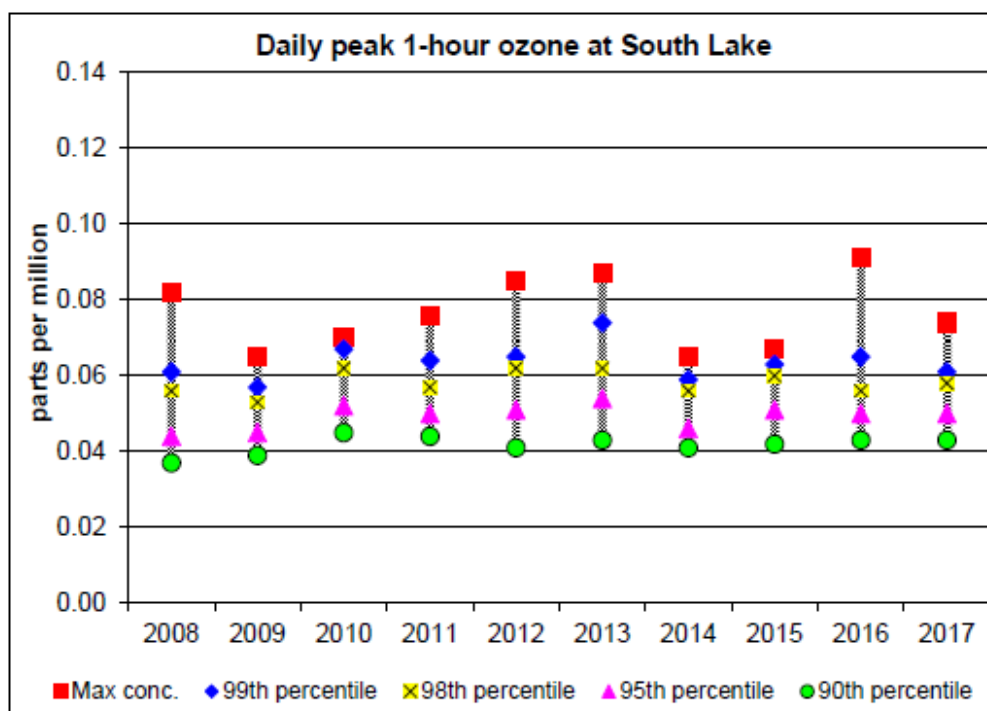


Figure 2-20 Long term 1-hour O₃ concentration percentiles at South Lake

Sulphur dioxide (SO₂)

Figure 2-21 shows the long term 1-hour SO₂ trends at South Lake. Sulphur dioxide is not monitored at Caversham. Concentrations do not vary considerably over the 10-year period with the exception of the maximum recorded concentration in 2010, which peaks in comparison to the other years. There does not appear to be an overall increasing or decreasing trend. Comfortable compliance with the Air NEPM maximum concentration criterion of 0.20 ppm is demonstrated.

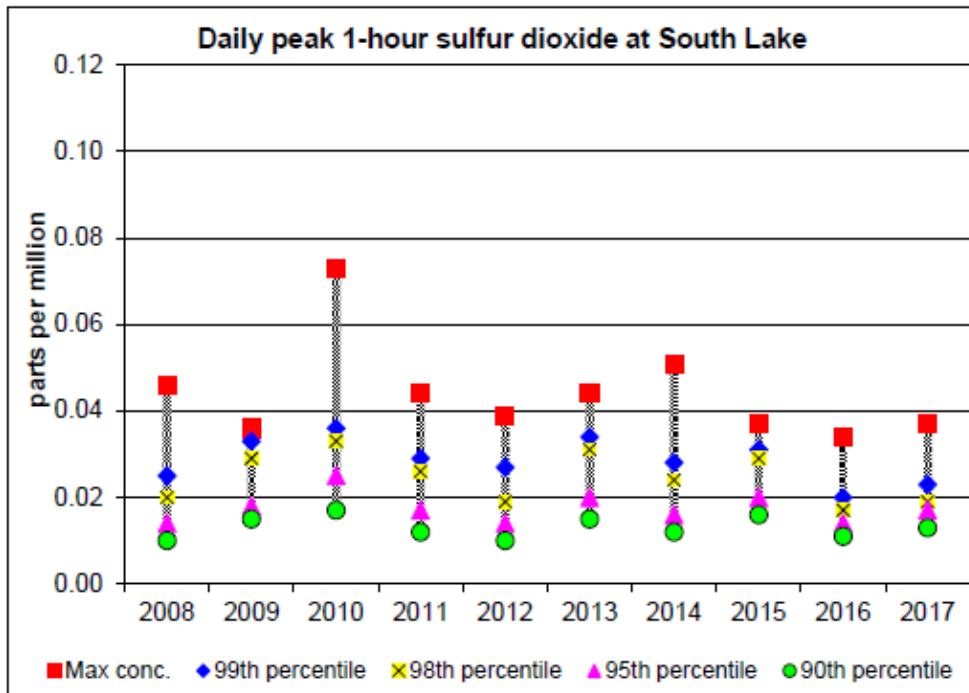


Figure 2-21 Long term 1-hour SO₂ concentration percentiles at South Lake

Particulate matter as PM₁₀

Figure 2-22 and Figure 2-23 show the long term 24-hour PM₁₀ trends at Caversham and South Lake respectively. The maximum concentrations recorded at both AQMS vary considerably compared to the 90th percentiles. However, the variation in maximum concentrations at the two sites do not appear to correlate. At Caversham, the maximum concentrations increase from 2008 to 2011 and then decrease steadily until 2016. In 2017, the maximum recorded concentration increases considerably. At South Lake, the maximum concentrations increase from 2009 to 2012, and then fluctuate around lower concentrations from 2013 to 2016. Exceedance of the Air NEPM maximum concentration criterion of 50 µg/m³ occurs during most years.

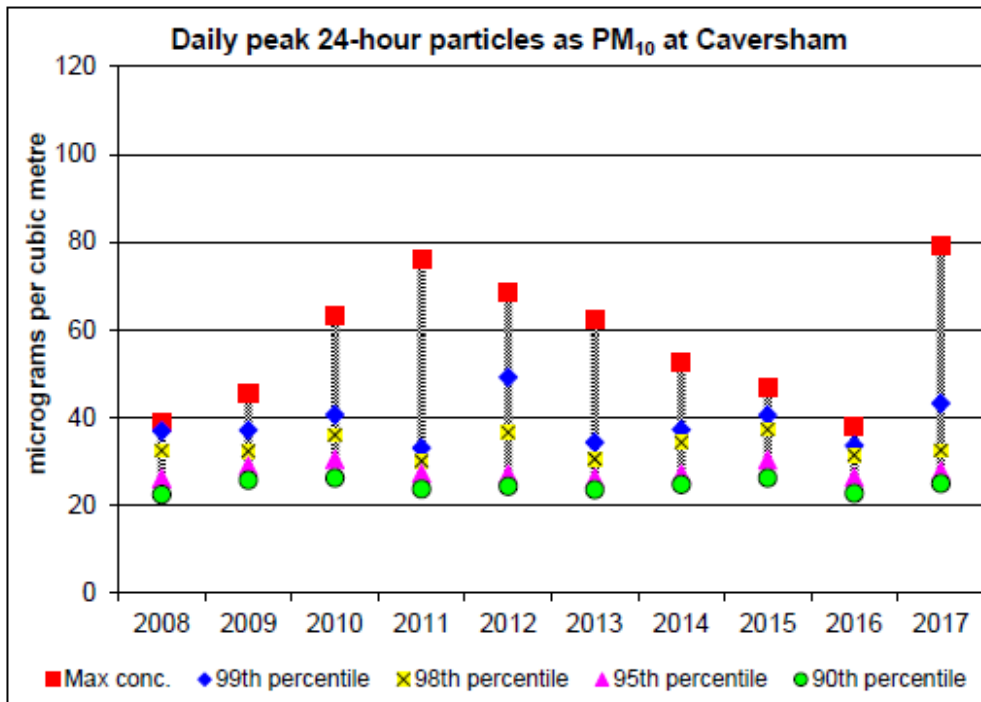


Figure 2-22 Long term 24-hour PM₁₀ concentration percentiles at Caversham

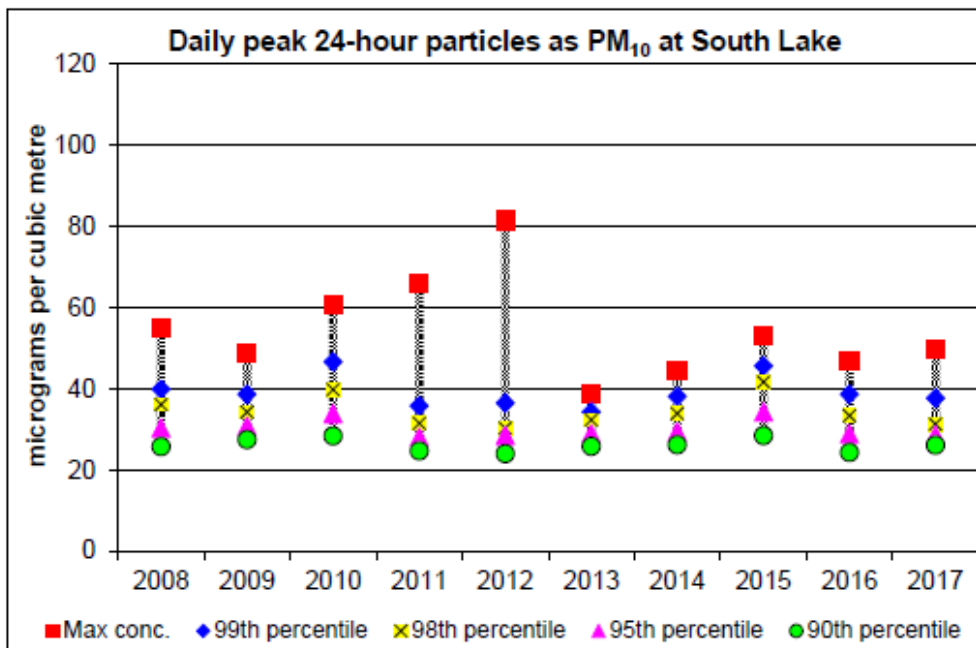


Figure 2-23 Long term 24-hour PM₁₀ concentration percentiles at South Lake

Particulate matter as PM_{2.5}

Figure 2-24 and Figure 2-25 show the long term 24-hour PM_{2.5} trends at Caversham and South Lake respectively. Similarly to the long-term PM₁₀ concentrations, the maximum percentiles fluctuate considerably. At Caversham, there does not, however, appear to be an overall increase or decrease in maximum concentrations. The peak in maximum

concentrations is evident in 2017. At South Lake, concentrations increase from 2009 to 2012, however no other discernible trend is evident. Exceedance of the Air NEPM maximum concentration criterion of 25 $\mu\text{g}/\text{m}^3$ occurs during most years.

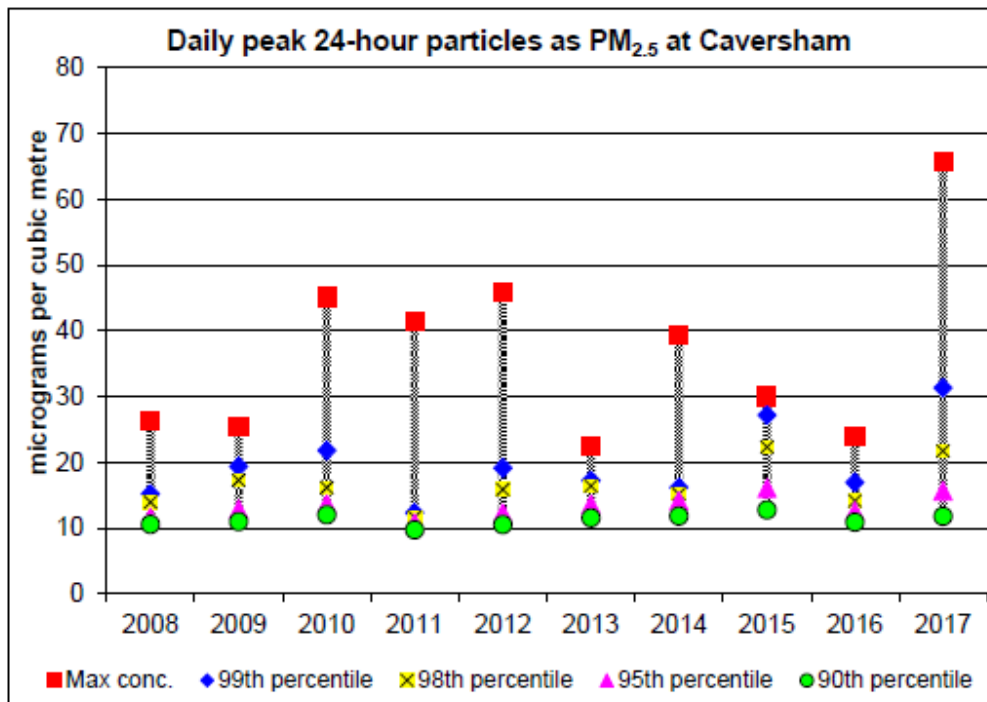


Figure 2-24 Long term 24-hour PM_{2.5} concentration percentiles at Caversham

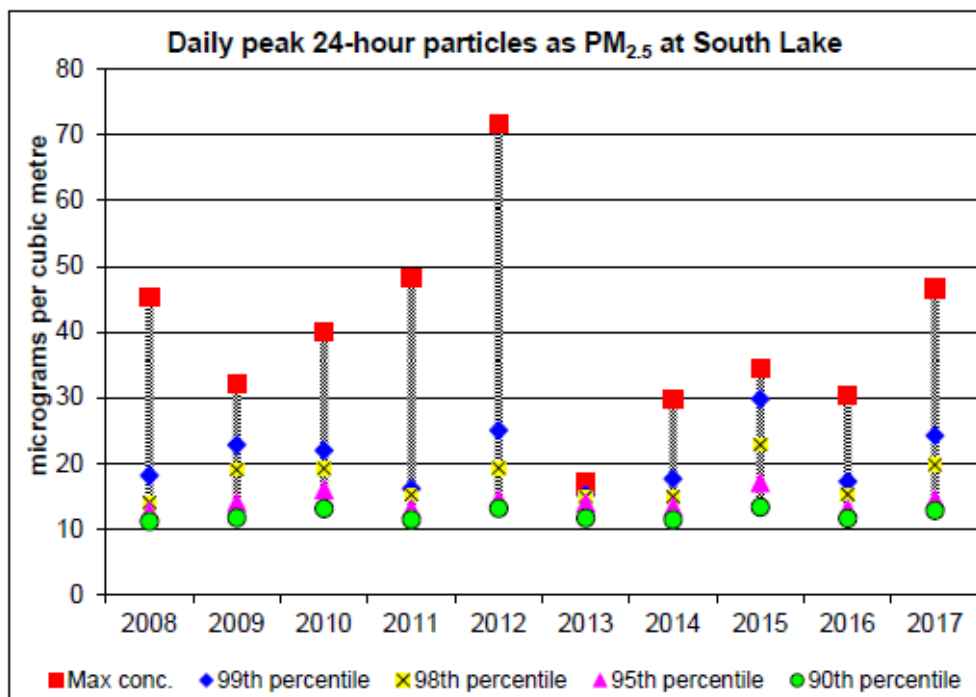


Figure 2-25 Long term 24-hour PM_{2.5} concentration percentiles recorded at South Lake

2.7 Pressures

We have identified five key pressures likely to impact the condition of the atmospheric environment as discussed below. Our team understands that the key pressures on ambient air quality within the Shire align with those identified in the Australia State of the Environment Report 2016: growing population, greater urban density and increasing car travel (with a slowing in the growth of public transport patronage). We will discuss these pressures in the local context and determine how the existing and projected responses may influence and change these pressures.

2.7.1 Population growth

In 2017, the population of the Shire of Serpentine Jarrahdale was estimated to be 29,566 (Australia Bureau of Statistics 2018). Western Australia Tomorrow forecasts population in the Shire to be between 59,220 and 66,100 by 2031 (Department of Planning, Lands and Heritage).

An increase in population is likely to lead to an increase in the consumption of natural resources, in the form of gas for cooking and heating, petrol and diesel combustion for transport and power, and wood burning for heating. The use of aerosols and other synthetic products also increases with population growth.

Population growth in the Shire of Serpentine Jarrahdale is likely to result in an increase in car use on local roads. However, Metronet has proposed to extend the Armadale train line approximately eight kilometres south to Byford (Shire of Serpentine Jarrahdale 2019a), servicing the Byford Town Centre. It is anticipated that this railway extension will support opportunities for redevelopment and increase the walkability of the district. The extension of the railway may also encourage the use of train to access Perth City, with the Armadale line terminating at Perth Underground Station. This will encourage public transport patronage and in turn help to reduce emissions from vehicles. Construction of the Armadale train line extension to Byford is expected to commence in 2021.

2.7.2 Urbanisation

Cities are major contributors to climate change: although they cover less than 2 per cent of the earth's surface, urban areas account for 71 to 76 per cent of the world's carbon dioxide from global final energy use and a significant portion of total greenhouse gas emissions (UN-Habitat).

Urbanisation in the Shire includes expansion of industrial and business areas such as the proposed West Mundijong Industrial Area. This area is situated in Mundijong in the Shire of Serpentine Jarrahdale and will cover an area of 474 ha. Currently, the land is zoned rural and is used for pasture. It has been proposed to re-zone the land for industry and would be split into the following land-use classes: fuel depot, general industry, light industry, trade display, transport depot and warehouse among others.

A change in land-use has the potential to affect the dispersion and fate of air pollutants, although on a local scale this effect is likely to be small. Surface roughness, Albedo and Bowen ratio are three parameters that are affected by land-use type and play a role in categorising the layer of air above that area and subsequently the movement of pollutants

in the air. For example a paved industrial area may be more subject to heating and cooling than vegetated land and this would affect the immediately surrounding air by encouraging convection or advection.

With an increase in industry, transport corridors will also be required to allow flow of people and materials. It has been proposed to extend Tonkin Highway to the proposed West Mundijong Industrial Area for this purpose. This will likely result in the increase of light and heavy road traffic, contributing to air emissions.

2.7.3 Climate change

Climate change is a significant stress on the atmosphere, affecting long-term climate trends and local weather, and as a result has the ability to affect air quality. Climate change cannot be resolved in one area locally, but is dependent on a global change made up of combined efforts from all over the world. In the Shire of Serpentine Jarrahdale, steps can be taken at the local scale to contribute to the mitigation of climate change (as discussed in Section 2.4).

2.7.4 Bushfires

Bushfires and prescribed burning are prevalent in Western Australia and have the potential for much destruction and detrimental emissions to air. Bushfires result in the emissions of particulate matter (total suspended particles, PM₁₀ and PM_{2.5}), carbon dioxide, and various volatile organic compounds from the burning of bush material. These pollutants can cause harm to human health, particularly to children, the sick and elderly. Particulate matter suspended in the air can also reduce visibility leading to dangerous situations. Once the particulate matter is deposited onto surfaces such as plants this may continue to cause detriment by reducing light to leaves and inhibiting photosynthesis until such time as rain washes the deposition away. This also has the ability to increase leaf temperature and interfere with diffusion of gases into and out of the leaves.

From Table 2-5 it can be seen that all exceedances of the NEPM standards for PM₁₀ and PM_{2.5} in 2017 were caused by prescribed burning at one or more locations in the south west of Western Australia.

2.7.5 Wood heaters

Wood heaters are widely used for residential heating in Australia. Regional towns in particular use firewood as their main source of heating compared to capital cities, which rely more on natural gas (Murdoch University 2019). Western Australians burn through 0.57 million tonnes of firewood per year (Driscoll, Milkovits & Freudenberg 2000). Smoke from wood heaters is a concern as it contributes to gas and particulate matter emissions (EPA Victoria 2016). In winter, wood smoke is particularly concerning when the use of wood heaters is extensive and prevailing weather conditions (often early in the morning) exacerbate wood smoke conditions. Several steps can be taken to reduce wood smoke emissions.

2.7.6 Industry

Industrial facilities may emit harmful emissions to air depending on the processes utilised at the facility. Certain facilities may also rely on stockpiling for storage of material or expose large areas of cleared land, both of which have the potential to contribute to wind-blown emissions.

The proposed industrial development in West Mundijong may have the potential to contribute to emissions of air pollutants both during the construction and operational phases. Mechanical dust generation from earthworks as well as gaseous emissions from diesel combustion (vehicle exhaust and power supply) may arise from both phases of development. However, these dust emissions can be managed through the use of dust management plans, and other air pollutants can be minimised through appropriate design and mitigation measures. Further information was not available as to the nature of operations at the proposed West Mundijong development at the time of writing this report as the proposal was in the statutory planning and approval process, however emissions of specific pollutants will vary depending on the facilities located at the site.

2.8 Responses

The following responses are suggestions to help minimise pressures on the atmosphere and are categorised based on the consequences of the pressures listed above. They have been designed to be implemented at the local government level and represent both long-term and short-term solutions.

2.8.1 Reduce vehicle emissions

One way to reduce vehicle emissions in a local area is to encourage alternate methods of transport including public transport, walking or cycling. This can be encouraged in several ways and on several scales for short-term and longer-term solutions.

The cost and required infrastructure for each solution varies and are shown in Table 2-6.

Table 2-6 Responses to reduce vehicle emissions

Solution	Investment	Cost	Desired outcome/benefit
Encourage walking for short trips through local advertising and engagement of community groups. Also encourage cycling for short-medium length trips.	Short-term	Lower	Reduction in vehicle usage for short trips.
Encourage walking or riding over driving to public transport nodes.	Short-term	Lower	Reduction in driving to public transport nodes. Additional benefit includes less congestion in public transport carparks.
Plan and construct walkable cities through urban design. Consider linkages between public transport nodes such as bicycle/walking paths. Consider end-of-trip facilities.	Long-term	Higher	A city that is designed for walking/riding will encourage such methods of transport over driving, reducing vehicle emissions. Linkages between public transport nodes and access to end-of-trip facilities will increase public transport patronage.
Consider zoning when planning city design. For example, keep retail, leisure and public spaces in one hub and industry in a separate hub.	Long-term	Higher	This will encourage errands to be completed in the one trip either via walking, or with a single trip in the car as opposed to several, reducing vehicle emissions.
Construct bicycle paths and bicycle-friendly road infrastructure.	Long-term	Higher	Reclaiming road space for the use of bicycles will encourage bicycle usage and reduce vehicle emissions.
Implement bike sharing scheme either through local government or a private enterprise.	Short-term	Lower	Bike-sharing will reduce car usage and vehicle emissions.

There are several initiatives already in place that aim to achieve a reduction in vehicle use.

YourMove is the main program within Western Australia that encourages alternate methods of transport. YourMove is a community based behaviour change program run by the Department of Transport (DoT) that supports schools, workplaces and individual participants to reduce their car use and instead try walking, bike riding, and public transport to get around their city and local area. This program has combined and replaced the TravelSmart (DoT) and ActiveSmart (DoT and Department of Sport and Recreation) programs. YourMove has not been actively rolled out in the Shire of Serpentine Jarrahdale, and there has therefore not been a huge uptake. However, the Woodland Grove Primary School is participating in the YourMove Schools program. The Shire can look at opportunities to partner with the Department of Transport in the roll out of the program locally – potentially combining with the Byford train station and new bike paths located within new residential developments.

The Shire of Serpentine Jarrahdale is currently reviewing its Cycling and Walking Plan. The revised plan is proposed to align with DOT's Perth and Peel Long Term Cycle Network Plan 2014-2031. This plan aims to encourage cycling as a widely accepted form of

transport, focussing on connectivity, convenience and safety. The goals of the Cycling and Walking Plan include:

- “Define Serpentine Jarrahdale’s long-term cycle and pedestrian network
- Recommend infrastructure improvements based on analysis of the current network and data collection
- Align routes with DoT’s Perth Transport Plan
- Consider end of trip infrastructure – bike parking and repair post
- Identify route connection opportunities from the Cycle and Walking Plans of neighbouring local governments
- Identify wayfinding signage improvements and behaviour change strategies to encourage the use of the existing and proposed facilities
- Consider events that relate to cycling or walking” (Shire of Serpentine Jarrahdale 2019c).



New development areas such as Byford are resulting in improved pedestrian and cycle paths. The Glades, Byford Revised Local Structure Plan 2019, for example, identifies Mead Street, Doley Road and Orton Road as suitable for cycle/dual use paths. The Byford Town Centre Local Structure Plan also highlights a community need for cycle/pedestrian paths to connect the centre to residential areas and primary schools.

The Mundijong/Whitby District Structure Plan (Shire of Serpentine Jarrahdale 2010) sets out recommendations in order to achieve certain principles and objectives relating to the area’s structure and form. The Structure Plan proposes a Transport Philosophy which promotes public transport, walking and cycling as attractive modes of transport over private vehicle usage. The Structure Plan recommends the following:

- High quality network of well-lit and safe footpaths, walking and cycling routes
- Connectivity between urban cells for pedestrians and cyclists
- Well designed and safe crossing points around local centres
- Cycle storage facilities
- Well designed and located public transport infrastructure (e.g. bus stops and shelters)
- Park and Ride facilities at bus and train interchanges

The Shire is developing a Cycling and Walking Plan. This plan investigates current participation in walking and cycling and impediments to active transport. The plan recommends continued investment in the primary, secondary and local path network with the aim to improve the network as the population grows (GHD 2019).

2.8.2 Bushfire

While prescribed burning is necessary to prevent larger, more destructive bushfires during the summer months, they have the potential to increase emissions of particulate matter as shown in Section 2.6.3. Steps can be taken, however, to minimise the risk of exceedances of Air NEPM criteria for particulate matter.

Prescribed burning in the Shire of Serpentine Jarrahdale is subject to the *Bush Fires Act 1954* (the Act) (Western Australian Government 2019). Residents within the Shire of Serpentine Jarrahdale require a burn permit prior to undertaking a prescribed burn on their property if the burn is to take place within the restricted burning period (April to May and October to November). The resident undertaking the burning must comply with the conditions set out in the burn permit.

A resident wishing to conduct a prescribed burn is required to notify the Department of Parks and Wildlife, local government, the Department of Fire and Emergency Services, all adjoining land owners and, if a permit is required, any other person as stated as a condition of the burn permit. By informing these authorities of the proposed prescribed burn, it is added to the Emergency WA App's list of prescribed burns. With this information, local government may designate specific dates on which the burn may take places so as to not allow several burns simultaneously, which is likely to cause adverse air quality impacts due to smoke.

The Shire of Serpentine Jarrahdale also recommends considering a Burn Plan (available on the Shire of Serpentine Jarrahdale website), which takes into consideration weather conditions such as wind direction, wind speed and forecasted wind shifts. The Burn Plan includes actions to take in the event that hazardous smoke conditions arise.



2.8.3 Reduce wood heater emissions

The most significant method to reduce smoke from wood heaters is to operate them correctly. NSW Environmental Protection Authority (EPA) provides ten steps to reduce smoke from wood heaters. These are:

1. “Don’t let your heater smoulder overnight – keep enough air in the fire to maintain a flame.
2. Burn only dry, aged hardwood in your wood heater. Unseasoned wood has lots of moisture, which causes a fire to smoke.
3. Store your wood under cover in a dry, ventilated area. Freshly cut wood needs to be stored for at least eight to twelve months.
4. Never burn rubbish, driftwood or painted or treated wood. These are sure to pollute the air and can produce poisonous gases.
5. When lighting a cold heater, use plenty of dry kindling to establish a good fire quickly.
6. Use several small logs rather than one large log and stack them loosely in your heater, so air can circulate around them. Don’t cram the firebox full.
7. Keep the flame lively and bright. Your fire should only smoke when you first light it and when you add extra fuel. Open the air controls fully for 5 minutes before and 15 to 20 minutes after reloading the heater.
8. Check your chimney regularly to see how well your fire is burning. If there is smoke coming from the chimney, increase the air supply to your fire.
9. Have the chimney cleaned every year to prevent creosote build-up.
10. If you are buying a wood heater, make sure it has a compliance plate showing it meets the Australian Standard (AS/NZS 4013:1999).” (NSW EPA 2018).

NSW EPA also provides information, including a Council Resource Kit, on how to reduce wood smoke locally through community education campaigning. Resources are available at <https://www.epa.nsw.gov.au/your-environment/air/reducing-wood-smoke-emissions/council-resource-kit>.

2.8.4 Industrial development

The construction of large new industrial areas will increase the emission of harmful pollutants to air; however, these facilities are required to comply with local and federal laws. The DWER regulates industrial emissions and discharges to the environment through a works approval and licensing process, under Part V of the *Environmental Protection Act 1986*. Large industries will also be required to report their emissions under the National Pollutant Inventory requirements to ensure these facilities do not increase their emissions above the allowed (licenced) limits.

An air quality monitor may be installed within the Shire of Serpentine Jarrahdale (particularly at sensitive receptors such as a residential area or school) in order to monitor the ambient air quality of the Shire. This may help to inform if emissions increase with population growth, urbanisation or any other pressure and if responses to these pressures are effective.

The Draft State Planning Policy 4.1 – Industrial interface (Draft SPP 4.1) guides planning decisions in order to avoid encroachment of sensitive receptors and land uses on industry

and infrastructure facilities (Department of Planning, Lands and Heritage 2017) and vice versa, seeking to prevent land use conflicts . The Draft SPP 4.1 states that local planning schemes should “Identify compatible land use zones and/or reserves to provide a transition between general industry and sensitive land uses” (Department of Planning, Lands and Heritage 2017).

The Draft SPP 4.1 also indicates that these land use zones (or buffers) should be determined taking into account potential impacts of the industry offsite as well as future planned development such as the requirement of an industrial facility to expand to service an increasing population. By including buffer regions between industry and sensitive land-use areas, the potential adverse impacts to air quality resulting from the industry are less likely affect the sensitive land use areas. The Draft SPP 4.1 suggests a light industry zone as a buffer as this will provide a range of industrial uses and service industries that are generally compatible with urban areas. A service/commercial zone is also considered an appropriate buffer zone between industry and sensitive land-use areas (Department of Planning, Lands and Heritage 2017).

2.8.5 Summary of responses

	Response	Potential actions
Climate change	2.4.1 Shire greenhouse gas emissions reductions	Energy audits (higher energy users, inc. solar/battery storage etc.) Small facility energy audits Continue participation in Switch Your Thinking
	2.4.2 Residential greenhouse gas emissions reductions	Continue participation in Switch Your Thinking Encourage utility scale battery use in new developments Improve sorting practices to increase recycling rates from hard waste
	2.4.3 Sustainable built form	Implement the Urban and Rural Forest Strategy 2018-2028 Consider preparation of design guidelines to complement SPP 7.0 and Design WA
	2.4.4 Schools greenhouse gas emission reductions	Continue participation in Switch Your Thinking Consider partnerships with State Government to promote existing programs e.g. YourMove Schools, Wastewise Schools
	2.4.5 Business greenhouse gas emission reduction	Continue participation in Switch Your Thinking
	2.4.6 Renewable energy production	Consider updates to the local planning framework to better consider renewable energy facilities
	2.4.7 Agriculture	Investigate partnerships with the State Government
Ambient air quality	2.8.1 Reduce vehicle emissions	Implement the Cycle and Walking Plan 2019
	2.8.2 Bushfire	Continue current practice
	2.8.3 Reduce wood heater emissions	Consider promotion of methods to reduce smoke from wood heaters
	2.8.4 Industrial development	Continue current practice

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Theme Two: Land

3. Theme Two: Land

3.1 Overview

The Shire is made up of several unique terrestrial landscapes, broadly classified as the Swan Coastal Plain and Darling Ranges, bisected by the Darling Scarp. These landscapes contain a diversity of animals, vegetation, soil biology and climates. The health and condition of the soils influence the types of vegetation that exists, while changes to vegetation caused by natural and human events such as bushfire, clearing and resource mining affect the condition of the soils. The Shire, as with all human economies, relies on the use of the land and its resources. Land management practices are critical in determining the health and condition of the Shire's soils and vegetation.

In this section, we describe the key components of land, being soil, vegetation and resources, along with how the various themes discussed in other sections of this report interact with land. This section also looks at how the key drivers of climate change, population growth and urbanisation impact land and recommendations for developing management approaches to address these pressures.

3.1.1 Strategic alignment

Managing impacts to land may be defined as falling under several categories in the Shire of Serpentine Jarrahdale Strategic Community Plan, namely Place and Prosperity.

Place – Managing land contributes to a sustainable natural environment and a productive rural environment reducing the impacts of the local settlements and activities to these environments

Prosperity – Managing land is critical to maintaining the important agricultural and horticultural activities that support the Shire's economy. Managing land also supports the health of the significant natural environment that attracts tourists to the area.

3.1.2 Policy and regulatory framework

3.1.2.1 Planning and Development Act 2005

The *Planning and Development Act 2005* (PD Act) establishes the Western Australian Planning Commission and provides for an efficient and effective land use planning system which promotes sustainable use and development of land. The PD Act is supported by State Planning Policies which are the highest level of planning policy control and guidance. State Planning Policies relevant to the protection and management of land include:

- State Planning Policy 2 – Environment and Natural Resources Policy (SPP 2)
- State Planning Policy 2.4 - Basic Raw Materials (SPP 2.4)
- State Planning Policy 2.5 – Rural Land (SPP 2.5)
- State Planning Policy 3.7 - Planning in Bushfire Prone Areas (SPP 3.7)
- State Planning Policy 4.1 – State Industrial Buffer Policy (SPP 4.1)

Under the PD Act, local governments are responsible for planning their local communities by ensuring appropriate planning controls exist for land use and development. They do this by preparing local planning schemes and strategies.

Local planning schemes set out the way land is to be used and developed, classify areas for land use and include provisions to coordinate infrastructure and development within the local government area. Town Planning Scheme No.2 (TPS2) is the local planning scheme for the Shire.

3.1.2.2 Environmental Protection Act 1986

The purpose of the *Environmental Protection Act 1986* (EP Act) is to protect the State's environment. The application of the Act must have regard to a number of principles, including the principle of conservation of biological diversity and ecological integrity. Clearing native vegetation is an offence under the EP Act, unless done under a clearing permit or the clearing is for an exempt purpose. The Department of Water and Environmental Regulation (DWER) administers the clearing provisions of the EP Act.

3.1.2.3 Land Administration Act 1997

The purpose of the *Land Administration Act 1997* is to manage matters relating to Crown land and compulsory acquisition of land. More specifically the Act includes matters relating, but not limited to, reserves, roads and easements, which are particularly relevant within the Shire. The Act is administered by the Department of Planning, Lands and Heritage.

3.1.2.4 Contaminated Sites Act 2003

The *Contaminated Sites Act 2003* was introduced to identify, record, manage and clean up contamination. Under the Act, known or suspected contaminated sites must be reported to the DWER, investigated and, if necessary, cleaned up (remediated).

DWER administers and enforces the Act which includes classifying sites (in consultation with the Department of Health) and making information on contaminated sites available to the public. Investigating and cleaning up contaminated sites is, in most cases, the responsibility of the polluter or current site owner.

A site classification is a description assigned to an area of land that has been reported to DWER under the Act, as a site that is known or suspected to be contaminated. DWER can allocate one of seven classifications to sites.

3.1.2.5 Soil and Land Conservation Act 1945

The *Soil and Land Conservation Act 1945* relates to the conservation of soil and land resources and aims to mitigate the effects of erosion, salinity and flooding. The Act has the ability to reserve land as soil conservation reserves, prepare conservation covenants and agreements for reserves and establish the Landcare Trust. The Act is administered by the Department of Primary Industries and Regional Development.

3.1.2.6 Mining Act 1978

The Mining Act 1978 relates to mining activities in Western Australia. The Act enables land to be set aside for prospecting, exploration and mining. Mining includes mineral sands which are present within the Shire. The Act is administered by Department of Mines, Industry Regulation and Safety.

3.2 Condition

Noongar Aborigines of the Whadjuk and, probably, Bindjareb tribes hunted and camped in the woodlands between modern-day Perth and Pinjarra. The Shire is located within the Gnaala Karla Boodja region and the recognised traditional owners are the Gnaala Karla Boodja people. Additional information on the traditional owners of land within the Shire can be found in Theme 6: Heritage.

The Shire's evolution is founded in the land it sits within. Good soils and access to markets allowed the growth of a very stable farming and orchard area. In recognition of the other natural resources present in the area, other industries formed - timber processing based on local forest products and brickworks based on local shale and clay. In the late seventies, these were supplemented by Alcoa's bauxite mining with a crushing plant in Jarrahdale, all of which provided local employment further connecting the people with the land.

Today, small-holdings and a rural lifestyle have seen the development of equestrian establishments and the Shire is a known focus area for those seeking rural lifestyle choices. The area is recognised for its food production capability and it is necessary to balance housing needs with the protection of agricultural land.

It is important to understand the many services that the land provides to protect the attributes important to successful agriculture, local industry, preservation of natural areas and maintaining the strong sense of character associated with the Shire.

3.2.1 Land use

Land use in the Shire has historically been focussed on rural land uses and forestry. Through the development of SJ2050 and draft Local Planning Strategy 2018, the Shire is planning for the continuation of these land uses with urban and residential expansion restricted to designated nodes in Byford, Mundijong and Serpentine (Figure 3-1).

A significant proportion of the Shire is designated for rural purposes and state forest under the Metropolitan Region Scheme (MRS) (Table 3-1).

The Agriculture, Forestry and Fishing industry sector makes up 10.7 percent of the Shire's employment and 13.6 percent of the Shire's economic output (second behind construction at 32.5 percent) (.idcommunity 2018). Agricultural land uses are focussed to the west of the Shire with forestry to the east in the State Forest.

Table 3-1 MRS land area within the Shire

Zone/Reserve	Approx. Land area (ha)	Percentage of total land area
Reserve		
State Forest	36,210	40.2%
Parks and Recreation	7,357	8.2%
Primary Regional Road	495	0.6%
Other Regional Road	80	0.1%
Railways	310	0.3%
Public Purpose*	578	0.6%
Waterways	1,170	1.3%
Zones		
Urban	2,889	3.2%
Urban deferred	241	0.3%
Industrial	592	0.7%
Rural	39,591	44.0%
Rural – water protection	483	0.5%

*includes hospital, prison, special use, State Energy Commission and Water Authority of WA

Rural lifestyle areas within the Shire provide an important opportunity for the community to live outside the urban settlements and enjoy the rural lifestyle of the Shire. The Shire's local planning scheme provides the following zones that cater for rural lifestyle lots:

- Special residential zone – allows for spacious living at lower densities than transitional residential areas, but higher than special rural zones.
- Rural residential zone – to facilitate rural living on lot sizes 2000m² – one hectare.
- Special rural zone – provides land for hobby farms, horse training and breeding, rural residential retreats and intensive horticulture.
- Rural living A and B zones – enables rural residential development on lots 4000m² – one hectare (rural living A) and two – four hectares (rural living B).
- Farmlot zone – provides land for rural living with larger land parcels (four – 40 hectares) and potentially suitable for some agricultural production.

Many of the Shire's rural lifestyle areas support the equestrian industry. The Shire's Draft Local Planning Strategy (2018) notes that the Shire is home to an estimated 3,876 horses – the highest for any local government area in the state. The Shire has also developed the Equine Strategy 2018 to continue to support the equine industry.

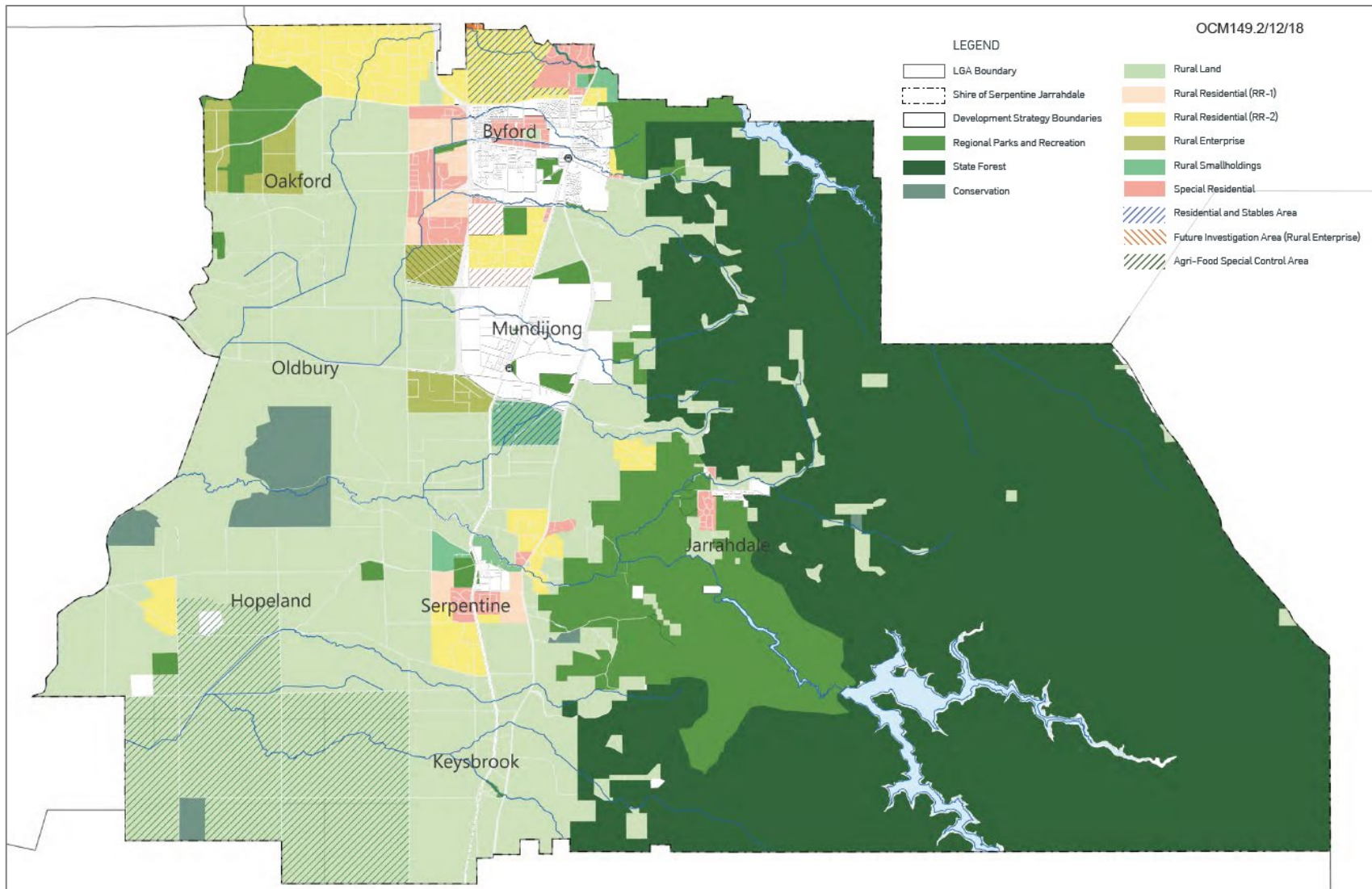


Figure 3-1 Identification of rural land, draft Local Planning Strategy (Shire of Serpentine Jarrahdale, 2018)

3.2.1.1 Land capability assessment

Land capability is the ability of land to support a given land use without causing damage. Assessment of land capability considers the specific requirements of the land use (e.g. rooting depth or soil water availability) and the risks of degradation associated with the land use (e.g. phosphorus export hazard or wind erosion) (DPIRD, 2019a).

Land capability assessments are a first step in assessing land suitability for a given use. 'Suitability' considers other factors such as economics, infrastructure requirements, labour access, water and energy access, conflicting and complementary land uses, and the policy framework (DPIRD, 2019a).

Land capability assessments have influenced how land has been zoned under Town Planning Scheme No.2 (TPS2). For example, land classified as having a high land capability for annual and perennial horticulture and grazing has been protected through scheme provisions and policy since 1994 when the Rural Strategy was originally developed by the Shire (Shire of Serpentine Jarrahdale, 2013).

3.2.2 Soils

The Australian Soil Resource Information System (ASRIS) provides a hierarchy for the classification of soil type and landforms present in Australia. This standardisation enables scientific research, communication and organisation of knowledge. The ASRIS classification has been used as an initial indicator for understanding soil within the Shire.

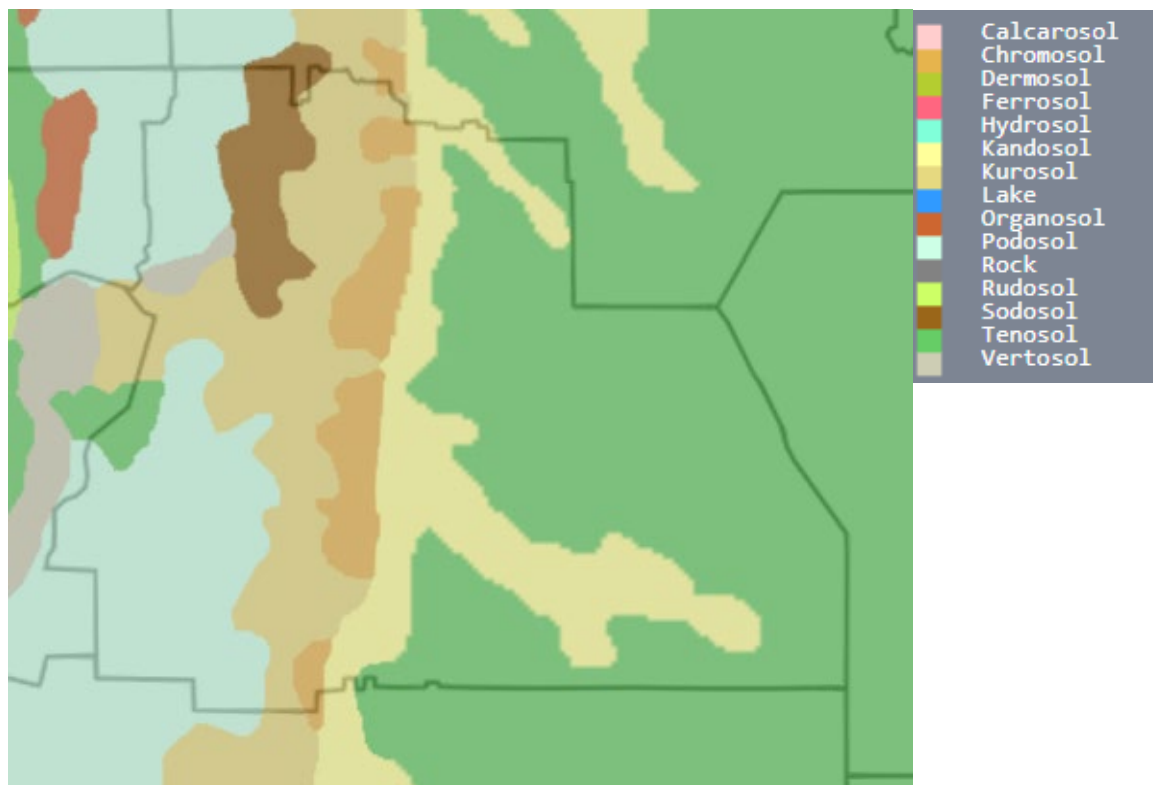


Figure 3-2 Generalised map of soil orders for Australia (Lan16, SoE 2016)

Soil classification within the Shire of Serpentine Jarrahdale is broadly influenced by the two geological regions within the Shire, being the Swan Coastal Plain to the west and the Darling Range to the east, bisected by the Darling Scarp.

There are five soil types within the Swan Coastal Plain region, moving in a generally linear pattern from the Darling Scarp westwards to the western boundary of the Shire. Kurosol and podosol soils make up the majority of the soil types within the Shire's Swan Coastal Plain region (Figure 3-2).

- Chromosol – Neutral to alkaline soils with a sharp increase in texture with depth
- Kurosol – Acid soils with sharp increases in texture with depth
- Sodosol – Soils with sodic subsoils, which are often alkaline and with a sharp increase in texture with depth
- Podosol – Soils with accumulated organic matter, aluminium and iron.
- Vertosol - Cracking clays
- Tenosol – Slightly developed soils

There are two soil types within the Darling Range landform comprising the eastern portion of the Shire, moving to the eastern boundary:

- Kandosol – Strongly weathered earths with minor changes in texture with depth
- Tenosol – Slightly developed soils

The Shire's Rural Strategy Review 2013 document identifies the various landscape systems within the Shire and their characteristics, including soil type, based on the DPIRD soil landscape mapping (GoWA 2018). Soil landscape systems are shown on Figure 3-3 and described in Table 3-2.

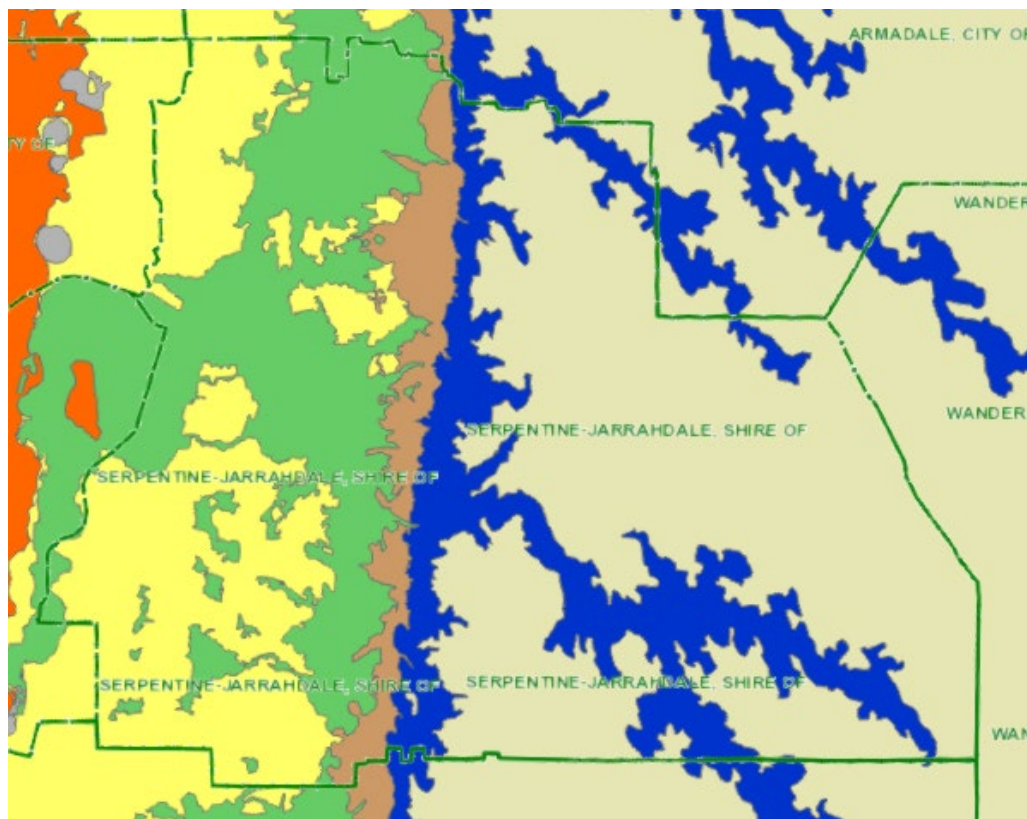


Figure 3-3 Soil Landscape Systems (DPIRD-064), legend provided in Table 3-2

Table 3-2 Soil landscape systems (DPIRD)

Landscape system	Landform	Geology	Soils	Location
Bassendean System	Sand dunes and sand plains with flats and swamps	Sandy alluvium over sedimentary rocks	Pale deep sands, semi-wet soils and wet soils	Stretches north to south throughout the western side of the Shire
Pinjarra System	Poorly drained coastal plain	Alluvium over sedimentary rocks	Semi-wet soils, grey deep sandy duplexes, brown loamy earths, pale sands and clays	Stretches north to south through the central section of the Shire (across the existing townsites) and extends west into the Palusplain
Forrestfield System	Undulating foot slopes of the Darling and Whicher Scarps	Colluvium over granitic and sedimentary rocks	Duplex sandy gravels, pale deep sands and grey deep sandy duplexes	Along the foothills of the Scarp
Murray Valley System	Deeply incised valleys	Colluvium over granitic rocks	Red loamy earths, shallow duplexes and rock outcrop	Stretches north to south along the Darling Scarp
Darling Plateau	Lateritic plateau	Deeply weathered mantle over granitic rocks	Duplex sandy gravels. Loamy gravels, shallow and deep gravels, deep sands and wet and semi-wet soils	Most of the eastern section of the Shire

Key indicators of soil condition can be found in its physical, chemical and biological makeup. In particular, these include changes to the soil's carbon dynamics, acidification and erosion. In addition, the contamination of soil due to human activity is also an indicator of soil condition. These topics are discussed in more detail in the sections below.

3.2.2.1 Carbon dynamics

The carbon content of soil is a key indicator of its health and reflects the soil's ability to undertake key biological processes including nutrient cycling, development of soil structure and water storage. The management of carbon within soils is central to the maintenance of soil health and ensuring global food security.

Soil organic carbon (SOC) is inherently low in Western Australian soils – limited by climate and soil type – with some potential to increase through management. Actual SOC stocks are only known for a small portion of Western Australia; however, benefits from increasing SOC in the agricultural areas include improved nutrient cycling, increased water-holding capacity, increased plant yield, and sequestering the greenhouse gas carbon dioxide.

There are no measured trends in SOC levels at district, regional or state level in WA.

3.2.2.2 Acidification

Native plants are adapted to the natural soil pH, whether acid or alkaline; however, acidity is an inevitable consequence of productive agricultural systems. Unless managed through the application of agricultural lime, the soil pH will decline (becoming more acidic), resulting in:

- Poor nutrient availability
- Poor root growth which leads to decreased nutrient uptake, water uptake, and therefore crop yield

(Gazey and Andrew, 2009).

pH levels below 5.5 are considered to be critical with subsurface soils continuing to acidify because there is insufficient alkalinity available to move down to treat on-going acidification due to agriculture. Once acidified, recovery of subsurface soil pH to levels where plant root growth is not affected by aluminium toxicity can be difficult, requiring applications of several tonnes per hectare of lime and 5 to 10 years (Davies et al., 2008). In 2009, topsoil sampling indicated an average pH of 5.1 in the Shire (below the critical level) from 33 samples (Gazey and Andrew, 2009). Current DPIRD mapping also indicates that current soil acidity is potentially quite low (below pH 4.5) across significant portions of the Shire (Figure 3-4).

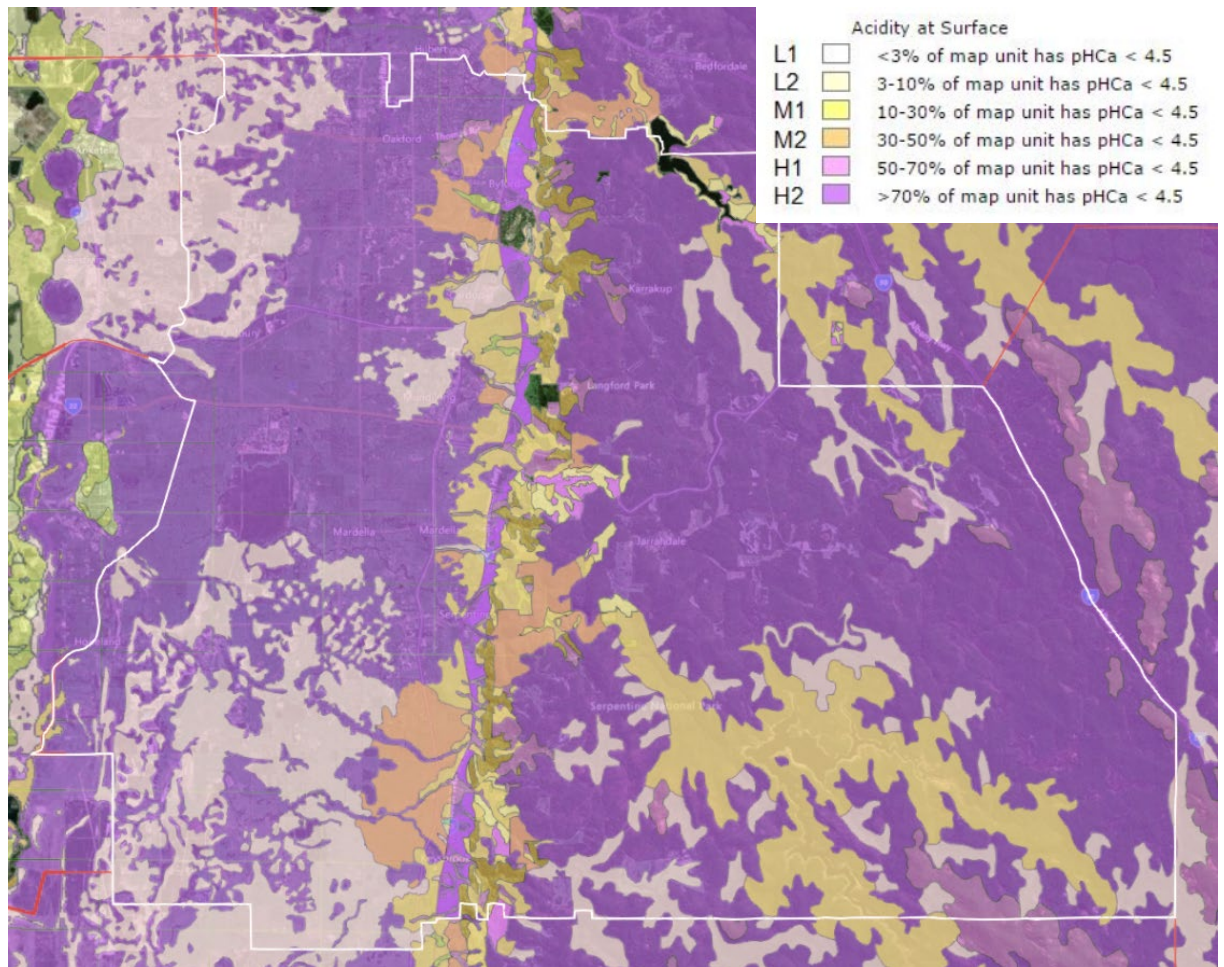
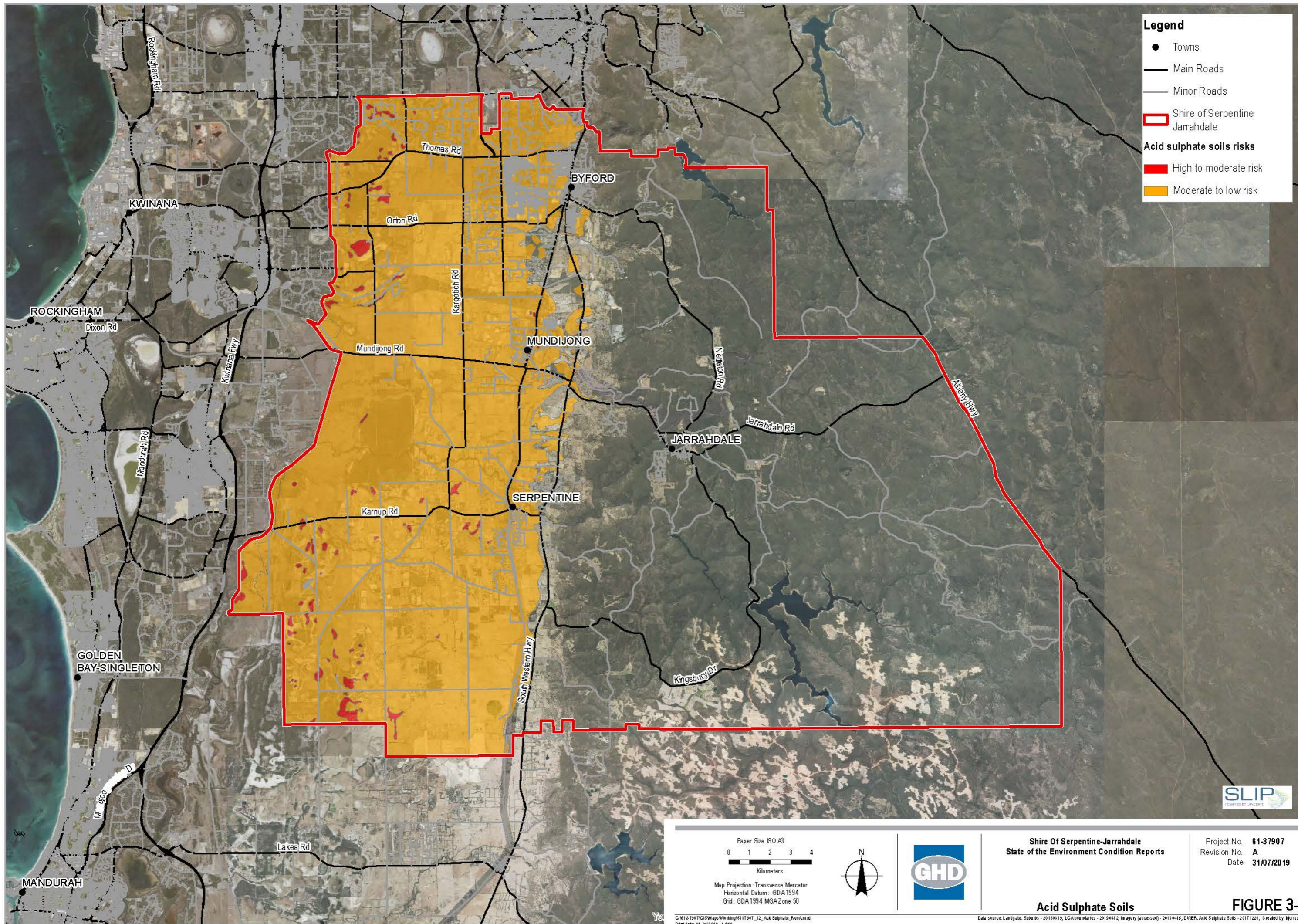


Figure 3-4 Current soil acidity (DPIRD-027, 2019)

3.2.2.3 Acid Sulfate Soils

Acid sulfate soils (ASS) occur naturally in Western Australia and are harmless when left in a waterlogged, undisturbed environment. However, when exposed to air, through drainage or excavation, the iron sulfides in the soils react with oxygen and water to produce iron compounds and sulfuric acid. This acid can release other substances, including heavy metals, from the soil and into the surrounding environment and waterways. Activities with the potential to disturb ASS must be managed carefully to avoid serious environmental harm (DWER, 2019).

Current mapping indicates that most of the soil within the Shire has a moderate to low risk of acid sulfate soils with pockets of high to moderate risk (Figure 3-5).

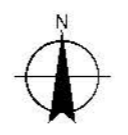
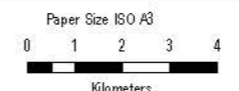


Legend

- Towns
- Main Roads
- Minor Roads
- ▭ Shire of Serpentine Jarrahdale

Acid sulphate soils risks

- High to moderate risk
- Moderate to low risk



Shire Of Serpentine-Jarrahdale
State of the Environment Condition Reports

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Date 31/07/2019

Map Projection: Transverse Mercator
Horizontal Datum: GDA1994
Grid: GDA1994 MGA Zone 50

Acid Sulphate Soils

FIGURE 3-5

3.2.2.4 Salinity

Dryland salinity is one of the greatest environmental threats facing Western Australia's agricultural land, water, biodiversity and infrastructure. Dryland salinity (salinity on non-irrigated land) is defined as salinity at or near the soil surface causing reduced plant growth, reduced water quality and damage to infrastructure (DPIRD, 2019).

More than 1 million hectares of agricultural land in the south-west of Western Australia (WA) is severely affected by salt. The lost agricultural productivity from salinity damage is estimated to be worth at least \$519 million per year. Even though climate change has resulted in reduced annual rainfall, saline watertables have risen in many areas, meaning that dryland salinisation is a threat to an additional 2.8 to 4.5 million hectares of low-lying or valley floor soils (DPIRD, 2019).

The DPIRD has undertaken salinity risk mapping across Western Australia; there are areas with a medium to high risk of salinization across the Shire (Figure 3-6). These locations are at risk from secondary salinity which develops as a result of changed land use and management. In Australia, clearing for agriculture (such as that which has occurred in the Shire) has been the major driver of this change, because deep-rooted, perennial native vegetation has been replaced with shallow-rooted annual crops and pastures, and this change allows more groundwater recharge (DPIRD, 2019).

Native vegetation has evolved deep roots and tolerance to the highly variable climate in southern Australia, whereas most agricultural plants are short-season annuals that generally have shallow root systems and do not use all of the rainfall. This unused rainwater either runs off or infiltrates beyond the root zone and accumulates as groundwater. The extra water entering the groundwater system (recharge) raises the watertable, mobilising salts stored in shallower unsaturated soil above. When the watertable nears the soil surface (less than 2 metres below the surface), groundwater can seep out (discharge) and evaporation concentrates salts at the surface (DPIRD, 2019).

Salinity is usually noticed when plants grow poorly and yields of farm crops and pastures are reduced by more than 25–30 percent. In severe cases, bare patches, known as salt scalds, develop with salt obvious on the surface. Where groundwater seepage is apparent, saline areas are referred to as saline seeps or seepage scalds.

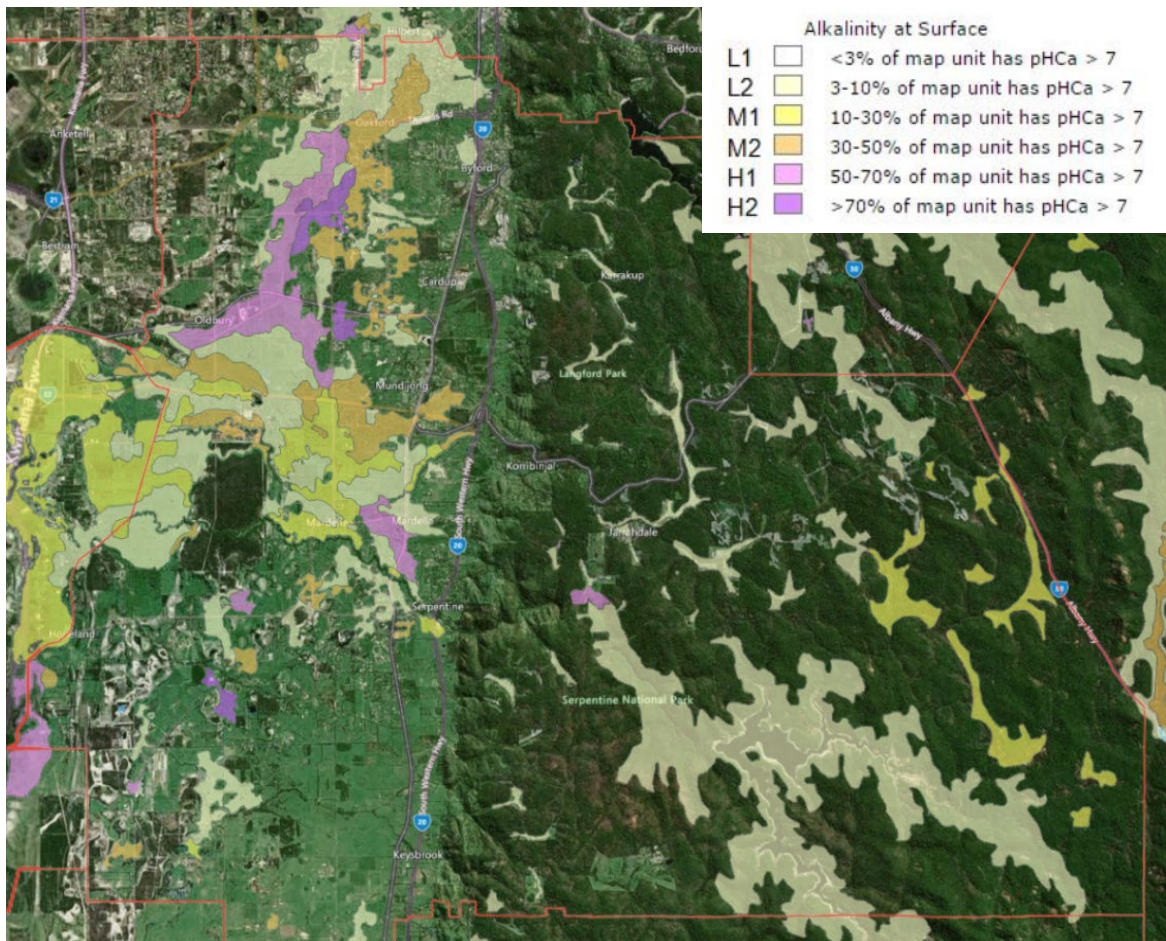


Figure 3-6 Salinity Risk (DPIRD-009)

3.2.2.5 Soil erosion

Water erosion to soil can occur when raindrops hit the soil surface and displace soil particles, and when water flowing over the land surface moves soil particles. It is a natural process often accelerated under agriculture, especially on cropped land. Water erosion causes loss of topsoil, reduced crop yields, damaged infrastructure, weed dispersal, eutrophication (algal blooms) and silting of dams and natural waterways.

The averaged annual direct cost of water erosion to dryland farming in Western Australia is estimated to be \$10 million, but the costs are much higher in years of severe summer storms. Water erosion reduces agricultural productivity by:

- Removing or moving nutrients
- Removing valuable topsoil where there is a 'hostile' subsoil, reducing effective rooting depth and plant-available water
- Silting of dams, waterways and lowlands with sandy sediments, which can make flooding and waterlogging even worse
- Reducing trafficability of paddocks
- Damage to tracks, fences and other infrastructure

There is a greater risk from water erosion on the Darling Scarp and Darling Plateau areas of the Shire (Figure 3-7).

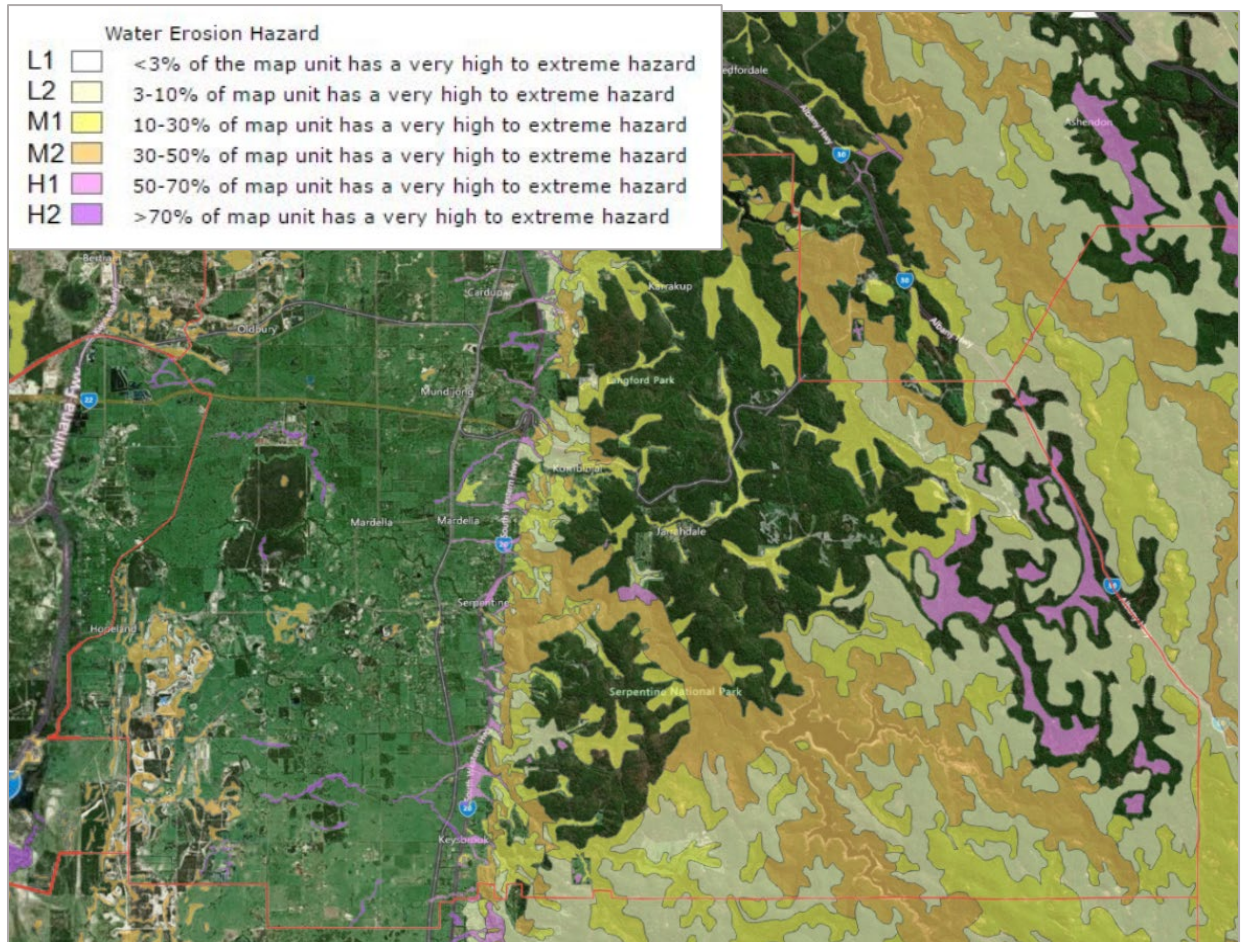


Figure 3-7 Water erosion risk (DPIRD-013)

3.2.3 Contaminated sites

The *Contaminated Sites Act 2003* was introduced to identify, record, manage and clean up contamination. A search of the DWER contaminated sites database identified nine sites within the Shire that have been classified under the *Contaminated Sites Act 2003* (summarised in Table 3-3).

Known contamination in the Shire has largely been caused by historical and existing petrol stations. Historical sites have been remediated and can be used as specified under the classification documentation (refer to Table 3-3). There is, however, one site, adjacent to the Karnet prison farm in Keysbrook which was historically used as an unauthorised landfill site. This site is contaminated with asbestos and requires remediation to remove the risk to human health.

A summary record for each contaminated site is provided in Appendix A.

Table 3-3 Contaminated Sites in the Shire (Contaminated Sites Database search, DWER 2019)

Site ID	Address	Contamination type	Classification
6218	640 South Western Highway, Byford WA 6122	Hydrocarbons	Remediated for restricted use (commercial/industrial)
12570	2 Jarrahdale Road, Jarrahdale WA 6124	Hydrocarbons	Remediated for restricted use (commercial/industrial)
13458	2428 South Western Highway, Serpentine WA 6125	Hydrocarbons	Remediated for restricted use (suitable for all land uses, no groundwater abstraction permitted)
20134	Road reserve, South Western Highway, 6124	Hydrocarbons	Remediated for restricted use (road reserve)
42429	49 Aquanita Rise, Darling Downs WA 6122	Hydrocarbons	Remediated for restricted use (current land use)
42430	34 Aquanita Rise, Darling Downs WA 6122	Hydrocarbons	Remediated for restricted use (current land use)
42434	Lot 300 on Plan 51299, Darling Downs WA 6122	Hydrocarbons	Remediated for restricted use (current land use)
42435	Road Reserve, Byford, 6122	Hydrocarbons	Remediated for restricted use (current land use)
55155	Keysbrook WA 6125	Asbestos	Contamination – remediation required

3.2.4 Resources

Basic Raw Materials and Minerals

Basic raw materials are a finite resource and access to basic raw materials with cost-effective proximity to future growth areas is important to housing affordability and moderating the cost of future infrastructure projects. The Shire has significant resources of bauxite, sand, gravel, clay and hard rock. The bauxite and mineral sands industries impact on large areas and require intensive rehabilitation to stabilise the surface.

There is increasing pressure to supply construction materials from places within the Shire. This is demonstrated by the number of active and pending mining tenements within the

Shire (Department of Mines, Industry Regulation and Safety, 2019). There are also 12 Shire approved extractive industries, including (Figure 3-8):

- 2 rock (scarp)
- 1 shale (scarp)
- 9 sand (coastal plain) – including 3 that have not commenced extraction but are approved.

(Shire of Serpentine Jarrahdale, pers. coms. 2019).

The South Metropolitan Peel Sub-regional Planning Framework also identifies areas of basic raw materials extraction. The sub-regional planning framework and State Planning Policy 2.4: Basic Raw Materials promotes sequential land use planning. It is important to allow basic raw extraction where they exist; however, further investigation is required to confirm presence and quality (Figure 3-9).

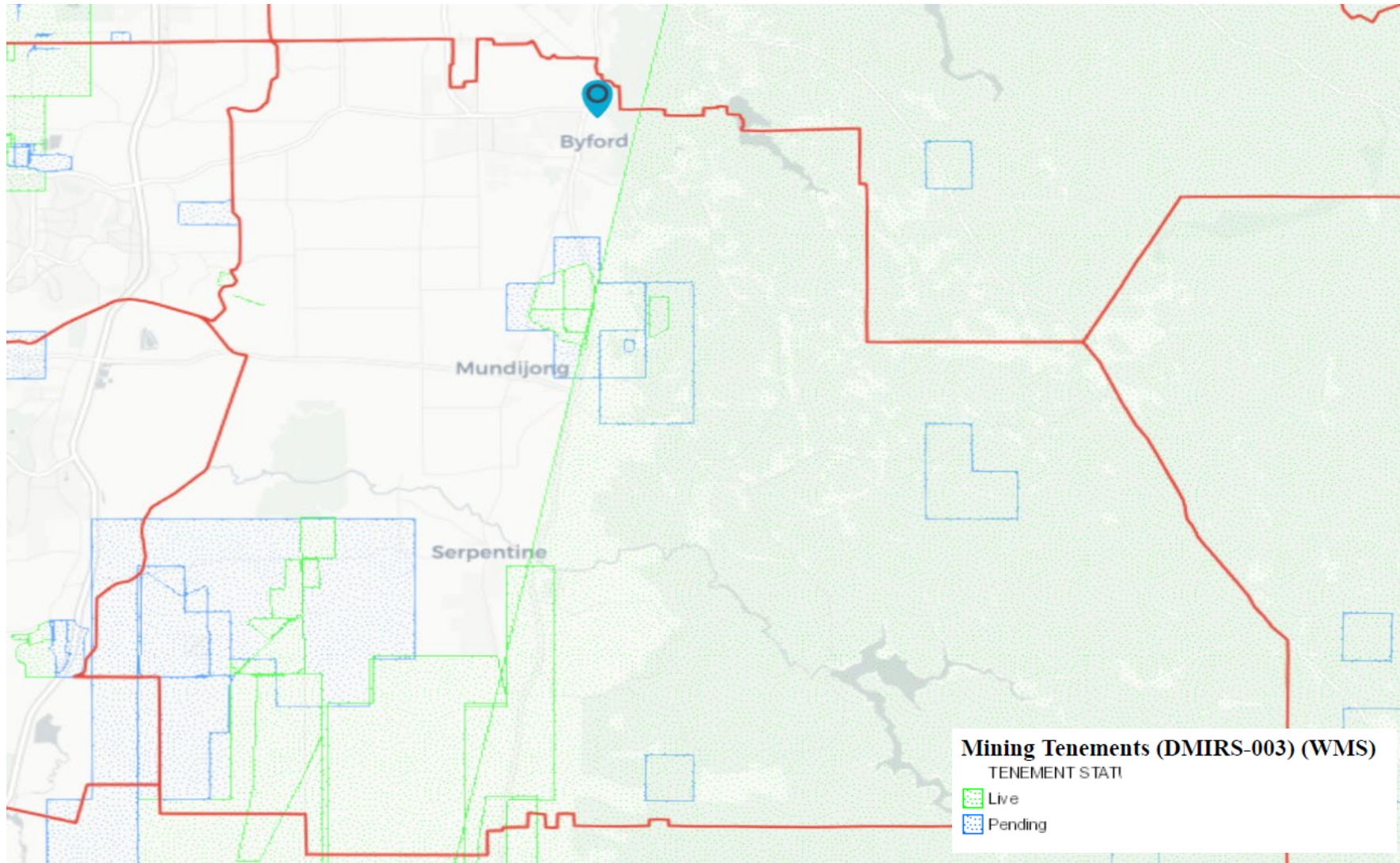


Figure 3-8 Mining Tenements in the Shire of Serpentine Jarrahdale

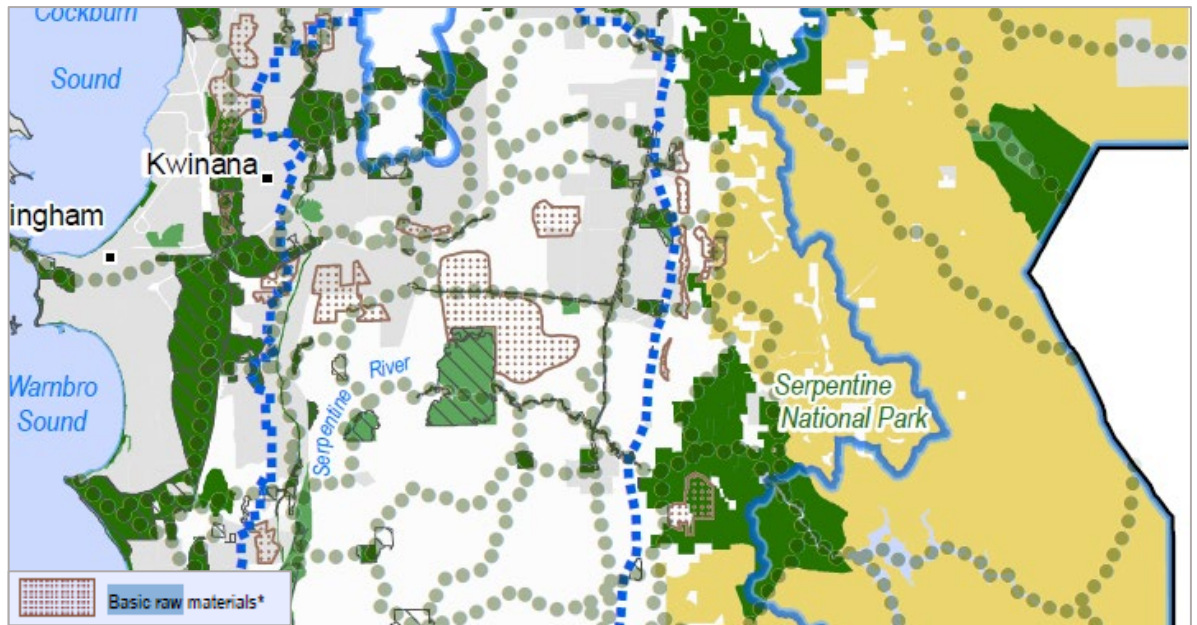


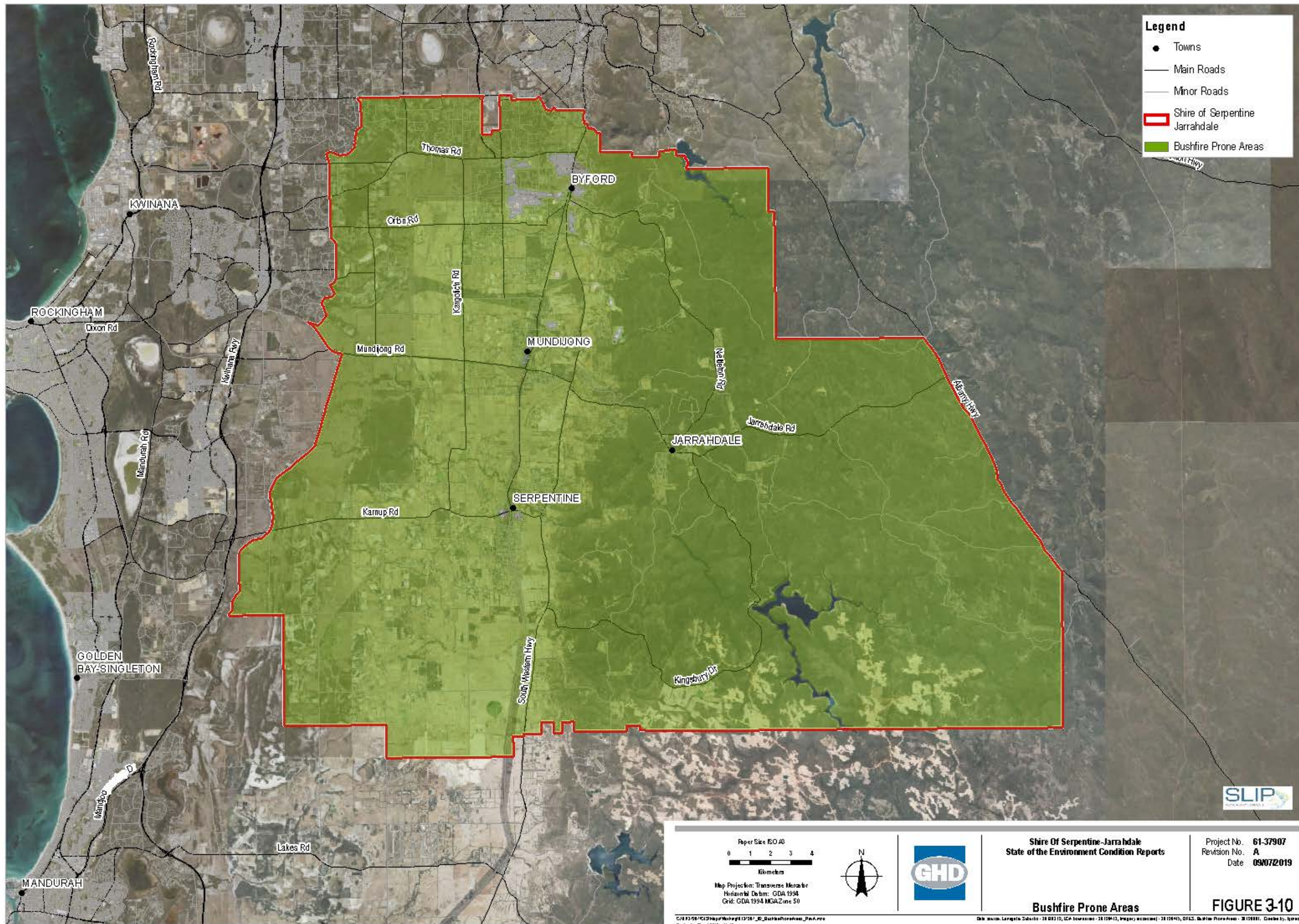
Figure 3-9 Potential basic raw materials (DPLH, 2018)

3.2.5 Biodiversity

Biodiversity is intimately and inextricably linked to land. The soil, vegetation and surface water bodies are part of the ecosystem that provides habitat for a diversity of species. In the same way, ecosystems can be altered by the animals within them. It is important to understand this link and not consider land or biodiversity in isolation, as with any of the six themes of this report. Theme 5 of this report assesses the condition of the Shire's biodiversity, the key pressures impacting the biodiversity values and recommended responses.

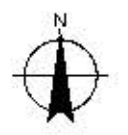
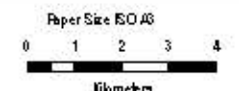
3.2.6 Bushfire

The majority of the Shire is within a declared bushfire prone area (Figure 3-10). Bushfire can have a significant impact on the land, including damage to crops and pasture areas, impacts on livestock and rural properties. In addition, fire can result in the loss of ground cover which can increase the risk of erosion during heavy rainfall.



Legend

- Towns
- Main Roads
- Minor Roads
- ▭ Shire of Serpentine Jarrahdale
- Bushfire Prone Areas



Shire Of Serpentine-Jarrahdale
State of the Environment Condition Reports

Project No. 61-37907
Revision No. A
Date 09/07/2019

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

Bushfire Prone Areas

FIGURE 3-10

C:\E:\2019\GIS\MapDocs\13287_06_BushfireProneAreas_PnA.mxd Date: 2019/07/09 10:52:10, UTM (zone 50), EPSG:31471, Paper: A4 (210x297), DWS: 0.01m, Print Area: 210x297, DWS: 0.01m, Scale: 1:10000

3.3 Pressures

3.3.1 Climate

Theme 2: Atmosphere assesses the condition of the atmosphere within the Shire of Serpentine Jarrahdale, the key pressures impacting the atmosphere and recommended responses. The Climate Future Tool from Climate Change in Australia estimates that the climate in the Shire of Serpentine Jarrahdale is changing – average daily temperatures are warming and annual rainfall decreasing. Rainfall is also likely to be less predictable and there are likely to be more extreme weather events.

Predicted climate changes as detailed above will impact on biological processes such as growth, timing of flowering, effective pollination, and seed dispersal. This will impact on the ability of the land to support native vegetation and productive agriculture.

A drying climate may result in increased acidification of soils, especially on the Swan Coastal Plain. Other hydrological changes may conversely result in increased salinity.

Extreme weather events may impact land in the following ways:

- Erosion due to flooding
- Increased frequency and intensity of bushfires will reduce the amount of time land has to recover from events which will potentially degrade natural areas and productive agricultural/horticultural land.
- Droughts

Forecast increases in temperature and decreases in rainfall are likely to result in decreased soil organic carbon (SOC) potential levels.

Predicted changes to climate may therefore impact on the ability of land within the Shire to support native vegetation and local biodiversity and reduce the capacity of the land to support agriculture.

3.3.2 Population growth and urbanisation

The Perth and Peel @3.5 Million strategic document released by the State Government in 2015 predicted population in Perth would grow by 1.5 million by 2050. To help enable this growth, the Shire is expected to accommodate nearly 100,000 additional people (Shire of Serpentine Jarrahdale, 2016).

The pressure of this population growth has the potential to impact on land within the Shire in the following ways:

- Increased land for urban expansion
- Loss of productive agricultural land
- Loss of biodiversity/habitat fragmentation
- Increased basic raw material extraction to provide materials for housing and associated infrastructure
- Increased pressure for land to be made available for waste management (e.g. landfills, collection depots)
- Increased pressure for land to be made available for cemeteries
- An increased requirement for the provision of industrial land

For the Shire, on the fringe of the Perth Metropolitan Area with significant remaining rural land, it is important to manage these competing pressures so that the values of the community are retained, there are food sources and resources available close to the city and local employment opportunities can be created.

3.3.3 Peri-urbanism

Rural lifestyle lots are typically located on the fringes of the urban areas and townships within the Shire. The draft Local Planning Strategy notes the importance of the rural living areas being contained within defined boundaries to protect from sensitive land uses and development encroachment. In addition, it will be important to manage the expansion of any rural living areas into traditional rural areas that may result in a loss of productive agricultural land.

3.4 Responses

3.4.1 Climate

Responses associated with climate change mitigation are discussed in Theme 2: Atmosphere. In addition to this, direct impacts to land because of climate changes can sometimes also be managed.

For example, lime can be added to acidic soils; however, this is largely the responsibility of private land owners with advice and support provided by the State Government (through the Department of Primary Industries and Regional Development).

3.4.2 Land use management

The Shire has a well established strategic planning framework to guide areas of urban expansion. This includes:

- Town Planning Scheme No.2
- Draft Local Planning Strategy
- SJ2050

These documents establish nodes for urban development. These documents and others such as the Rural Strategy Review 2013 also provide guidance for use and development within rural areas. This ensures the protection of agricultural land and a rural lifestyle that is important to current Shire residents. They allow for rural activity without reducing the capacity of the land by maintaining appropriate lot sizes and guiding land use.

Industrial land has also been identified. This allows for the strategic provision of industrial land in appropriate locations and helps ensure that industrial development is contained.

Land is also reserved for forestry, conservation and recreation.

3.4.2.1 Cemetery Management Plan

In recognition of the expected population, the Shire has recognised that there may be additional land set aside for cemeteries. In response to this the Shire has:

- Developed a local law guiding use of cemeteries
- Committed to the development of a Cemetery Management Plan - this plan will investigate capacity of current cemeteries, ongoing management and assess the need for a new site

- Included cemeteries as a use class in the zoning table of TPS2 – with approval requirements.

3.4.2.2 Waste Management

There are no landfill sites currently within the Shire although two areas are zoned Special Use allowing for waste disposal, composting and landfill, with appropriate buffers. Waste disposal is not specifically prohibited as a land use in the zoning table included in TPS2.

The capacity of the soils on the Swan Coastal Plain (sand) preclude the development of landfills due to environmental concerns. There is also unlikely to be much capacity on the Darling Scarp and Darling Plateau given existing land uses and State Forest. It is unlikely that there will be a push for more landfills within the Shire; however, given the last landfill to close was located in an old clay pit, the Shire should consider strengthening the scheme provisions to ensure any proposals are properly considered. This could include specifying waste disposal as a prohibited land use across all land zoning; applicants could then apply to amend TPS2 to allow the development.

Once the existing landfill sites reach the end of their life, consideration of the subsequent land use can also be considered. Historically this has been limited; however, the South Fremantle Solar Farm, for example, is planned for operation on the former South Fremantle Landfill that was operational between 1930 and 1991. This site has limited development potential due to contamination, but DWER has recently confirmed that it is suitable for use as a solar farm and may provide an example of activation of land that would otherwise be restricted.

The Shire provides waste collection – weekly general waste collection and fortnightly recycling collection. The Shire’s 2017/2018 Annual Report provides waste collection data for that year on a Shire-wide basis; however, data is not available for specific areas. Notwithstanding this, the percentage of dwellings distributed across the Shire, based on the 2016 Census, has been used to extrapolate the waste data for individual settlement (refer to Theme 5 – Human Settlements) and all other areas (Table 3-4). It should be noted that as the Census data only relates to dwelling count, figures relating to commercial waste will not be accurate.

Table 3-4 Waste data for the Shire and non-settlement areas

Annual Report (2017/2018)	Whole of Shire	Non – settlement areas
Percentage dwelling count (%)	100	29
Green Waste (tonnes)	676	194
Hard waste (large items that cannot fit in a regular bin) (tonnes)	1,142	327
General waste (household and commercial waste) (tonnes)	7,916	2,267*
Recycled reusable waste (tonnes)	2,461	705
Waste to land-fill (tonnes)	8,836	2,531
Waste bins annually (collected)	516,528	147,934

Annual Report (2017/2018)	Whole of Shire	Non – settlement areas
Recycle bins annually (collected)	522,312	149,590
Commercial waste bins annually (collected)	17,952	N/A*
Commercial recycle bins annually (collected)	4,464	N/A*

*Data with commercial waste

There may be opportunities for increased recycling and waste collection. For example, the introduction of a container deposit scheme (to be rolled out in 2020) may result in an increased desire for facilities for collection of recyclables. The Shire should consider the likelihood of this and make any updates to TPS2 or local planning policies to facilitate this use. A model local planning policy for container deposit scheme infrastructure has been developed by the Department of Planning, Lands and Heritage. The Shire can consider adoption of this policy.

3.4.2.3 Landcare

Landcare SJ Inc. is a not-for-profit community organisation that provides environmental support to the community. They provide technical advice and access to funding and resources. The Shire should continue to support the work undertaken by Landcare SJ Inc.

3.4.2.4 Bushfire

State Planning Policy 3.7 – Planning for bushfire prone areas (SPP3.7) and associated guidelines provide a strong framework for integration of bushfire risk into planning and development. The Shire should continue to implement the requirements of SPP3.7 and the Shire of Serpentine Jarrahdale Shire Bushfire Risk Management Plan 2018-2023. Significant additional information can be found on the Shire's website which provides guidance on total fire bans and firebreak requirements on private property.

3.4.3 Summary of responses

Response	Potential actions
3.4.2 Land use management	<ul style="list-style-type: none"> Continue to utilise the local planning framework to guide how land within the Shire is used Develop a Cemetery Management Plan to guide allocation of additional land for cemeteries Investigate the need to update TPS2 to specifically prohibit waste disposal Investigate any updates to the local planning framework that will be required to support the container deposit scheme Continue to support Landcare SJ Continue to implement the SPP3.7 and the Bushfire Risk Management Plan

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Theme Three: Inland Waters

4. Theme Three: Inland Waters

4.1 Overview

Inland waters, both above and below the ground, are inextricably linked to the complex web of ecological systems they sustain, and of fundamental importance for the human settlements that rely upon them to exist. They provide water to our communities and industries, and provide the key connection between our land, atmosphere, coastal and marine environments.

The state of inland water resources, including both surface-water and groundwater resources, is largely determined by factors of climate and land use, and further influenced by water resources infrastructure and operational management (Argent, 2017).

Consistent with the approach of Argent (2017) in Australia State of the Environment 2016: Inland water, this theme considers two key lenses of focus. Firstly, the 'unregulated' component of the aquatic environment: that which is subject to natural and climatic factors that are upstream of major control structures and, therefore, less affected by water management infrastructure. Second is that of water management, where water policy and directed management actions respond to and address the various environmental and human induced pressures impacting upon the state of inland water resources.

Inland waters will be discussed in relation to water dependent ecosystems and water supply.

4.2 Strategic alignment

4.2.1 Strategic Community Plan (2017 – 2027)

Contributing to the protection and enhancement of the Shire's inland water resources is consistent with and contributes to the overarching objectives of the Shire's Strategic Community Plan as they relate to People, Place, Prosperity and Progressive.

People – Ensuring the ongoing supply and provision of water resources will support the objective of a connected, thriving, active and safe community by helping to provide well planned water supply infrastructure and maintained public open space which in turn leads to a healthy community environment.

Place – Maintaining the integrity of inland water resources aligns with the objective of a protected and enhanced natural environment. Development, maintenance and implementation plans for Shire controlled parks, reserves, and natural assets helps achieve a sustainable natural environment. Inland water resources are also central to a productive rural environment, and a precursor to the identification and promotion of rural and agricultural industry opportunities.

Prosperity – Inland water resources underpin the natural ecological systems that support human settlements, and in turn support the ability to achieve an innovative, commercially diverse and prosperous economy.

Progressive – Leading by example in the protection, sustainable use and management of inland water resources will help to promote the community's objective of a resilient organisation demonstrating unified leadership and governance.

4.2.2 SJ 2050

Protecting the health and integrity of the Shire's inland water resources underpins the key objectives of SJ 2050 as they relate to the natural environment; specifically, the strategic aspiration to ensure that ecological linkages continue to be maintained and enhanced to provide for integrated biodiversity networks. It is by understanding the state of inland water resources (and the associated pressures) that the most effective and efficient responses can be implemented to ensure that the intrinsic value of the natural environment is factored into strategic planning.

4.2.3 Policy and regulatory framework

4.2.3.1 Water Services Act 2012

The *Water Services Act 2012* enables water service providers to deliver water supply, irrigation, sewerage and drainage services. It facilitates easier entry of new water service providers to the market, allowing for increased competition in the water services industry.

4.2.3.2 Water management legislation

Water resource management is currently managed under six separate acts; those relevant to the Shire are discussed below.

Through the *Water Agencies (Powers) Act 1984*, the Department of Water and Environmental Regulation (DWER) leads water resource management in Western Australia by coordinating cross-government efforts to protect and manage water resources. Where appropriate, the Shire works with the DWER to improve water management.

The *Rights in Water and Irrigation Act 1914* (RIWI Act) provides for the regulation, management, use and protection of water resources. The RIWI Act provides for a licensing system for taking water, and a permitting system for activities that may damage, obstruct or interfere with water flow or the beds and banks of watercourses and wetlands in proclaimed rivers, surface water management areas and irrigation districts. The Shire is required to obtain licences to take water to irrigate public open space. Shire residents are also required to obtain licences to take water for activities such as crop irrigation, dust suppression and irrigation of pasture and may need to manage the impacts of stocking on water resources.

Metropolitan Water Supply, Sewerage and Drainage Act 1909 and associated by-laws protect the State's public drinking water sources, i.e. proclaimed catchment areas, water reserves and pollution areas (underground water pollution control areas).

The clearing of vegetation is controlled under the *Environmental Protection Act 1986*; clearing of native vegetation affects salinity of water resources, infiltration levels, runoff and erosion of waterways. Declared waterways management areas are managed under the *Waterways Conservation Act 1976* (e.g. Peel Inlet).

The *Metropolitan Arterial Drainage Act 1982* provides for an arterial drainage scheme and the declaration of drainage courses.

The Western Australian government is currently working to reform legislation and policy to consolidate water resources management legislation into one Act (Department of Water and Environmental Regulation, 2019).

4.2.3.3 Planning and Development Act 2005

The *Planning and Development Act 2005* (PD Act) establishes the Western Australian Planning Commission and provides for an efficient and effective land use planning system

which promotes sustainable use and development of land. The PD Act is supported by state planning policies which are the highest level of planning policy control and guidance. State Planning Policies relevant to the protection and management of water resources include:

- State Planning Policy 2.1 – Peel-Harvey Coastal Plain Management (SPP 2.1)
- State Planning Policy 2.3 – Jandakot Groundwater Protection (SPP 2.3)
- State Planning Policy 2.7 – Public Drinking Water Source Policy (SPP 2.7)
- State Planning Policy 2.9 – Water Resources (SPP 2.9)

Under the PD Act, local governments are responsible for planning their local communities by ensuring appropriate planning controls exist for land use and development. They do this by preparing local planning schemes and strategies.

Local planning schemes set out the way land is to be used and developed, classify areas for land use and include provisions to coordinate infrastructure and development within the local government area. Town Planning Scheme No.2 (TPS2) is the local planning scheme for the Shire.

4.2.3.4 Better Urban Water Management

Better Urban Water Management (BUWM) provides guidance on the implementation of SPP 2.9 Water Resources. It is designed to facilitate better management and use of our urban water resources by ensuring an appropriate level of consideration is given to the total water cycle at each stage of the planning system. The document intends to assist regional, district and local land use planning, as well as subdivision and development phases of the planning process. It should be applied to both new greenfield and urban renewal projects where residential, commercial, industrial and rural residential uses and development are proposed, including in rural townsite areas. An overview of the integration between water and land use planning is provided in Figure 4-1.

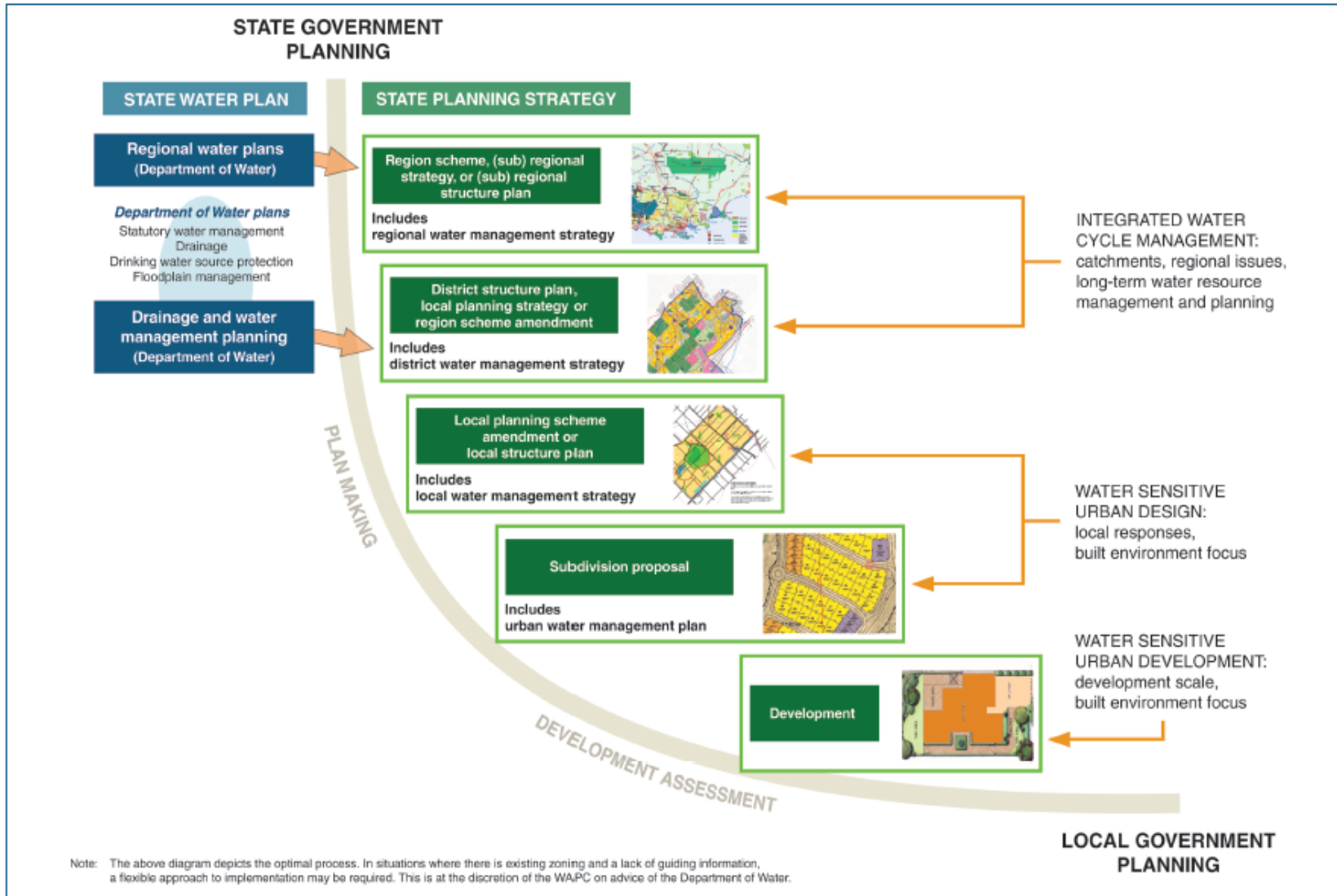


Figure 4-1 Integrating water planning with land planning processes (GoWA, 2008)

4.3 Condition

4.3.1 Climate - rainfall

The average annual rainfall recorded at Wungong Dam since 1911 is 1,225 mm but this has declined in recent years to an average of 1,012 mm since 1975, and 998 mm since 1995 (Figure 4-2). The minimum recorded annual rainfall occurred in 2010 at just 520 mm and the maximum was recorded in 1917 at 1,958 mm.

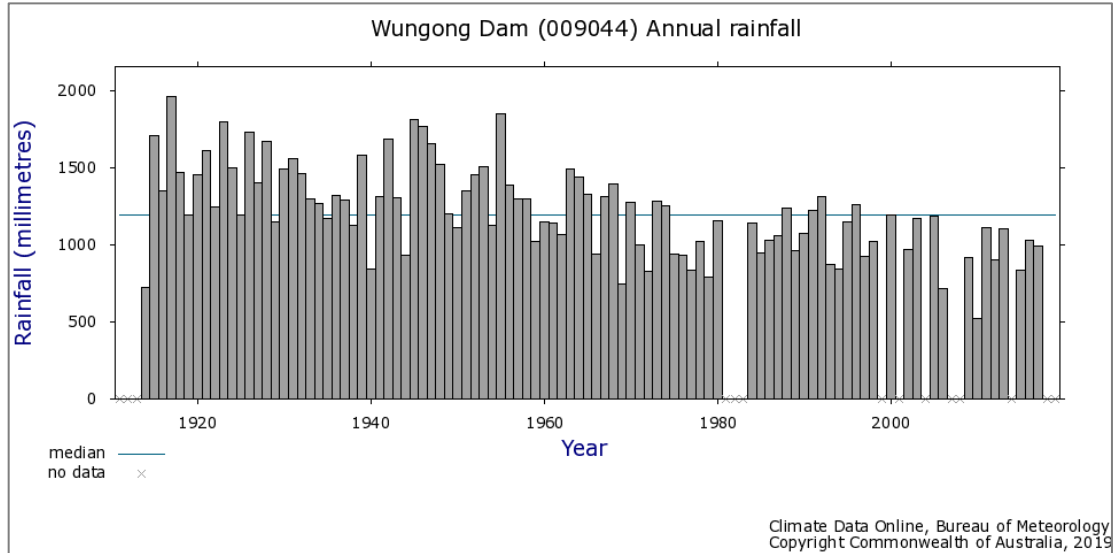


Figure 4-2 Annual rainfall Wungong Dam (Bureau of Meteorology, 2019)

The average annual rainfall on the Swan Coastal Plain is generally less than that on the Darling Plateau, typically ranging from 800 mm to 1,000 m (Figure 4-3).

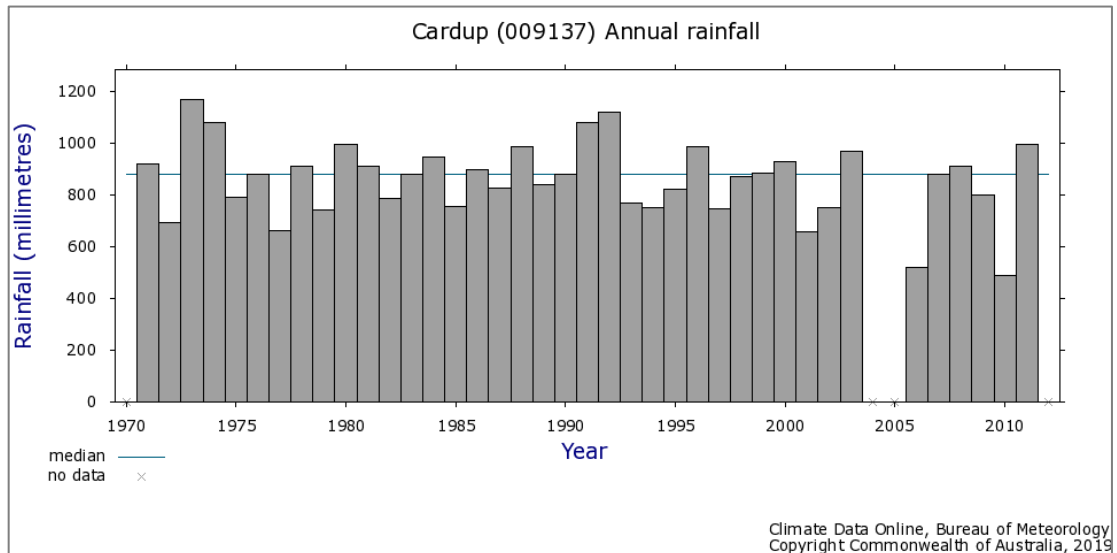


Figure 4-3 Annual rainfall Cardup (Bureau of Meteorology, 2019)

The majority of rainfall occurs in winter between May and September, with the driest months being January and February. Whilst average annual rainfall has generally declined in recent years, it has actually increased in the late winter and early spring months of August and September. This may be indicative of changing rainfall patterns bringing more

frequent intense rainfall events later in the year, with longer dry periods in between (Essential Environmental 2016).

Declining stream flows and superficial groundwater levels have been observed over the past ten years, most likely as a result of declining annual rainfall (Essential Environmental, 2016). This is discussed further in the sections below.

4.3.2 Surface waters

4.3.2.1 Landform

As identified in Theme 2: Land of this report, the Shire possesses a unique topography and landform with two distinct parts, the low and flat topography to the west that is typical of the Swan Coastal Plain, with the eastern portion characterised by undulating ridge peaks and troughs associated with the landform of the Darling Plateau (Essential Environmental, 2016). The topographic features of the Darling Plateau and Darling Scarp (which forms the junction with the landform of the Swan Coastal Plain) allow for substantial water bodies to form. These include the Serpentine and Wungong Dams which provide important catchments for surface water runoff.

4.3.2.2 Catchments

The majority of the Shire is situated within the Peel-Harvey Estuary – Serpentine River catchment. As shown in Figure 4-4, the Peel Harvey Estuary is an estuarine system that consists of the round Peel Inlet and elongated Harvey Estuary, connected to the Indian Ocean through a natural entrance channel in the northern Peel Inlet and an artificial entrance channel, the Dawesville Channel, in the northern part of the Harvey Estuary (Fretzer, 2011).

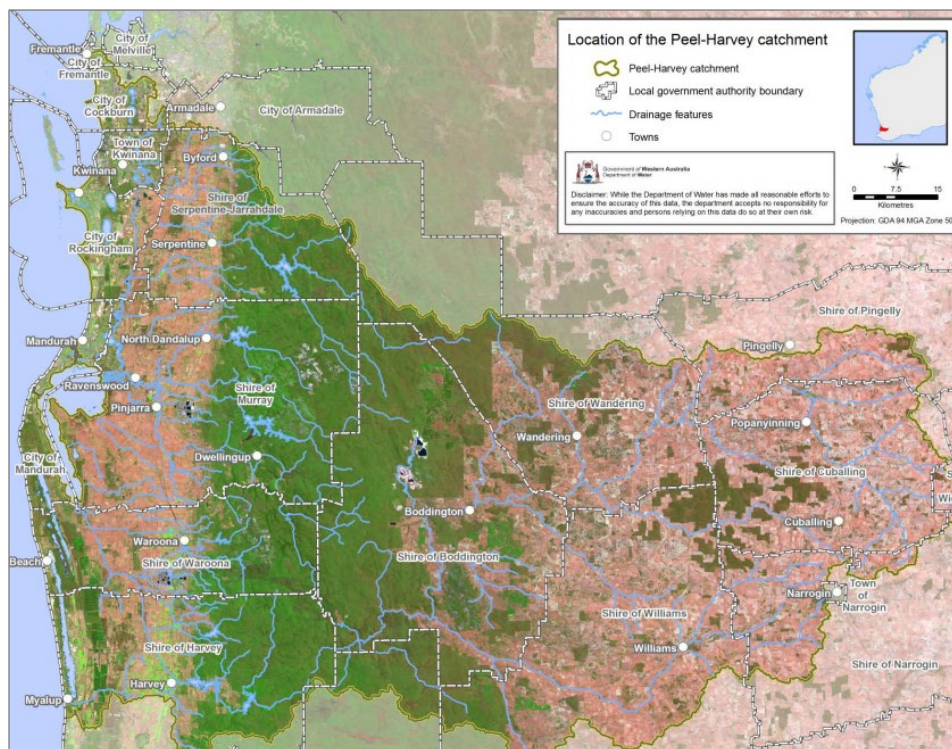


Figure 4-4 The Peel-Harvey catchment (Department of Water, 2011)

The Shire is located across a number of sub-catchments that form part of the Peel-Harvey catchment, the largest of which being the Upper Serpentine River catchment. As shown in

Figure 4-5, the Upper Serpentine River catchment sits within the northern portion of the Peel-Harvey catchment and comprises land between Lake Amarillo and the Serpentine Dam draining to the Serpentine River. The Birriga Main Drain drains the north of the catchment.

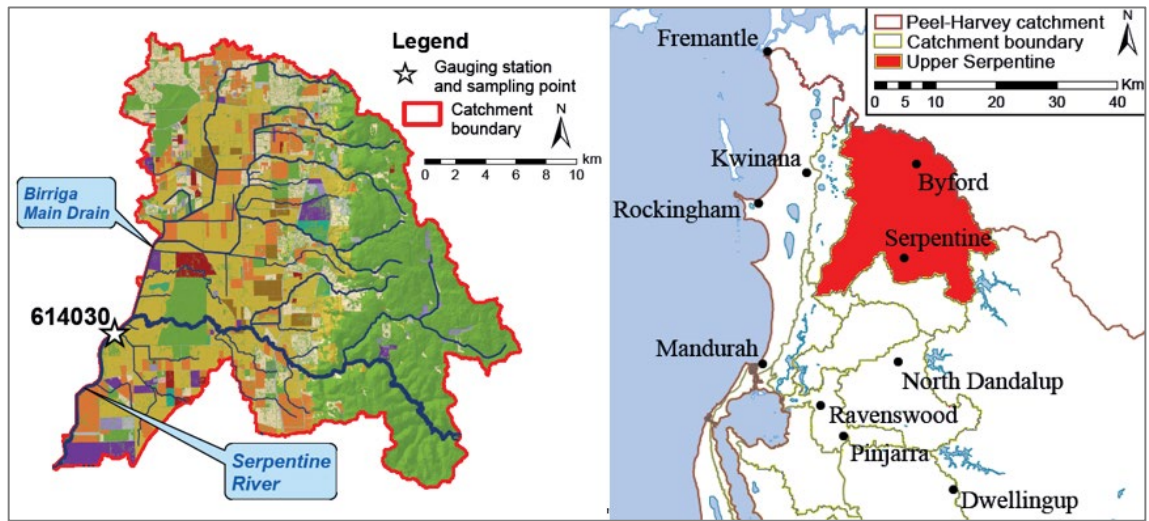


Figure 4-5 Upper Serpentine catchment (Department of Water, 2015 and 2017)

Dirk Brook begins on the Darling Plateau before flowing onto the Swan Coastal Plain where it is joined by Myara Brook. To the north, Karnet Brook also flows from the plateau, becoming Karnet Drain before its confluence with Dirk Brook. It is at this point the modified drainage system is re-named Punrak Drain (Department of Water, 2017).

Punrak Drain flows into Lake Amarillo, one of the Serpentine Lakes, and is responsible for contributing large amounts of nutrients, especially nitrogen, to the Serpentine River and lakes, and depositing sediment at the drain's outflow point (Department of Water, 2015) (Figure 4-6).

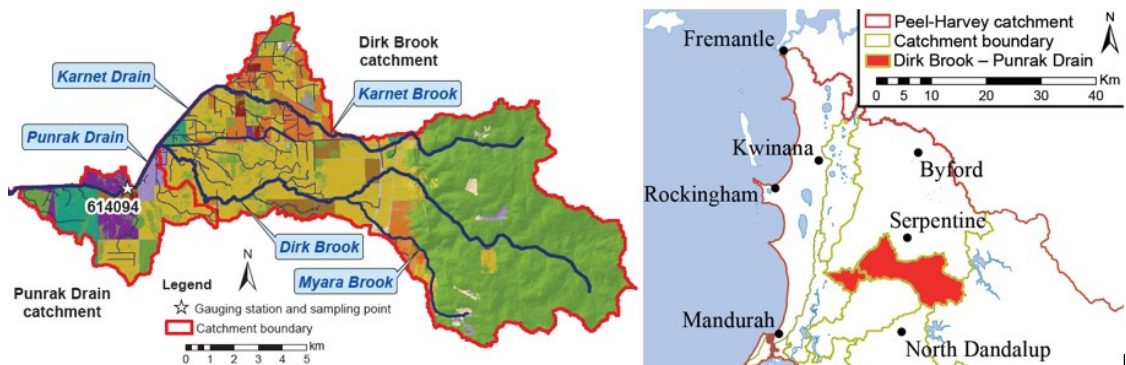


Figure 4-6 Dirk Brook - Punrak Drain (Department of Water, 2015)

4.3.2.3 Waterways

As illustrated in Figure 4-8, traversing south-east and flowing through the western boundary of the Shire where it adjoins the City of Kwinana, the Serpentine River is the most significant waterway in the Shire. It hosts both the Serpentine Pipehead and Serpentine Main Dam which form part of the Integrated Water Supply Scheme (IWSS) operated by Water Corporation (DWER, 2017). With a capacity of 137.7 million kilolitres, the Serpentine Main Dam is one of the largest dams supplying the Perth metropolitan area.

At the Bureau of Meteorology's monitoring site in Karnet, average rainfall has declined by ten percent for the period 2008 to 2015 (1,035 mm/year) compared against the 1975 to 2007 average of 1,444 mm/year. This has resulted in a 58 percent reduction in inflows to the Serpentine Main Dam. In 2015 the entire network of IWSS dams experienced record low inflows of 11.4 GL (with combined inflows into the Serpentine dams of 1.7 GL). Despite a slight improvement in 2016, as the climate dries it is likely that years of zero or close to zero inflows to the dams will be experienced. Evaporation rates are also expected to increase (DWER, 2017).

Releases into the Serpentine River have been occurring since the dams were constructed; however, in response to increasingly low dam inflows and the need to more precisely manage scheme water supply, in 2010 the (then) Department of Water began trialling reduced release volumes as part of a comprehensive IWSS release review. In 2017 the newly formed Department of Water and Environmental Regulation released an allocation statement outlining new release arrangements to achieve a better balance water for public water supply with the downstream values and their associated water requirements. Inflows are categorised and less water is released when the inflows are low, with the amount of water released over summer subject to whether inflows represent a 'standard' or 'low-inflow' year (DWER, 2017).

Since construction of the dams, the downstream flow regime has experienced significant change, largely due to the presence of the dams. Reductions in local flows from lower rainfall in the downstream catchment in conjunction with declining groundwater levels have also contributed.

In its allocation statement for managing releases for the Serpentine River, DWER (2017) notes that *"during summer, some areas further downstream on the Swan Coastal Plain continued to flow due to groundwater contributions. Hydrological monitoring and onsite investigations suggest that this groundwater discharge zone is moving towards the west, so we will continue to see less contributions to flow from groundwater in the areas influenced by releases"*.

Reductions to the historical inflows into Serpentine Main Dam are shown in Figure 4-7. In order to understand the way in which dams will be affected by varying rainfall and run-off patterns, DWER has utilised CSIRO (2009) projections to estimate future dam inflows.

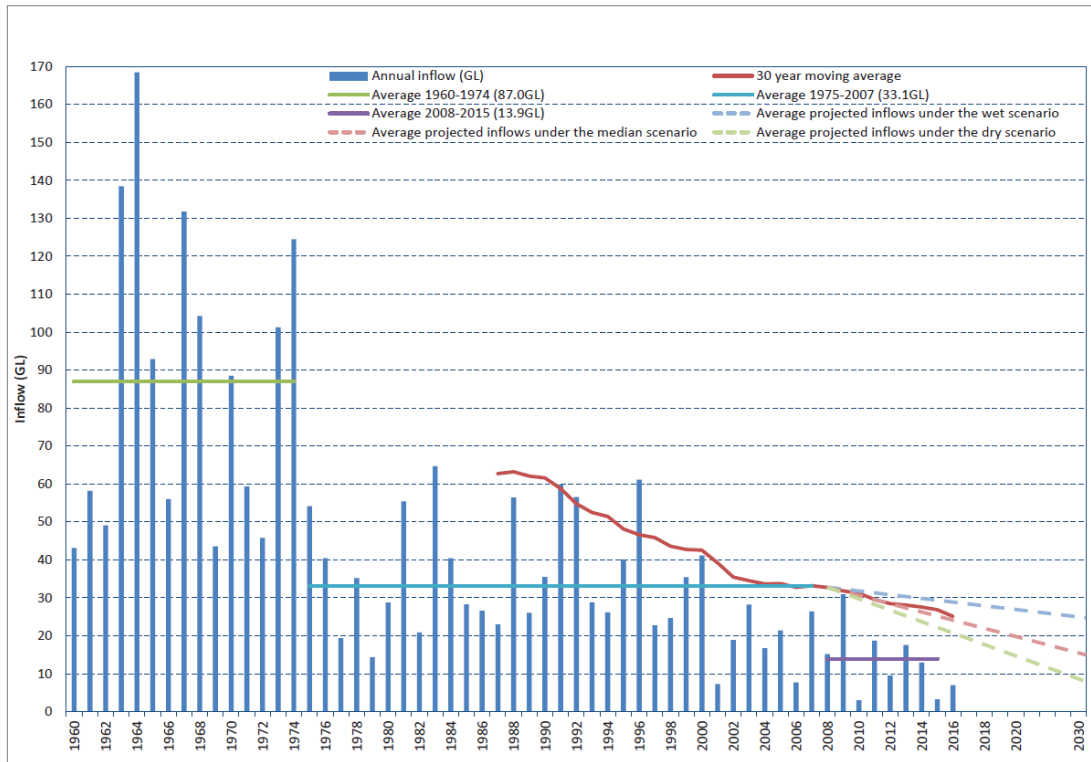
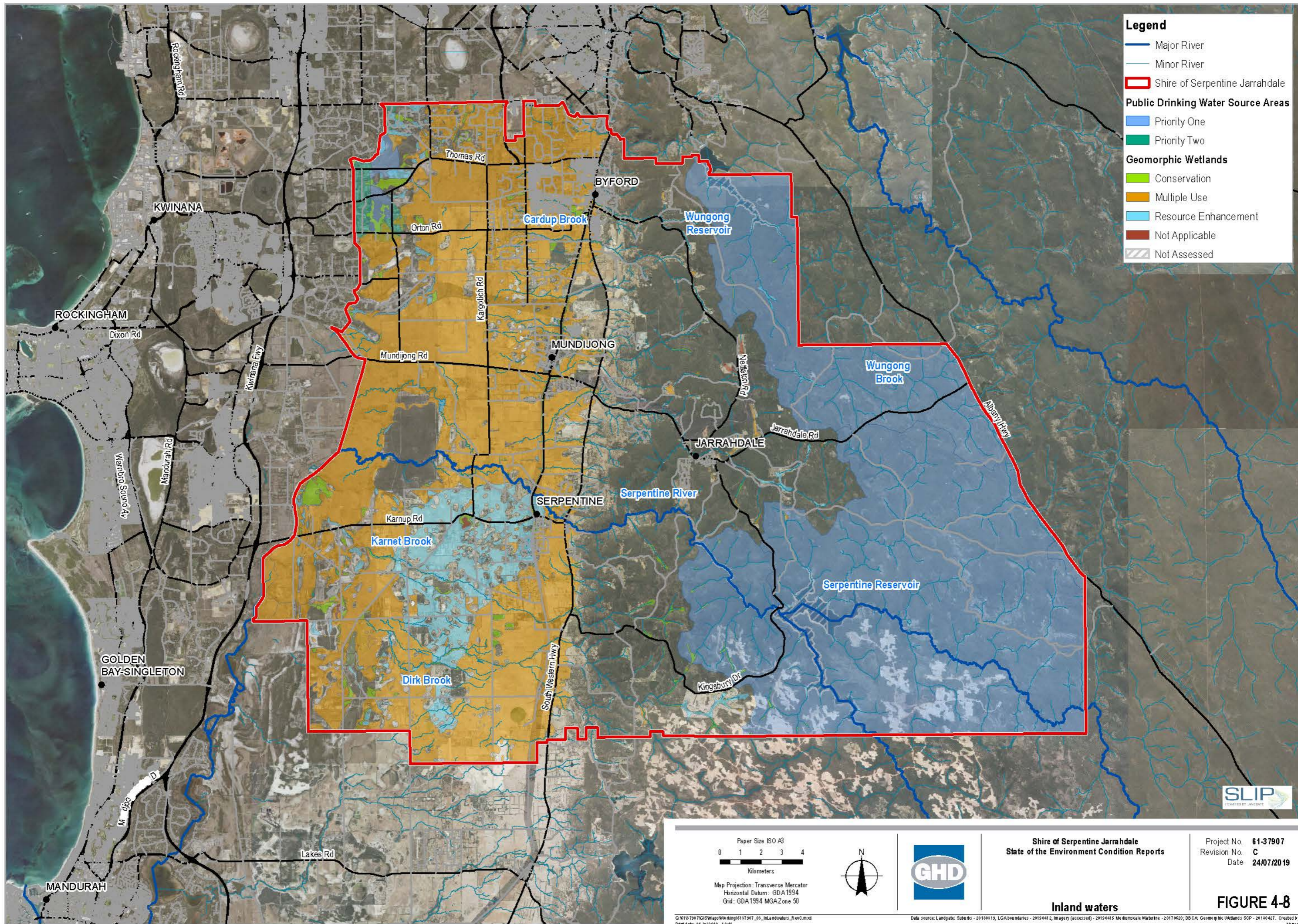


Figure 4-7 Historical inflows into Serpentine Main Dam and projected future inflows (DWER, 2017)

The CSIRO model estimates a 45 per cent reduction in future inflows against the 1975 to 2007 average based on a ‘median’ climate scenario whilst the ‘wet’ scenario is still drier than the 1975 to 2007 average. Moreover, if the ‘dry’ scenario eventuates it is possible that there could be a 70 percent reduction in future inflows and more years of zero or near-zero inflow into the dams (DWER, 2017).

Figure 4-8 provides an overview of waterways within the Shire. Several brooks traverse the Hopeland-Keysbrook area located in the southwest portion of the Shire which include the Karnet and Dirk Brooks. Within the northern portion of the Shire, north of Mundijong lie the Cardup, Beenyup and Manjedal Brooks, and Birrega Main Drain.

A large portion of the Wungong Reservoir is situated in the north-eastern corner of the Shire, with a significant amount of the Reservoir’s catchment located within the Shire’s boundaries (Essential Environmental, 2016)



Legend

- Major River
- Minor River
- Shire of Serpentine Jarrahdale
- Public Drinking Water Source Areas**
 - Priority One
 - Priority Two
- Geomorphic Wetlands**
 - Conservation
 - Multiple Use
 - Resource Enhancement
 - Not Applicable
 - Not Assessed

Paper Size ISO A3 0 1 2 3 4 Kilometers Map Projection: Transverse Mercator Horizontal Datum: GDA1994 Grid: GDA1994 MGA Zone 50			Shire of Serpentine Jarrahdale State of the Environment Condition Reports	Project No. 61-37907 Revision No. C Date 24/07/2019
Inland waters			FIGURE 4-8	

G:\110 790 TGISM ap\W\110790_03_Inlandwaters_RevC.mxd
 Print date: 24 Jul 2019 - 11:41
 Data source: Landgate: Suburbs - 20100119, LGA boundaries - 20190412, Imagery (accessed) - 20190415 Mediumscale Waterline - 20170620; DECA: Geomorphic Wetlands SCP - 20190427. Created by: bp/ncz

4.3.2.4 Wetlands

Wetlands are an intrinsic part of the hydrology of a region. They are widely recognised as significant for their ecological, hydrological, social and economic values. Wetlands have characteristic vegetation, faunal assemblages and geomorphology, and typically support a high level of biological productivity and diversity (EPA 2008). Wetlands can act as biological filters by retaining sediment, and absorbing nutrients and pollutants (Hill et al. 1996). They also provide flood control by storing and detaining storm water.

Severe loss and degradation of wetlands has occurred on the Swan Coastal Plain since European settlement. Only 17 percent of remaining wetlands on the Swan Coastal Plain have high conservation significance and 14 percent are formally protected (EPA 2007). Waterways, wetlands, floodplains and catchments have been dramatically altered to allow for settlements, agriculture, water supplies and infrastructure development. Alterations of areas from their natural state inevitably results in detrimental changes to water quantity and quality. The majority of wetlands on the Swan Coastal Plain are not well documented and consequently there is little available information to determine condition.

There are no wetlands of International Importance (RAMSAR sites) located within the Shire of Serpentine Jarrahdale. The Shire does contain rivers and other waterways that are located upstream from the Peel-Yalgorup System RAMSAR site.

According to the Geomorphic Wetlands dataset there are 583 wetlands (including creeks, dampland, palusplain, sumpland, artificial lake, dryland, and floodplain) occurring within the Shire of Serpentine Jarrahdale. A wetland management category is assigned to a wetland based on the evaluation of its attributes, functions and values. It provides guidance on the nature of management and protection the wetland should be afforded (EPA 2008). The categories applied to the Swan Coastal Plain in Western Australia are conservation, resource enhancement and multiple use.

There are 229 Conservation Category Wetlands (CCW) within the Shire (Figure 4-8 and Table 4-1). The conservation category wetlands located within the Shire are mostly surface expressions of the water table. As shown in Figure 4-8, the western portion of the Shire situated within the Swan Coastal Plain is largely categorised as Multiple Use Wetland, primarily due to the geological system of the Guildford Formation, typically sand over clay, which is largely seasonally waterlogged, flat land (Essential Environmental, 2016).

Table 4-1 Total area mapped as Geomorphic Wetland within the Shire of Serpentine Jarrahdale (GoWA 2019a)

Wetland Management Category	Total listed wetlands	Total Area
Conservation	229	1,359.85 ha
Multiple Use	183	26,076.84 ha
Resource Enhancement	165	3,778.30 ha
Not Applicable (no longer a wetland)	4	70.5 ha
Not assessed	6	592.19 ha

4.3.2.5 Drainage

Historically, an extensive network of rural drains was developed in the flat, low-lying part of the Swan Coastal Plain (the palusplain), east of the Peel-Harvey Estuary and the Serpentine River (Essential Environmental, 2016). The extensive drainage networks, which intercept surface and groundwater, have been effective in draining the system to enable agriculture and other land uses. However, in doing so the drains have transported nutrients

directly and quickly into the Serpentine and Murray Rivers. This has resulted in detrimental impact to the integrity of these waterways which are now suffering from algal blooms and fish deaths occurring each year which is impacting the ecological integrity of the Peel–Harvey Estuarine System (Safstrom, 2012).

4.3.2.6 Flooding

As described in Section 4.3.2, there are many rivers and brooks that pass through the Shire. There is an associated flood risk to development near waterways. DWER has mapped the 1 in 100 year floodplain, which is the area modelled to be inundated during 1 in 100 year rainfall event (Figure 4-9). Risk of flooding is especially important when considering areas of new development around Byford and Mundijong.

The drainage flow through Byford and Mundijong is in an east to west direction and follows the waterways through the settlement.

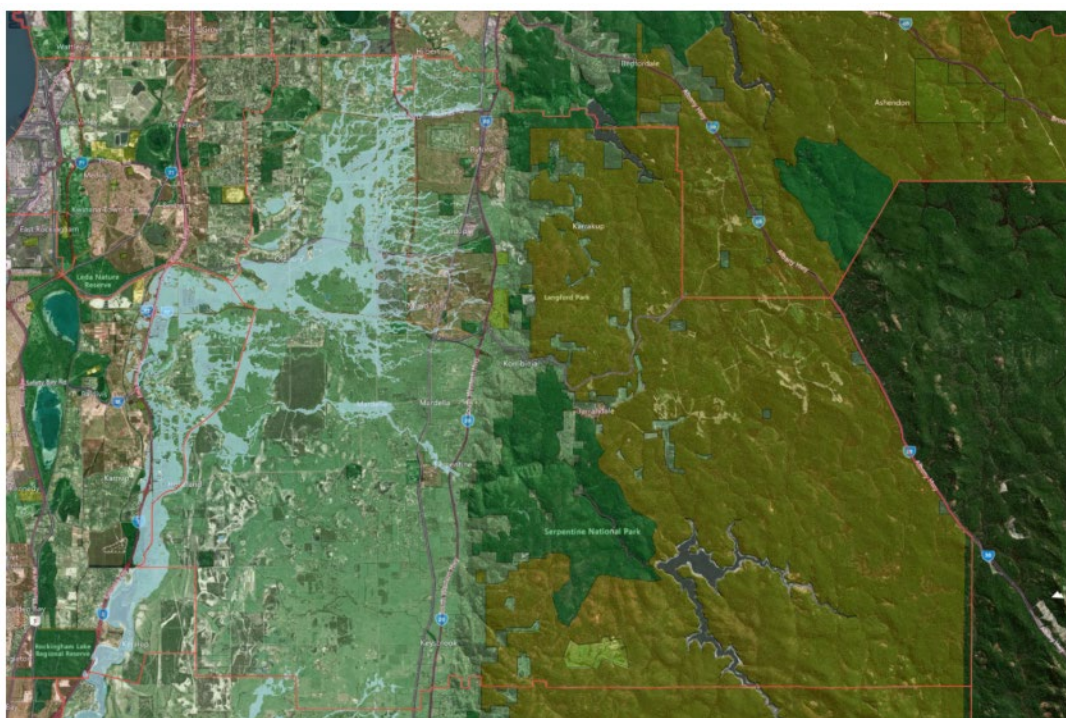


Figure 4-9 1 in 100 year floodplain mapping (DWER-020)

4.3.3 Groundwater

Groundwater is water that is found below the earth's surface, stored in the cracks and spaces in soil, sand and porous rocks. Most groundwater comes from rain that has infiltrated through the ground and has accumulated over many thousands of years (DWER, 2019).

Superficial (surface) and artesian (confined) aquifers underlie most of the Swan Coastal Plain with the groundwater flowing east-west, discharging to rivers and wetlands and connecting the two systems. Generally speaking, water quality is typically good; however, information on groundwater quality is limited (Shire of Serpentine Jarrahdale, 2018).

The nature of the geology of the Darling Plateau results in groundwater that is located in fractured rock aquifers and therefore it is not considered reliable or readily available for abstraction. As shown in Figure 4-10, groundwater is generally within three metres of the surface in areas of sand (Essential Environmental, 2016).

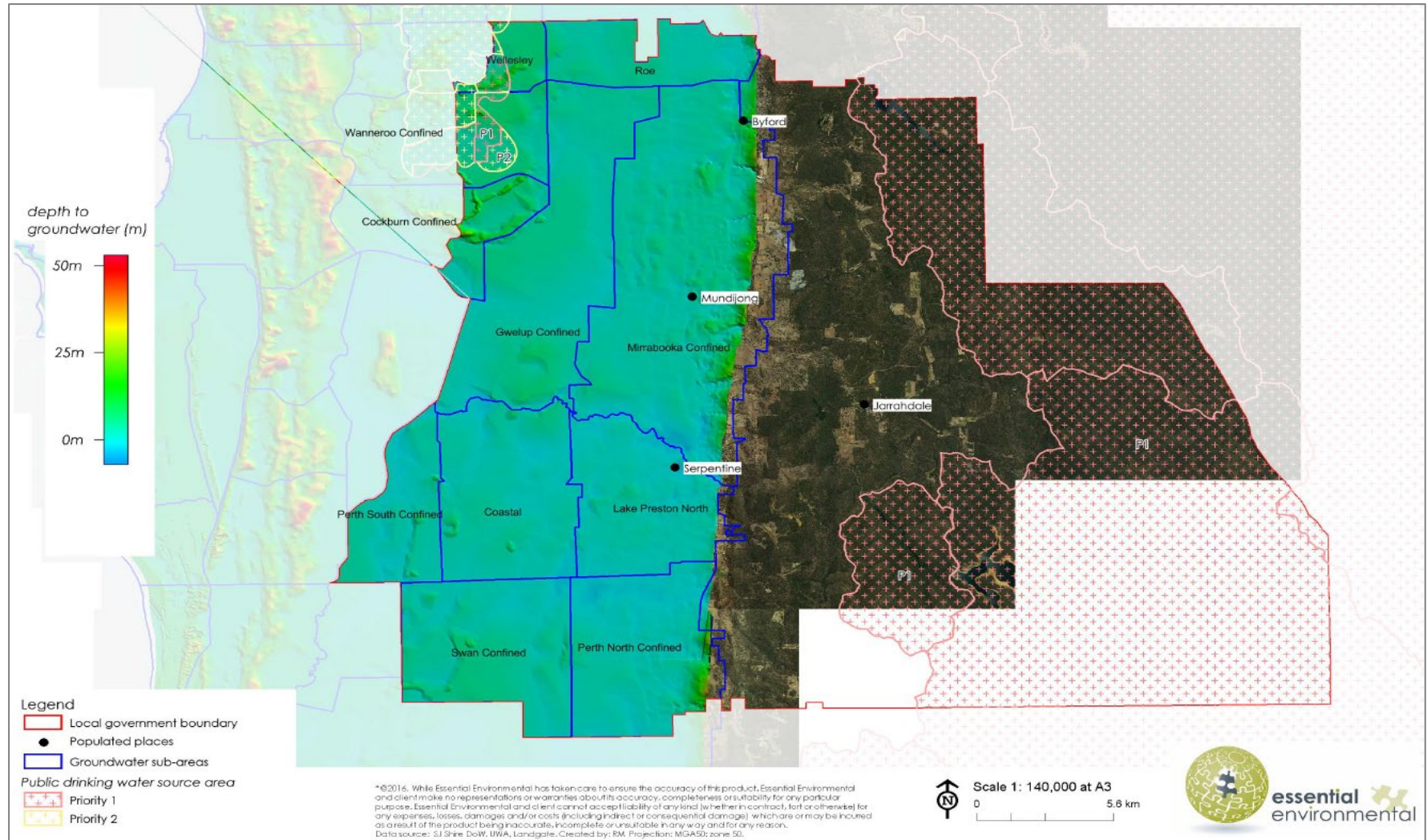


Figure 4-10 Depth to Groundwater (Essential Environmental, 2016)

The most significant groundwater resources underlie the western portion of the Shire within the Swan Coastal Plain and include the superficial aquifer, which is unconfined and recharged by rainfall, and the deeper confined aquifers of the Leederville and Yarragadee aquifers (Shire of Serpentine Jarrahdale, 2018). The Jandakot Groundwater Mound extends into a small area in the northwest of the Shire.

There is currently no groundwater allocation plan for the Serpentine Groundwater area and allocation limits are quite old, calculated using analytical methods which do not include future climate scenarios.

Water entitlements are currently available from the Superficial aquifer, however this is underutilised as much of it is not easily accessed due to limited saturated thickness or low bore yields. The Leederville aquifer is nearing full allocation across the groundwater area. The Leederville aquifer is also thin or not a good aquifer in certain locations close to the Scarp. Some water level decline is occurring in this aquifer. The Cattamarra Coal Measures Aquifer in the Byford 3 subarea is fully allocated. The Cattamarra Coal Measures is not present everywhere; it is only present in a strip between the Darling Scarp and the Serpentine Fault. Water levels are declining due to heavy localised abstraction in this area, and regionally to the north. A reduction in recharge due to reduction in rainfall is also likely to be impacting levels. Initial future climate projections show that rainfall and recharge are likely to decline and there will be less groundwater available over time.

4.3.4 Proclaimed areas

To protect water sources, groundwater and surface water areas are proclaimed by DWER under the *Rights in Water and Irrigation Act, 1914* (Figure 4-11). It is illegal to take water from a watercourse or groundwater aquifer without a licence in a proclaimed area under the *Rights in Water and Irrigation Act 1914*. Licences define how much and when water may be taken and specify any obligations the licence holder must meet when using the water. During drought periods, restrictions make sure that available water is shared and that any potential damage to the environment, the resource and the user is minimised (DWER, 2019).

The Shire of Serpentine Jarrahdale is within the Serpentine groundwater area, which is further split into a number of sub-catchments.



Figure 4-11 Proclaimed Groundwater Areas (DWER, 2009)

Whilst it is difficult to determine the number of individual groundwater licenses in the Shire (as the sub-catchments do not align with the Shire’s boundary), a search of the DWER Water Register indicates that the Shire holds five licences to take groundwater to irrigate public open space. These are summarised in Table 4-2.

Table 4-2 Licences to take groundwater issued to the Shire of Serpentine Jarrahdale (Water Register search results, DWER 2019)

WRI Number	Groundwater area	Groundwater subarea	Aquifer	Allocation (kL)
65672	Serpentine	Byford 3	Perth – Leederville (artesian)	37,125
105634	Serpentine	Serpentine 3	Perth – Leederville (artesian)	110,000
171765	Serpentine	Byford 3	Perth – Superficial Swan (surface)	9,000
174001	Serpentine	Byford 3	Perth – Superficial Swan (surface)	32,625
202018	Serpentine	Byford 3	Perth – Cattamarra Coal Measures (artesian)	85,000

4.3.5 Public Drinking Water Source Areas

As the responsible authority for the management and protection of Western Australian water resources, DWER protects catchment and recharge areas of drinking water reservoirs and bore fields by gazetting water reserves, catchment areas and underground water pollution control areas (DWER, 2018). Collectively, these are known as Public Drinking Water Source Areas (PDWSAs). That is, surface water catchments and groundwater areas that provide drinking water to the State's cities, towns and communities.

PDWSAs are proclaimed under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* or the *Country Areas Water Supply Act 1947*. By-laws created under these statutes enable us to manage potentially polluting activities, regulate land use and inspect premises.

In order to effectively guide land use decisions, PDWSAs are classified according to their priority:

- Priority 1 (P1) areas are defined and managed to ensure there is no degradation of the quality of the drinking water source with the objective of risk avoidance.
- Priority 2 (P2) areas are defined and managed to maintain or improve the quality of the drinking water source with the objective of risk minimisation.
- Priority 3 (P3) areas are defined and managed to maintain the quality of the drinking water source for as long as possible with the objective of risk management.

As shown in Figure 4-8, a significant part of the eastern portion of the Shire is classified as a Priority 1 (P1) area in connection with the Serpentine Dam Catchment Area, Serpentine Pipehead Dam Catchment Area and Wungong Brook Catchment Area.

There are also P1 and P2 areas associated with the Jandakot Underground Water Pollution Control Area which falls within the western portion of the Shire.

4.3.6 Water quality

Catchment nutrient reports published by DWER provide a summary of monitoring data collected at various sampling sites across the south-west of Western Australia. The reports detail the concentrations and loads of nutrients leaving the catchments and entering the receiving environment, typically estuaries, and are an important indicator of the ecological conditions and integrity of estuarine systems.

Catchment nutrient reports are prepared every five years with annual updates where appropriate and are prepared for 13 of the catchments of the Peel Harvey Estuary, which include two catchments located within the Shire: the Upper Serpentine River catchment and Dirk Brook – Punrak Drain catchment.

4.3.6.1 Upper Serpentine River catchment

To provide an indication of surface water quality across the Shire, the Serpentine River sampling site at Dog Hill (614030), located within the Peel Harvey catchment, has been utilised. It is located on the border between the Shire of Serpentine Jarrahdale and the City of Rockingham (Figure 4-5). Flow has been measured since 1979 and nutrients monitored from 1983.

Water quality is influenced by soil type and surrounding land use, with a mixture of soil types found within the catchment and only a small area subject to flooding (5 percent). As shown by the areas that are not shaded purple (which denotes high phosphorus export

risk) in Figure 4-12, more than half the catchment has a low or very low risk of phosphorus leaching to the waterways (62 percent).

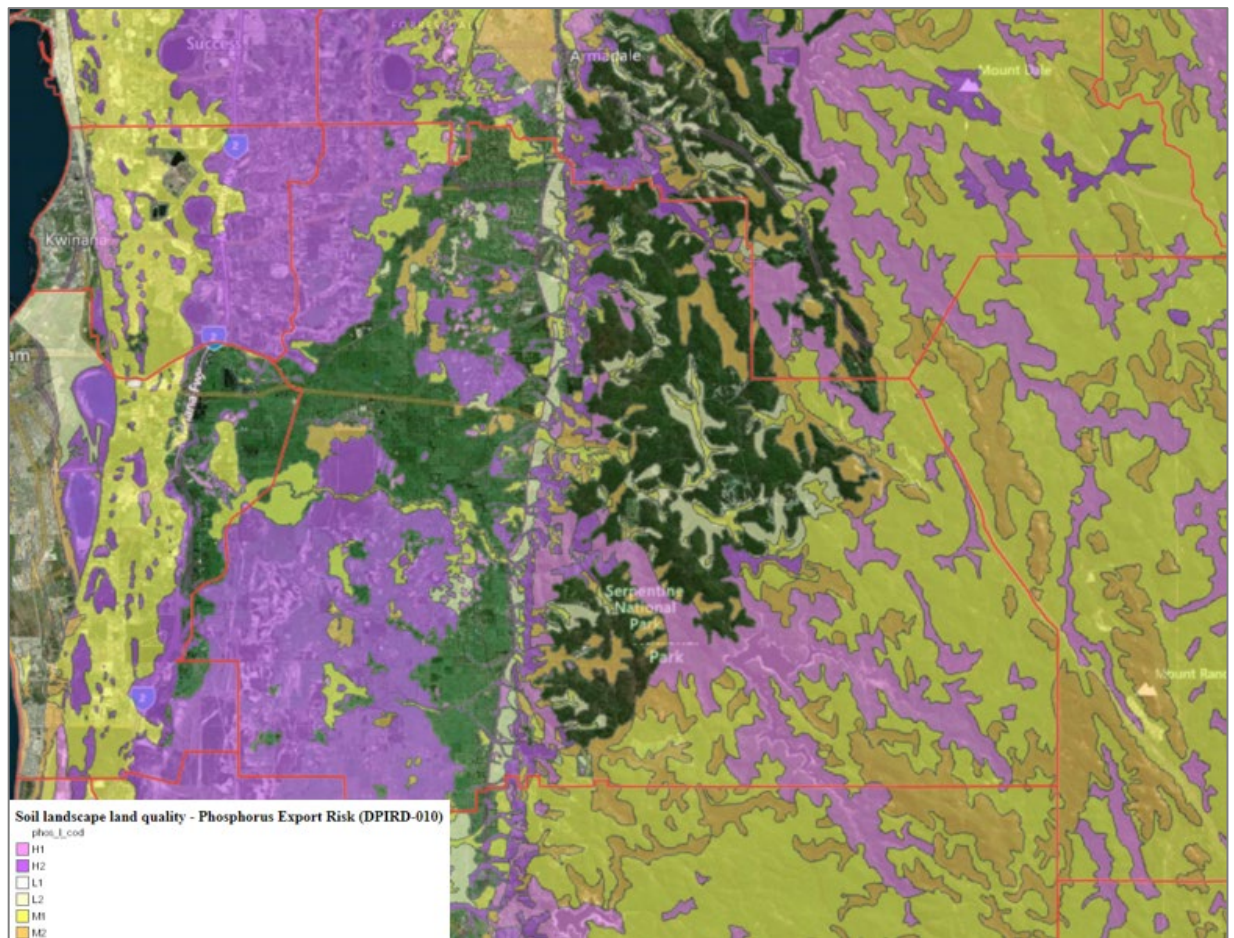


Figure 4-12 Phosphorus export risk DPIRD-010 (GoWA, 2019)

To the east of the Darling Scarp, the catchment remains relatively undisturbed, whereas west of the Scarp the land has been cleared, mostly for agriculture (e.g. stock grazing) and lifestyle blocks. More intensive land uses such as sheep feedlots, poultry farms and piggeries are also present (DWER, 2017), which poses a higher risk of eutrophication² due to the potential for nutrient runoff from the land associated with animal waste and fertiliser reaching the estuarine system.

Nitrogen concentrations

The annual percentage of total nitrogen (TN) samples from Dog Hill that exceeded the ANZECC³ guideline for lowland rivers (1.2 mg/L) ranged between 6 percent (2006) and 42 percent (2005). Between 2005 and 2009, 30 percent of samples exceeded the guideline. This value increased slightly to 34 percent for the period between 2010 and 2014 (Figure 4-13 and Figure 4-14).

Phosphorus concentrations

² Eutrophication is nutrient enrichment which drives excess primary productivity in waterways (DWER)

³ Australian guidelines for water quality monitoring and reporting

The annual percentage of total phosphorus samples from Dog Hill that exceeded the ANZECC guideline for lowland rivers (0.065 mg/L) ranged between 53 percent (2001) and 100 percent (2008 and 2011). Between 2005 and 2009, 81 percent of samples exceeded the guideline. This value decreased to 76 percent for the period between 2010 and 2014 (Figure 4-13 and Figure 4-14).

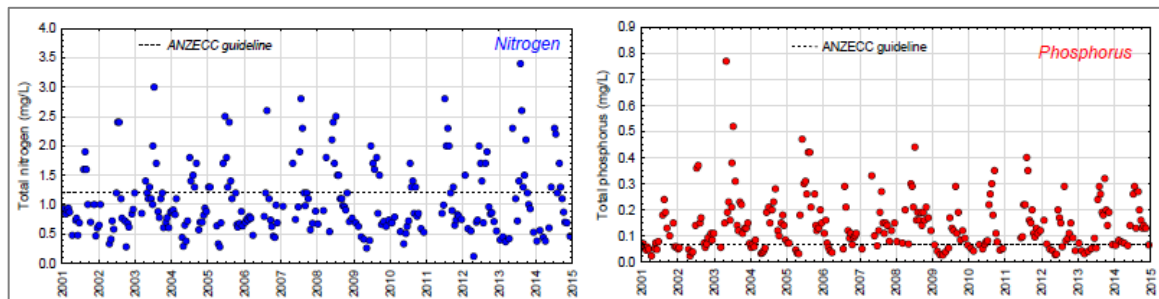


Figure 4-13 Total nitrogen (TN) and total phosphorus (TP) concentrations (2001-14) at Dog Hill

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Annual flow (GL)	59	34	63	9.7	35	49	51	7.7	46	16	38	28	6.4	24
TN median (mg/L)	1.1	0.86	1.2	0.75	1.0	1.1	0.70	0.76	0.95	0.84	1.1	0.79	0.88	1.5
TP median (mg/L)	0.19	0.11	0.20	0.10	0.13	0.18	0.09	0.08	0.14	0.09	0.14	0.13	0.08	0.17
TN load (t/year)	110	59	111	14	63	88	93	10	83	21	70	47	8.1	39
TP load (t/year)	18	9.0	19	2.0	9.4	16	15	1.4	14	2.9	11	7.0	1.1	5.7

Status classification: ■ Low ■ Moderate ■ High ■ Very high
 Status reported for three-year period end (i.e. 2012–14 reported in 2014)
 TN = total nitrogen TP = total phosphorus

Figure 4-14 Nutrient summary: median concentrations, loads & status classifications at Dog Hill (Department of Water, 2017)

Ecological condition was assessed across three reaches of the Serpentine River between the Serpentine Dam and the Birriga Main Drain confluence using the South West Index of River Condition harnessing data collected at field sites in summer 2014 and available desktop data.

The assessment identified the presence of six native fish and crayfish species; however, a greater abundance of two exotic species were found (mosquito fish and yabby). It was noted that dissolved oxygen at two sites on the downstream reach (below the Darling Scarp) was at the lower end of optimal conditions for around half of the-24 hour sampling period. Temperature and salinity were within acceptable ranges.

Greater than 95 percent of the length of all three reaches was vegetated to an average width of between 38 m (lower reach) to >50 m (upper reach) on each river bank. However, more than 75 percent of the groundcover at field sites assessed was non-native. The extent of erosion was variable, ranging from 5 percent to > 50 percent of the bank length affected, with sites on the downstream reach having more erosion. No data was available for the upper reach, but given its location within a national park the proportion of exotic species and erosion would be expected to be minimal (Department of Water, 2015).

4.3.6.2 Dirk Brook – Punrak Drain catchment

Water quality has been monitored since July 2006 near the bottom of the catchment from the gauging station at Yangedi Swamp (Figure 4-6). Punrak Drain flows year-round during wet years and most of the catchment is subject to seasonal inundation (52 percent). Flows stop around December to May in dry years (Department of Water, 2015).

Similar to the adjoining Upper Serpentine River catchment, to the east of the Darling Scarp the catchment is largely undisturbed whilst land to the west has been cleared, primarily for agriculture (e.g. stock grazing), and more intensive land uses (e.g. piggeries and turf farms).

Although soils vary across the wider Peel Harvey Estuary catchment, the Punrak Drain catchment consists entirely of sandy and clayey swamps and leached sands and has a high or very high risk of phosphorus leaching to waterways (Department of Water, 2015).

Nitrogen concentrations

The Dirk Brook – Punrak Drain catchment nutrient report identifies that the annual percentage of TN samples that exceeded the ANZECC4 guideline for lowland rivers (1.2 mg/L) ranged from 50 percent (2003) to 94 percent (2007).

Between 2001 and 2014, 75 percent of samples exceeded the guideline, however this value increased to 80 percent for the period between 2010 and 2014 (Department of Water, 2015) (Figure 4-15 and Figure 4-16).

Phosphorus concentrations

During the period between 2001 and 2014, all but one sample (2002) exceeded the ANZECC4 guideline for lowland rivers (0.065 mg/L). Moreover, 15 percent of TP samples exceeded 0.65 mg/L, which is equivalent to 10 times the guideline. With the exception of 2014, each year had at least one sample with a TP concentration greater than 0.65 mg/L (Department of Water, 2015)(Figure 4-15 and Figure 4-16).

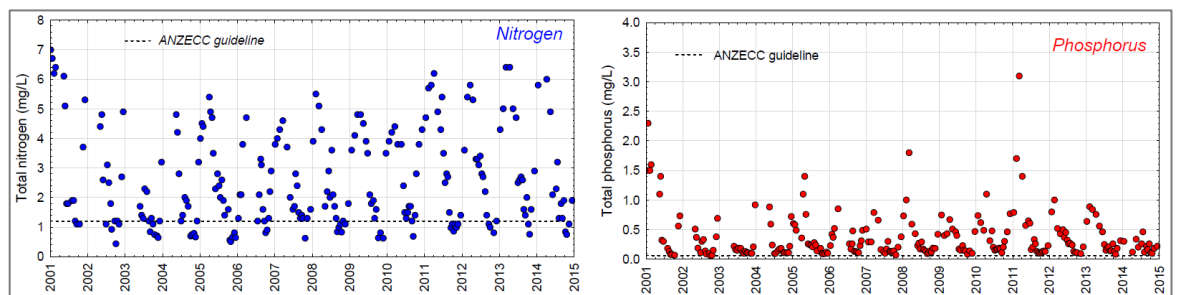


Figure 4-15 Total nitrogen (TN) and total phosphorus (TP) concentrations (2001-2014) at Yangedi Swamp

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Annual flow (GL)	42	-	-	4.1*	15	15	18	6.8	12	5.5	11	9.6	2.0	6.3
TN median (mg/L)	1.3	1.6	2.4	2.1	1.7	2.0	2.8	2.4	2.8	3.0	2.6	1.9	3.5	2.2
TP median (mg/L)	0.14	0.16	0.24	0.26	0.17	0.23	0.32	0.30	0.26	0.30	0.25	0.21	0.14	0.20
TN load (t/year)	95	-	-	8.3*	31	31	38	12	24	10	21	18	3.6	11
TP load (t/year)	11	-	-	0.97*	3.8	3.6	4.3	1.3	2.7	1.1	2.4	2.0	0.38	1.2
Status classification	Low			Moderate			High			Very high				
Status reported for three-year period end (i.e. 2012–14 reported in 2014)												* Best estimate using available data (- not applicable)		
TN = total nitrogen TP = total phosphorus														

Figure 4-16 Nutrient summary: median concentrations, loads & status classifications at Yangedi Swamp (Department of Water, 2017)

4.3.7 Water use

Water supplied to Western Australian residents is currently sourced from groundwater, groundwater replenishment, desalination and dams (surface water). In the Shire of Serpentine Jarrahdale, however, the main water sources are groundwater and dams.

In 2003, the State Water Strategy set a target to reduce Perth's consumption to less than 155 kilolitres year a person per year (from a high of 185 kilolitres a person a year) by 2012. The community achieved this target by adopting a range of water conservation measures, including the two day a week sprinkler roster system. In 2007, total Perth scheme water consumption averaged 153 kilolitres a person a year (including use for households, commerce, agriculture, parks, firefighting and water treatment). Of this total, residential water use averaged 106 kilolitres a person a year.

The State's Water Plan 2007 therefore included a priority action to "reduce annual household use of scheme water in Perth to less than 100 kilolitres per person".

Many local governments recognise that, as large consumers of water, they also have a responsibility to show leadership by providing for the needs of the community in a sustainable and efficient manner. The Shire is one such local government and was one of the first local councils in Western Australia to join the ICLEI Water Campaign™ and is an accredited Waterwise Council.

The Water Campaign is an international freshwater management program that has a proven record in managing Integrated Water Management worldwide. Applicable to all local administrations, the Water Campaign's Local Action Planning process and performance monitoring tools are the benchmark for effective resource management.

The Waterwise Council program is a partnership between Water Corporation and the DWER that supports councils to improve their water efficiency and build waterwise communities.

4.3.7.1 Shire of Serpentine Jarrahdale Council water use

The Shire uses potable water (drinking water) in its buildings and facilities. Water required for other uses, such as irrigation of parks, is primarily supplied from groundwater. Through its Local Water Action Plan and participation in the Waterwise Council program, the Shire tracks corporate and community water usage. The method for tracking water use has changed over time, but water usage over the past three years is summarised in Table 4-3 and Table 4-4 below.

Table 4-3 Total Shire water use over time (Shire of Serpentine Jarrahdale 2018)

	2015/16	2016/17	2017/18
Potable water use (kL)	19,636	17,091	19,559
Non-potable water use (kL)	166,105	176,776	169,988

Table 4-4 Water use in Council facilities (Shire of Serpentine Jarrahdale 2018)

Top water using council facilities	2015/16 water use (kL)	2016/17 water use (kL)	2017/18 water use (kL)
Reserves, POS and gardens (non-potable)	166,105 kL (2015/16)	176,776 kL (2016/17)	169,988 kL (2017/18)
Reserves, POS and gardens (potable)	7,799 kL (2015)	6971 kL (2016)	11,619 kL (2017)
Fire stations, hydrants and standpipes	3734 kL (2015)	3118 kL (2016)	4,769 kL (2017)
Serpentine Sports Reserve – multi-use hall, pony club hall and golf club	3,345 kL (2015)	1,901 kL (2016)	2,464 kL potable) 31,048 kL non-potable (2017/18)
Briggs Park facilities and hall, BMX track watered weekly, Recreation Centre	1,696 kL (2015)	1,791 kL (2016)	2,875 kL potable) 30,195 kL non-potable (2017/18)
Byford Hall - includes irrigation of Byford streetscape	1,726 kL (2015)	2,600 kL (2016)	1,826 kL (2017)

4.3.7.2 Community water use

The Shire is working with the Water Corporation to be a waterwise Council. This includes tracking community water use (Table 4-5 below).

Table 4-5 Community water use in the Shire of Serpentine Jarrahdale (Shire of Serpentine Jarrahdale, 2019)

	2015/16 water use (kL)	2016/17 water use (kL)	2017/18 water use (kL)
Total water use	1,922,533	2,236,069	2,267,502
Per person water use (across Shire)	69.5	80.9	77.0

Water use in the Shire is below the Water Corporation target of 110kL supplied per person by 2030. The Water Corporation's water use by suburb calculator also indicates that water use across Shire suburbs (where available) is also under the target of 110kL except for the suburb of Serpentine (Water Corporation, 2019).

Table 4-6 Water use across Shire suburbs (Water Corporation, 2019)

Suburb	Average water use per household (kL)	Average water use per person (kL) ⁴
Jarrahdale	234	86
Mundijong	254	91
Serpentine	302	112 ⁵
Byford	302	101

4.4 Pressures

4.4.1 Population growth

The population projections of Perth and Peel @ 3.5 million establish a clear mandate and growth agenda for urban consolidation with an additional 100,000 residents expected to be accommodated within the Shire by 2050. The anticipated population growth will place significant pressure on both the diminishing water resources supplying human settlements, and the ecological health of surface and groundwater systems that provide the supply of water.

The rapid population growth being experienced by the Shire has typically been characterised by low density residential development in the form of single detached residential dwellings. Vegetation clearing, filling of lands and the installation of artificial drains to accommodate this form of residential development has resulted in a loss of wetlands and altered hydrology to a detrimental impact on the state of inland waters. With population growth comes increased demand for water resources which represents a key pressure underlining the fundamental importance of balancing the need to protect the ecological integrity of inland waters, whilst accommodating the additional residential dwellings that will be needed to house anticipated population growth.

4.4.2 Climate change

As described in Section 4.3.1, rainfall in the Shire is decreasing. The CSIRO has modelled a number of projections based on the outputs of global climate models (CMIP5) which forecast anticipated changes in regional climate for defined natural resource management clusters. The Shire is located within the Western Australian Southern and South-Western Flatlands sub-cluster (Hope P. et al., 2015), an area that the CSIRO predicts will experience a decline in winter rainfall by up to approximately 15 percent in the near future (2030), and up to around 30 percent in the late century (2090) under an intermediate emissions scenario (RCP4.5). This increases to a 45 percent decline in rainfall under a high emission scenario (RCP8.5) (CSIRO, 2007).

To this end the CSIRO (2007) indicates that the impacts of climate change are likely to result in lower spring and winter rainfall in WA's south west, in conjunction with more intense rainfall events and longer periods of drought as a result of reduced soil moisture and increased evaporation rates. The CSIRO (2007) states that *"this variability has the*

⁴ Per person water use was calculated using 2016 census data (number of people per dwelling), ABS 2016

⁵ Water use exceeds Water Corporation target

potential to result in localised flooding from stormwater during extreme events, which may become more frequent in the future”.

Rolling reductions in annual rainfall are likely to maintain the pattern of unpredictability and increasing variability of rainfall patterns which may have significant impacts on surface and groundwater availability for both human and environmental needs. Moreover, as groundwater levels decrease, climate change may also increase the risk of:

- Acidification and heavy metal contamination due to the disturbance of acid-sulphate soils (Essential Environmental, 2016)
- Death of native vegetation dependent on groundwater
- Drying of wetlands

Changes to rainfall also have the potential to result in localised flooding, elevated pressure on stormwater systems and damage to infrastructure, as well as pressure on available water sources (Ibid.) due to lower dam inflows and reduced groundwater aquifer recharge which are the main water sources supplying Shire residents.

4.4.3 Changing land use and management

As outlined by Argent (2017) in Australia State of the Environment 2016: Inland water, changing land use and management can create pressures on aquatic environments that include changes to flow, water quality and the availability of habitat.

The historical trends of large scale land clearing and changes to land cover associated with urbanisation and intensive agricultural land uses *“have left a legacy of changes in quality and flow regimes, such as changes in biota and sediment, and nutrient concentrations in streams”* (Argent, 2017).

4.4.3.1 Urbanisation and population growth

As part of the overall Perth and Peel metropolitan region, Serpentine Jarrahdale is situated within the South Metropolitan Peel Sub-Region. Between 2004 and 2014 the Perth and Peel area accounted for 83 percent of population growth in the State; an area that by June 2014 had grown by 497,762 persons to 2,011,676 (Shire of Serpentine Jarrahdale, 2018) representing an annual growth rate of 2.9 percent.

As shown in Figure 4-17, population growth within the Shire of Serpentine Jarrahdale has experienced a higher rate of growth than the South Metropolitan Peel (SMP) Region, and Western Australia overall (Shire of Serpentine Jarrahdale, 2018).

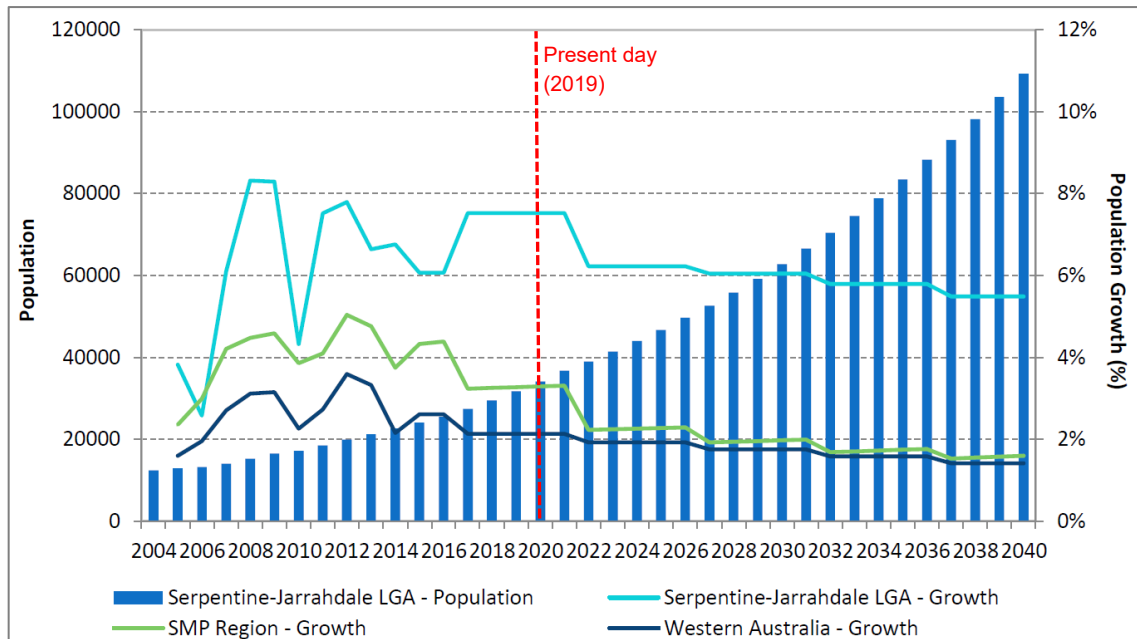


Figure 4-17 Historic population snapshot and growth trends

Population growth to date has largely been accommodated within the settlements of Byford, Mundijong/Whitby, Serpentine and Jarrahdale. These settlements are also expected to accommodate the predicted population growth. Limiting the extent of further urban sprawl by consolidating existing urban areas and restricting further encroachment of land uses that have the potential to compromise the ecological integrity of inland water resources is a critical component of managing the pressures associated with urbanisation and accommodating anticipated population growth.

Whilst a supply of urban land remains to accommodate anticipated population growth, if current patterns of residential development (i.e. the proliferation of single detached dwellings on large lots) are maintained, the available supply of currently identified urban land will not be able to accommodate a population of over 100,000 (Shire of Serpentine Jarrahdale, 2018). This would create a significant pressure on inland water resources due to the potential for encroachment of residential development into rural areas and the associated impacts associated with land clearing, filling of land and altered hydrology.

4.4.3.2 Altered hydrology

The impacts of altered hydrology are a key water resource consideration. Filling of land associated with conventional residential development has led to a loss of wetlands and the installation of drains which have significantly altered the natural hydrology of the landscape and resulted in a loss of environmental values (Essential Environmental, 2016).

4.4.3.3 Erosion

The clearing of remnant vegetation to provide land for agricultural and urban uses, particularly along the Darling Scarp, can result in erosion and the loss of sediments to receiving waterbodies which is further exacerbated by the action of wind or winter (Essential Environmental, 2016).

Erosion leads to the mobilisation of soil particles which are in turn released into the air and tributaries which increases turbidity within a water body. Increased turbidity within a water body also impacts upon other environmental constituents i.e. smothering riparian

vegetation and reducing light transfer within the water column which affects plant growth (Department of Water, 2007)

4.4.3.4 Flood risk

As mentioned in Section 4.3.2.3 there are many rivers and brooks that traverse the Shire and which flow down from the Darling Scarp across the Swan Coastal Plain. Whilst providing a key natural attribute that attracts residents to the area, there is an associated flood risk to development near these waterways (Essential Environmental, 2016). The presence of residential and agricultural land uses near waterways increases the risk of nutrient and contaminant runoff during periods of high rainfall or flooding which creates further pressure on the ecological integrity of the aquatic environment.

4.4.3.5 Eutrophication

Owing to the historical pattern of agricultural land use in the western portion of the Shire, in conjunction with the presence of saturated clays with their tendency to absorb nutrients, soils within the Shire are typically high in legacy nutrients (Essential Environmental, 2016).

Sub-soil drainage infrastructure that was created to facilitate agricultural land uses and enable the cultivation of land within the Shire has also resulted in nutrient transport to receiving water bodies. This is an important consideration for inland water resources, and particularly important for the Peel Harvey catchment, which has been identified as being at significant risk of eutrophication (Essential Environmental, 2016).

With over 90 percent of the Shire located in the Peel Harvey catchment, as intensive agriculture and residential land use grows, there is a greater risk of increasing nutrient export and pressure on the aquatic environment.

4.4.3.6 Contamination

Nutrient loading of an estuarine system is a form of contamination. There is also the ability for drinking water sources to be contaminated with pathogens through activities involving the direct contact of human and domestic animals.

Landfill sites and industry are a potential source of pollutants to ground and surface waters, and must be carefully designed, managed and monitored to avoid impacts.

4.5 Responses

4.5.1 Local planning framework

There are a number of provisions in the Town Planning Scheme No.2 (TPS2) that relate to protection of the water resources and water management in specific zones in the scheme area which are written into the scheme text, as outlined below.

- Residential development – R Codes apply to residential development which includes provisions relating to landscaping and stormwater management
- Rural living A and rural living B – Land within this zone shall be subject to conditions that include the application of the relevant guidelines in the Council's Planning Guidelines for Nutrient Management (1993) and satisfactorily designed storm water drainage
- Farmlot zone – Land within this zone shall be subject to conditions that include the application of the relevant guidelines in the Council's Planning Guidelines for Nutrient Management (1993) and satisfactorily designed storm water drainage

- Agriculture protection zone - Land within this zone shall be subject to conditions that include the application of the relevant guidelines in the Council's Planning Guidelines for Nutrient Management (1994),
- Rural groundwater protection zone – Land use and development in this zone is to be in accordance with State Planning Policy 2.3 (SPP2.3) – Jandakot Groundwater Protection Policy. SPP2.3 aims to '*protect the Jandakot Groundwater Protection ...from development and land use that may have a detrimental impact on the water resource.*'

The Metropolitan Region Scheme (MRS) and TPS2 are also used to reserve land. Water catchments are included on the scheme maps under MRS reserves.

In addition, the following local planning policies (LPP) have been adopted by the Shire to guide assessment of development and land use proposals that impact on water resources and to guide how water is managed in an urban setting.

- LPP 2.4: Water Sensitive Design
- LPP 2.8: Public Open Space Policy
- LPP 4.4: Dams and Lakes Policy

4.5.1.1 Draft Local Planning Strategy

The Draft Local Planning Strategy (LPS) identifies that the management of both existing and future drainage systems will need to be addressed in areas identified for future development in order to restore the health of the waterways and reduce other risks to ecosystems, infrastructure and property. Modification of existing drainage schemes to incorporate best practice for water-sensitive design and nutrient management may be required and could include the use of detention basins, amended soils and/or nutrient stripping facilities (Draft LPS).

Key water resource considerations for strategic planning, consistent with State Planning Policy 2.9: Water Resources and LPP 2.4: Water Sensitive Design, identified as part of the draft LPS are:

- Climate change – declining levels in superficial groundwater systems coupled with increased abstraction from superficial systems may impact on the health of groundwater dependent ecosystems. Strategies should aim to restore local hydrological conditions where possible, through design of integrated water cycle systems and solutions.
- Altered hydrology – filling of the land has resulted in a loss of wetlands and the installation of drains has significantly altered the hydrology of the landscape. Aim to re-establish lost values and design systems to cope with soil waterlogging and minimise nutrient and sediment export.
- Eutrophication - as intensive and residential land use grows, there is a risk of increasing nutrient export into the Peel Harvey catchment. Water sensitive design and revegetation in new development should continue to address this issue.
- Groundwater availability – declining rainfall may result in reduced recharge and consequently availability to residents in the future.
- Shallow groundwater – conventional building practices are designed for sandy sites with good separation to groundwater. Alternative building practices including

appropriate footings which do not require the use of fill should be encouraged across the Swan Coastal Plain. Infrastructure should be designed to meet appropriate standards.

- Flooding from stormwater - adequately manage the risk of flooding in urban areas through application of State Planning Policy 2.9: Water Resources. The Shire of Serpentine Jarrahdale may also need to review existing townsite drainage systems and ensure appropriate levels of service will be maintained as development occurs and water quality of stormwater is addressed.
- Continued water use efficiency.
- Water reuse – due to the availability of groundwater, it is considered that water recycling and reuse to provide fit-for-purpose sources of water may not be considered cost effective. However, consideration should be given to the establishment of decentralised systems which optimise (re)use of the total water cycle – especially in industrial areas.
- Declining soil health – clearing of land for agriculture and/or development may result in threats to water quality, including exposure of acid sulphate soils, sediment and nutrient export and chemical pollutants.
- Contamination of water resources - landfill sites are a potential source of pollutants to ground and surface waters, and must be carefully designed, managed and monitored to avoid impacts. The use of clean fill in wetland areas is also a threat, reducing the area of wetland ecosystems and changing the hydrology.

Adapted from Local Planning Strategy – Environmental Profile (Essential Environmental 2016).

4.5.2 State Planning Policies

The State Government is currently amalgamating SPP 2.1, SPP 2.9 and SPP 2.10 to form one single SPP that will cover water resources for Western Australia. It is important that the Shire is involved in this review process to ensure specific local issues relating to water management are captured and adequate decision making guidance included, particularly as state planning policy carries greater weight in decision-making than local planning policy. The revised SPP will address climate change, water use efficiency, new technologies, water sensitive urban design and flood risk management.

SPP 2.3 and SPP 2.7 may also be amalgamated into one SPP with SPP 2.2.

4.5.3 Application of Better Urban Water Management

To align with the process outlined in Better Urban Water Management (BUWM) and support the Drainage and Water Management Plan (DWMP) planned for the Lower Serpentine region, the DWER's Urban Water Management Branch has instigated the following projects:

- A floodplain strategy for Birriga and Oaklands drains including inundation and local catchment stormwater modelling
- Hydrological studies to determine pre-development groundwater levels, water balance modelling, climate impacts, extent of current waterlogged areas and impact of development

- Preparation of the Birriga and Oaklands drains DWMP
- Planning for future DWMPs for the Lower Serpentine area.

To effectively plan for the expected population growth and subsequent urbanisation and to align with the land use and water planning framework outlined in BUWM, district structure planning and associated district water planning has occurred as described below (pers. coms. DWER, 2019).

Byford

In 2008 the Department of Water prepared the Byford townsite drainage and water management plan. The summary plan within the document identifies the 100 Year ARI Floodways which are not to be developed or obstructed. The management plan notes that the town centre is proposed in an area at substantial risk of flooding. It will be important for future Local Structure Plans to address flooding in this area. The management plan notes the key objectives for urban water use relate to:

- Efficient use of water resources in newly-developing urban form
- Ensuring opportunities for future generations

A floodplain management plan was prepared by SKM for the Byford catchment. It recommends some key planning measures for floodplain management relating to raised floor levels, design of residential streets, incorporation of best practice WSUD on new urban areas, construction of waterways and design of new drainage corridors.

The management plan includes a list of best management practice principles to reduce flood risk on housing and infrastructure, as well as treating stormwater. In summary these are:

- Implementing controls near the source to treat stormwater and mitigate pollutants
- Using structural and non-structural best management strategies
- Applying best management practices on a residential lot scale, commercial lot scale, street scale, estate scale and area scale

Two Local Water Management Strategies and two Urban Water Management Plans for the Byford area have also been approved by DWER in the Byford area (GoWA, 2019).

The Byford District Structure Plan, approved by Council for advertising in December 2018, outlines the processes for subsequent land use and water planning in the area and supports water efficiency, water sensitive urban design and fit-for-purpose water use.

An integrated water management strategy for the Shire has been drafted, including consideration of long-term water security in Byford. The draft strategy was endorsed for public comment by the Shire Council on 19 August 2019.

Mundijong Whitby

A District Structure Plan (DSP) was prepared for Mundijong-Whitby in December 2010 to guide land use and development within this area and accommodate approximately 30,000 residents. The Mundijong Whitby DSP included the preparation of a District Water Management Strategy (DWMS). The DWMS outlines strategies and design criteria for future development in the area. Subsequent water planning should follow the process outlined in BUWM, with local water management strategies and urban water management

plans provided at relevant planning stages. A Local Water Management Strategy for Whitby has been prepared and is approved by DWER.

Jandakot

The Jandakot Structure Plan was developed to coordinate the development expectations associated with the area whilst balancing environmental constraints, conservation, infrastructure provision and lifestyle, and community and neighbourhood objectives. The structure plan identifies the need to prepare a water resource management strategy.

4.5.4 Drinking Water Source Protection

Public Drinking Water Source Areas in the Shire are largely protected through MRS zoning (State Forest), water catchment identification on the MRS mapping and Priority 1 and 2 drinking water source area classifications. This is an important mechanism to protect groundwater resources from land use impacts at the surface and should continue.

4.5.5 Catchment remediation

4.5.5.1 Examples of water sensitive urban design

In alignment with SPP 2.9 and LPP 2.4, water sensitive urban design is being implemented across new developments.

For example, the Glades is a residential development located approximately 2 km south-west of the Byford town centre. The development includes raingardens as part of a train of structural controls designed to treat stormwater before discharging it into a tributary of Cardup Brook, which discharges into the Peel–Harvey Estuary. Monitoring of the raingarden indicates that the raingarden reduces peak storm flows by 89 percent, reduces total phosphorus load by up to 90 percent and total nitrogen by an average of 72 percent.

The Glades includes a bioretention basin which receives stormwater runoff from a 9.24 hectares catchment. Due to the low infiltration capacity of the local soils, onsite infiltration at the lot scale was not considered viable. Stormwater quantity and quality treatment was undertaken at the neighbourhood catchment scale through the construction of a bioretention basin. Sand fill was imported to the site to provide sufficient groundwater clearance for construction, and subsoil drains were installed to manage the local perched groundwater.

These are examples of many initiatives implemented as part of new development that help improve nutrient loads into receiving waters.

4.5.5.2 Landcare SJ Inc.

Landcare SJ Inc. were involved in the Peel-Harvey Rivers 2 Ramsar: connecting river corridors project from 2013 to 2017. Achievements relating to improved water quality include:

- 4.3 kilometres of fencing to protect waterways from stock.
- Eight hectares of revegetation, to improve the health and resilience of natural areas associated with waterways.
- Three riffles installed – Two on the Serpentine River and one on the Karnup Creek, to slow down water flow and create in-stream habitat.
- Four off-stream watering points to remove stock from a waterway.

The Shire contributes \$227,000 per year in financial and in-kind support to Landcare SJ. Inc. Landcare SJ Inc. supports the work of the Peel Harvey Catchment Council.

4.5.5.3 Dirk Brook Catchment Nutrient Report

Many nutrient reduction measures have been made in the Dirk Brook catchment. In 2001 an artificial wetland was constructed and riffles and meanders were also installed in several waterways. Revegetation and stock exclusion occurred during subsequent years. The aim was to reduce nutrient concentrations and sediment loads, while enhancing the system's ecological values by slowing the flows, increasing oxygen concentrations and providing habitat.

The effect of individual interventions on nutrient concentrations could not be assessed due to insufficient data. Similarly, ecological monitoring was not undertaken after these activities so their effectiveness in improving stream health could not be determined.

No improvement was observed in nutrient concentrations at the bottom of the catchment. This is not surprising given the extent of the remediation works relative to the size of the catchment, as well as land use intensification.

4.5.6 Water resource planning

As discussed in Sections 2.3.3 and 2.4.2, groundwater aquifers are fully allocated and aquifer recharge is reducing. These discussions have resulted in a commitment from the DWER to review allocation limits for the Serpentine Groundwater area in the near future.

DWER is working on a number of projects across the Shire which will contribute to the development of a groundwater allocation plan. The area of the Shire south of the Serpentine River is covered by the Peel Integrated Water Initiative (PIWI) where, in partnership with CSIRO, DWER is reviewing the conceptualisation of the groundwater system, undertaking a water resource assessment and reviewing allocation limits. To support this CSIRO has reviewed the historical and projected climate of the region.

The area of the Shire north of the Serpentine River is being reviewed internally by DWER in parallel to the CSIRO work to review allocation limits. DWER continues to undertake monitoring of groundwater to inform allocation of groundwater resources.

Serpentine Dam

Inflows into the Serpentine Dam are projected to decline. In response to this, DWER will continue to take an adaptive approach to water sharing, continuing to monitor rainfall and inflows and review release arrangements if necessary. DWER will continue to consult with stakeholders about their water needs and, where possible, assist with identifying alternative water sources (DWER, 2017)

4.5.7 Water resource use and efficiency measures

The Shire is recognised as a Waterwise Council and is progressing the implementation actions to achieve the goals set out in its Water Efficiency Action Plan (WEAP). The Shire's 2018 Waterwise Council Annual Report identifies progress towards implementation of the WEAP (summarised below).

Corporate water conservation goal

To achieve a 15 percent reduction in water consumption (per capita population of the Shire), based on 2016/17 consumption data, by the year 2026/27, and to ensure no net increase over the same period.

Progress:

Potable water consumption increased markedly (by 44 percent) from 2016 to 2017, mostly due to the handover of new reserves irrigated by potable water. This will be an ongoing issue as non-potable water is in short supply and many more reserves will be handed over in the near future.

A water account which should not and has not been billed to the Shire has been included in WaterCorp's water use report. Without this account, consumption has still increased, but only by 14 percent.

Non-potable water consumption decreased by 4 percent from 2016/17 to 2017/18, but this is within the range of historical variation.

Corporate water quality goal

To implement actions from the 2017 WEAP to improve water quality by 2026/27.

Progress:

Ongoing – relating to implementation of water sensitive urban design and public engagement.

Community water conservation goal

To achieve a domestic scheme consumption average of 100 kL per person per annum within the Shire of Serpentine Jarrahdale community by 2018.

Progress:

Community per capita water use is well below the target, and decreased by 5 percent from 2016 to 2017.

Community water quality goal

To implement actions from the 2017 WEAP to improve water quality by 2026/27.

Progress:

Ongoing – relating to implementation of water sensitive urban design and public engagement.

A full copy of the WEAP is provided in Appendix B.

4.5.8 Summary of responses

Response	Potential actions
4.5.1 Local Planning framework	Continue to utilise the local planning framework to guide water use and management within the Shire Finalise and implement the draft Local Planning Strategy
4.5.2 State Planning Policies	Liaise with the State Government to ensure the Shire is aware of and inputs into review of key State Planning Policies that relate to water
4.5.3 Better Urban Water Management	In collaboration with the DWER, continue to support new development through the application of BUWM
4.5.5 Catchment remediation	Continue to incorporate WSUD in new developments Continue to support Landcare SJ Inc. and other initiatives that reduce nutrient inputs into the catchment
4.5.6 Water resource planning	Liaise with DWER to remain informed about changes to water allocations and potential alternative water sources
4.5.7 Water resource use and efficiency	Continue to participate in the Waterwise Council program

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Theme Four: Biodiversity

5. Theme Four: Biodiversity

5.1 Overview

Biodiversity is the variety of all living things, the different plants, animals and micro-organisms, the genetic information they contain and the ecosystems of which they are a part. The Shire is within the South-West Botanical Province, one of the world's 25 original biodiversity hotspots. Biodiversity hotspots are defined as regions "where exceptional concentrations of endemic species are undergoing exceptional loss of habitat". These biodiversity values are especially important in the corridor between Byford and Keysbrook, which forms part of the eastern side of the Swan Coastal Plain.

Natural areas and biodiversity in the Shire have been significantly impacted since European settlement, especially on the coastal plain and foothills. This level of over-clearing, coupled with the impact of feral animals and other degrading processes, has resulted in significant local extinction of mammals and birds and the deterioration of bushland and wetlands. It has also contributed to the pollution of downstream rivers and the Peel Harvey Estuary (Shire of Serpentine Jarrahdale 2008).

Protecting biodiversity means conserving the full range of genes, species and ecosystems into the future. Given the range of threatening processes, including the prospect of climate change, this will be no mean feat. Protecting biodiversity is, however, essential, as biodiversity underpins the processes that support life, including human life, on this planet. Biodiversity also provides many economic, recreational, cultural and scientific benefits. This theme will discuss the current condition of the Shire of Serpentine Jarrahdale biodiversity.

5.1.1 Strategic alignment

The beauty of the natural environment was one of the core community values identified in the Shire of Serpentine Jarrahdale Strategic Community Plan 2017-2027. The community values the beauty of the landscape and natural environment and believes it requires proper integration into residential development. Maintaining and protecting biodiversity within the Shire of Serpentine Jarrahdale aligns with three of the four key themes in the Shire's Strategic Community Plan, namely People, Place and Prosperity.

People Protecting the Shire's natural areas and its biodiversity will contribute to the enjoyment and wellbeing of the local community. Protected areas can contribute positively to human health in various ways and promote the healthy development of future generations. Natural areas can enhance mental health and well-being by providing quiet spaces for contemplation. It also helps maintain Aboriginal connections to the land by protecting culturally significant places and sites.

Place Natural areas provide places for recreation, education and tourism and protects places and sites of special value to people. Preserving and enhancing the natural environment supports the biodiversity dependent on those ecosystems. Natural vegetation also helps stabilise the natural landscape and maintain natural hydrological systems which can help reduce the risk and consequences of extreme weather events such as storms, flooding and drought. Maintaining and improving natural areas protects biodiversity and the natural systems and processes that are essential for clean air, water and soil.

Prosperity Natural area protection (including the biodiversity they contain) supports tourism and recreational uses and services which can provide direct and indirect economic benefits to the community.

Management of biodiversity is a priority for the Shire, and a number of local strategies have been put in place to address the management of biodiversity on land managed by the Shire and on private land. The Shire of Serpentine Jarrahdale's Strategic Community Plan recognises the need to protect, restore and manage our landscapes and biodiversity. The Shire's Local Biodiversity Strategy 2008 provides a framework for the protection of biodiversity values. The Bio-Diversity Local Planning Policy provides guidance on the information required to assess the impact of development proposals on biodiversity. The Shire has also developed an Urban and Rural Forest Strategy to guide actions to maintain and improve tree canopy and vegetation within the Shire's communities now and into the future. One of the many environmental benefits of an urban forest is increasing biodiversity and faunal habitat. The Shire also supports the Healthy Habitats program and has a number of incentives to encourage biodiversity protection on private land.

5.1.2 Legislative framework

5.1.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's key piece of environmental legislation, providing a national scheme of environment and heritage protection and biodiversity conservation. The EPBC Act:

- Protects matters of national environmental significance
- Conserves biodiversity
- Provides the national environmental approvals process
- Enhances protection and management of important natural and cultural places
- Controls the international movement of plants and animals (wildlife), wildlife specimens and products made or derived from wildlife
- Promotes ecologically sustainable development
- Recognises the role of Indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity
- Promotes the use of Indigenous peoples' knowledge of biodiversity

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

Sections 5.2.7 and 5.2.9 provide information on species and ecological communities listed under the EPBC Act.

5.1.2.2 Biodiversity Conservation Act 2016 and Biodiversity Conservation Regulations 2018

On 1 January 2019, the *Biodiversity Conservation Act 2016* (BC Act) and *Biodiversity Conservation Regulations 2018* replaced both the *Wildlife Conservation Act 1950* and the *Sandalwood Act 1929* and their associated regulations. The BC Act and Regulations provide greater protection for the Western Australian biodiversity, particularly threatened species and threatened ecological communities.

The BC Act and associated Regulations are administered by the Department of Biodiversity Conservation and Attractions (DBCA).

Sections 5.2.7 and 5.2.9 provide information on species and ecological communities listed under the BC Act.

5.1.2.3 Environmental Protection Act 1986

The purpose of the *Environmental Protection Act 1986* (EP Act) is to protect the State's environment. The application of the act must have regard to a number of principles including the principle of conservation of biological diversity and ecological integrity. Clearing native vegetation is an offence under the EP Act, unless done under a clearing permit or the clearing is for an exempt purpose. The Department of Water and Environmental Regulation (DWER) administers the clearing provisions of the EP Act.

5.1.2.4 Biosecurity and Agriculture Management Act 2007

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and its regulations prevent new animal and plant pests entering Western Australia, manage the impact and spread of pests already present, safely manage the use of agricultural and veterinary chemicals, and control safe of agricultural chemicals containing volatile chemical residues. The Shire is responsible for controlling declared pests and weeds of national significance on land owned or vested in the Shire for management.

The BAM Act and associated Regulations are administered by the Department of Primary Industries and Regional Development (DPIRD).

5.1.2.5 Planning and Development Act 2005

The *Planning and Development Act 2005* (PD Act) establishes the Western Australian Planning Commission and provides for an efficient and effective land use planning system which promotes sustainable use and development of land. The PD Act is supported by state planning policies which are the highest level of planning policy control and guidance. State Planning Policies relevant to the protection of biodiversity protection include:

- State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region
- State Planning Policy 3.7: Planning in Bushfire Prone Areas.

Under the PD Act, local governments are responsible for planning their local communities by ensuring appropriate planning controls exist for land use and development. They do this by preparing local planning schemes and strategies.

Local planning schemes set out the way land is to be used and developed, classify areas for land use and include provisions to coordinate infrastructure and development within the local government area. Town Planning Scheme No.2 (TPS2) is the local planning scheme for the Shire.

5.2 Condition

Anthropogenic modification of landscapes can have adverse effects on the native biodiversity supported by that landscape (Fischer and Lindenmayer 2007). Condition indicators assess the current state of various elements of biodiversity. These elements include vegetation community types, remnant vegetation remaining, and threatened species and ecological communities. For the purpose of this report we focus on the amount of intact habitat areas (remnant vegetation), amount of nature reserves and native bushland listed as conservation protected for the future, species diversity located within the Shire, and of those, the number of conservation significant species present as well as the presence of threatened ecological communities.

While parts of the Shire of Serpentine Jarrahdale have been cleared for agriculture and urban development, around 51 percent of the Shire is still covered by native vegetation and hosts almost one hundred conservation significant species. The below sub-headings explore what is believed to be the current condition of biodiversity within the Shire of Serpentine Jarrahdale. The condition of the existing biodiversity within the Shire helps us to understand its resilience.

5.2.1 Regional biogeography

The Shire of Serpentine Jarrahdale is situated within the Swan Coastal Plain (SWA) and Jarrah Forrest (JAF) bioregions, and Perth (SWA02) and Northern Jarrah Forest (JAF01) subregions as described by the Interim Biogeographic Regionalisation for Australia (IBRA). The Perth subregion is dominated by heath and/or Tuart woodlands on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials and a complex series of seasonal wetlands (Mitchell et al. 2002). The Northern Jarrah Forest incorporates the area east of the Darling Scarp and comprises Jarrah-Marri forest in the west with Bullich and Blackbutt in the valleys grading to Wandoo and Marri woodlands in the east with Powder bark on breakaways. There are extensive but localised sandsheets with *Banksia* low woodlands and heath on granite rocks (Williams and Mitchell 2001).



5.2.2 Remnant vegetation communities

In total, native vegetation currently covers approximately 51 percent (46,382 ha) of the Shire's 90,500 ha. Most of this vegetation remains within the Darling Plateau, with only 12 percent or 5,120 ha of the original 40,585 ha of native vegetation remaining on the Shire's Swan Coastal Plain (as at March 2019) (Government of Western Australia (GoWA) 2019a, b).

Regional vegetation complex mapping has been completed by Heddle *et al.* (1980) with updates from Webb *et al.* (2016) based on major landform boundaries on the Swan Coastal Plain and forested region of south-west Western Australia. A total of 16 vegetation complexes are mapped across the Shire of Serpentine Jarrahdale, of which seven occur on the Swan Coastal Plain and nine occur on the Darling Plateau. The GoWA (2019a) provides statistics on the pre-European and current extents of the vegetation complexes of the south-west of Western Australia. The statistics for the vegetation complexes occurring within the Shire are provided in Table 5-1 and remaining vegetation extent with vegetation complex is shown on Figure 5-1.

Removal of native vegetation is a major threatening process affecting biodiversity. Four of the vegetation complexes on the coastal plain in the Shire are of particular significance because of the low levels of retention in the Perth Metropolitan Region (below 10 percent remaining). These are the Dardanup Complex, Southern River Complex, Beermullah Complex and Guildford Complex.

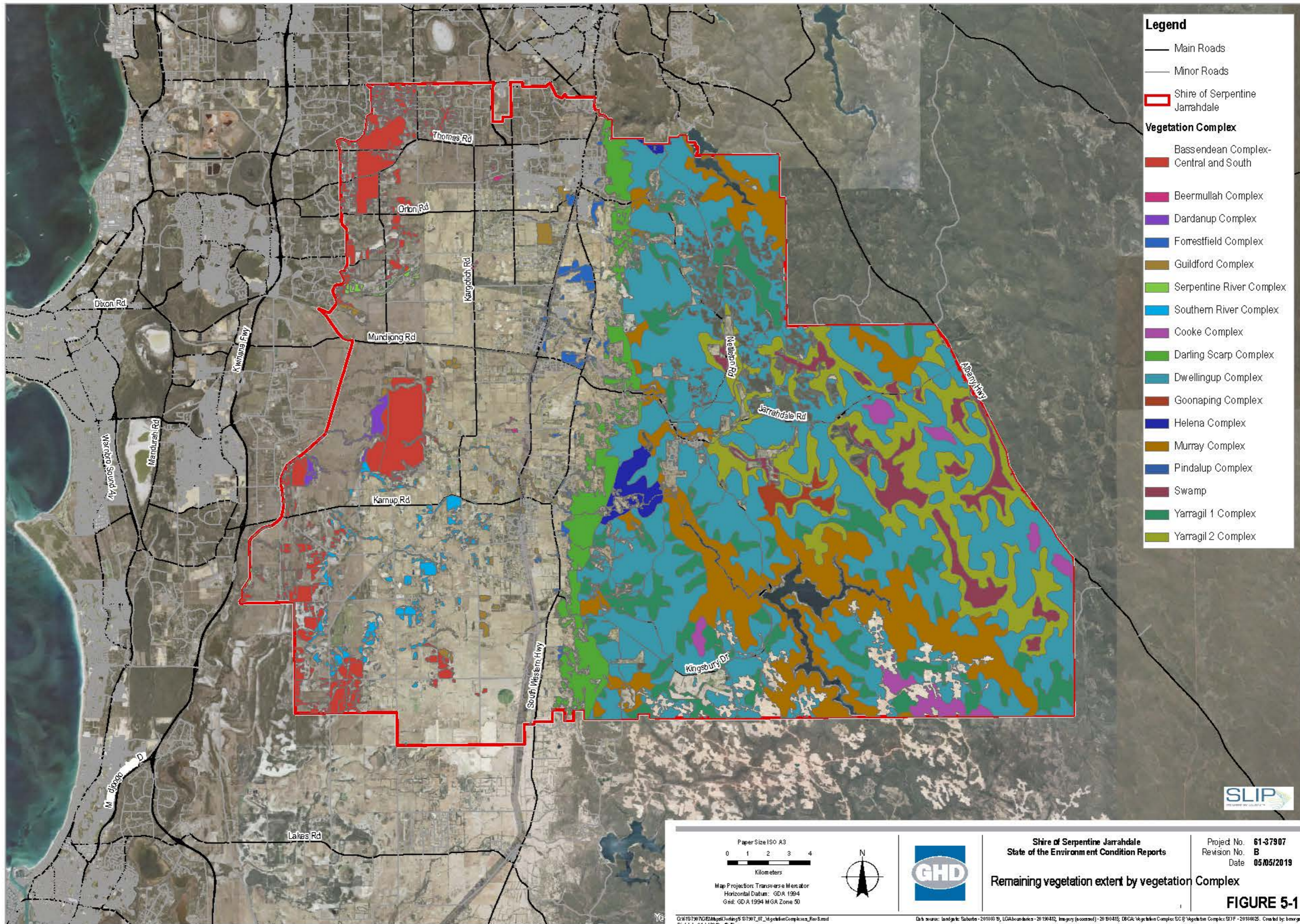
There is a general presumption against clearing any vegetation complex that is retained or protected at less than 10 percent within the Perth Metropolitan Region (Western Australian Planning Commission 2005). The Environmental Protection Authority (EPA) (2006) also considers these vegetation complexes to be potentially regionally significant and worthy of protection where possible.

Table 5-1 Extent of vegetation complexes (remnant native vegetation) mapped within the Shire of Serpentine Jarrahdale as at March 2019 (GoWAa)

Complex	Pre-European Extent (ha)	Current extent (ha)	% Remaining
Swan Coastal Plain			
Bassendean Complex – Central and South	9,852.42	3,166.25	32.14
Southern River Complex	7653.19	674.36	8.81
Beermullah Complex	3,682.79	42.73	1.16
Dardanup Complex	1,112.91	194.63	17.49
Guildford Complex	12986.67	552.25	4.25
Serpentine River Complex	782.91	79.65	10.17
Forrestfield Complex	4514.76	411.02	9.10
Darling Plateau			
Cooke	919.71	780.09	84.82
Darling Scarp	4046.66	2322.88	57.40
Dwellingup 1	11036.59	8975.70	81.33
Dwellingup 2	11397.57	10136.49	88.94
Goonaping	304.21	289.12	95.04
Helena 1	599.17	512.11	85.47
Murray 1	8542.73	7018.90	82.16
Pindalup	0.17	0.15	89.35
Swamp	1797.68	1580.93	87.94
Yarragil 1	4732.97	4061.53	85.81
Yarragil 2	6032.99	5583.58	92.55
Total	89,996.11	46,382.27	51

The Swan Coastal Plain has changed the most significantly, with large areas cleared for agriculture and residential uses as well as draining of wetlands. As large sections of the

Swan Coastal Plain have been cleared the majority of remnant vegetation within this section of the Shire is considered both locally and regionally significant. Along the Darling Scarp the slopes have been cleared for mining, rock quarries, forestry and agriculture which have led to erosion and loss of sediments, nutrients, organic matter and water retention capacity (Shire of Serpentine Jarrahdale 2016). The condition of most of the Darling Plateau is good, as a large proportion of the vegetation cover has been retained. The majority of this is managed as State Forest, water catchment or conservation reserves.



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 Data source: landgate: Suburbs - 201803 10, LGA boundaries - 20190412, Imagery (aerial) - 20180415, DECRA Vegetation Complex SCF Vegetation Complex SDF - 20180625. Created by: bmcguckin
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5.2.3 Conservation areas and Bush Forever sites

The Shire currently manages 36 reserves and open spaces for purposes including conservation, this includes 22 reserves containing local natural areas with significant areas of vegetation in good condition and a further 14 reserves containing local natural areas with degraded remnant vegetation (Shire of Serpentine Jarrahdale 2018). The eastern area of the Shire is dominated by conservation, timber and water catchment uses with approximately 39 percent of the Shire comprising State forest. The State Forest is managed by the State Government for multiple purposes including recreation, water production, bauxite mining and timber production. There is one national park (Serpentine National Park) and two regional parks (Jandakot Regional Park and Wungong Regional Park) within the Shire which are managed by the DBCA (refer to Table 5-2).

There are a total of 30 Bush Forever Sites within the Shire of Serpentine Jarrahdale. Bush Forever Sites within the Shire include unique areas of high biodiversity value, some recognised as scientific reference areas. Bush Forever Sites often contain threatened ecological communities which are protected under the BC Act and EPBC Act. Bush Forever Sites are also mapped as Environmental Sensitive Areas (ESAs) which are protected under the State *Environmental Protection Act 1986* (EP Act). The sites have varying levels of protection, including DBCA nature reserves, Shire reserves, and privately owned bush blocks.

Table 5-2 Total area of conservation reserves and Bush Forever within the Shire of Serpentine Jarrahdale (GoWA 2019a)

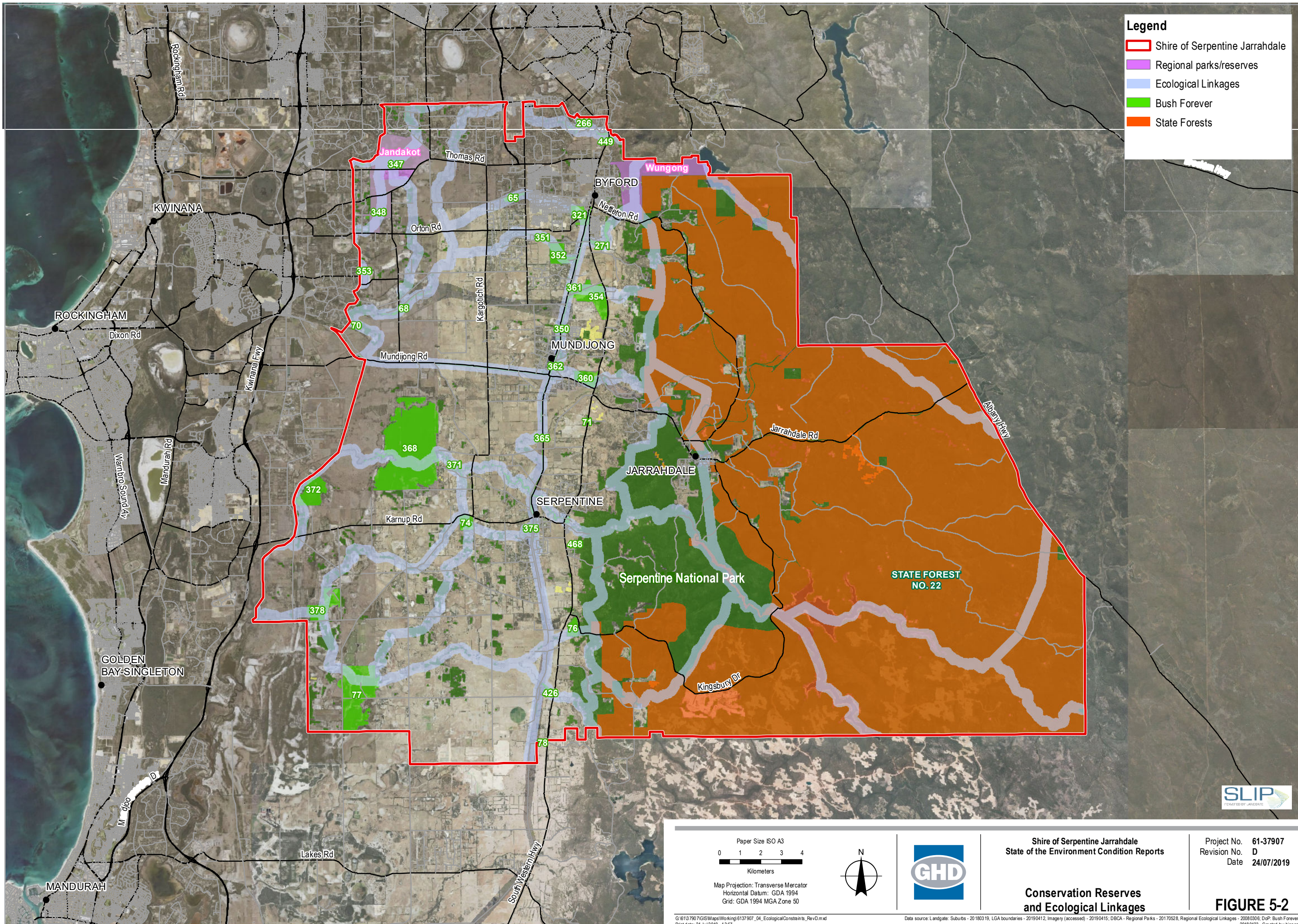
Conservation Type	Total area
Bush Forever	3,480.56 ha
Nature Reserves/Conservation Park	2,050.78 ha
Regional Parks (Jandakot and Wungong)	1,314.66 ha
State Forest (Jarrahdale)	37,477.01
National Park (Serpentine)	4,282.82 ha

5.2.4 Regional Ecological Linkages

Maintenance of the biodiversity of a fragmented landscape is dependent on the distribution of its remaining natural areas. Many fauna species, particularly small birds and mammals, need continuous corridors of dense vegetation to move throughout the landscape. Ecological function can potentially be maintained through a series of linkages or connected patches of remnant vegetation of suitable size. This connectivity is important in facilitating movement of animals, seeds and pollen and providing resilience to disturbances such as fires and climate change.

The EPA defines 'ecological linkage' as a network of native vegetation that maintains some ecological functions of natural areas and counters the effects of habitat fragmentation (EPA 2008). Regional and local ecological linkages have been identified in Perth and parts of the South West region following a methodology outlined in the Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region (Del Marco et al. 2004).

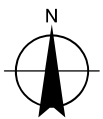
Regional ecological linkages have been proposed across the Shire to encompass natural linkage features, including a number of major waterways. The Regional Ecological Linkages have been previously designated by the State Government in Bush Forever, Perth's Greenways and the System 6 Study and supported by the WA Local Government Association (Del Marco et al 2004). Regional Ecological Linkages are shown on Figure 5-2.



- Legend**
- Shire of Serpentine Jarrahdale
 - Regional parks/reserves
 - Ecological Linkages
 - Bush Forever
 - State Forests



Paper Size ISO A3
 0 1 2 3 4
 Kilometers



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

Shire of Serpentine Jarrahdale
 State of the Environment Condition Reports

Project No. 61-37907
 Revision No. D
 Date 24/07/2019

**Conservation Reserves
 and Ecological Linkages**

FIGURE 5-2

G:\6137907\GIS\Map\Working\6137907_04_EcologicalConstraints_RevD.mxd
 Print date: 24-Jul-2019 - 13:57
 Data source: Landgate: Suburbs - 20180319, LGA boundaries - 20190412, Imagery (accessed) - 20190415, DBCA - Regional Parks - 20170528, Regional Ecological Linkages - 20080306, DoP: Bush Forever - 20180123. Created by: b.jones2

5.2.5 Wetlands and waterways

Wetlands are an intrinsic part of the hydrology of a region. They are widely recognised as significant for their ecological, hydrological, social and economic values. Wetlands have characteristic vegetation, faunal assemblages and geomorphology, and typically support a high level of biological productivity and diversity (EPA 2008). Wetlands can act as biological filters by retaining sediment, and absorbing nutrients and pollutants (Hill *et al.* 1996). They also provide flood control by storing and detaining storm water. Severe loss and degradation of wetlands has occurred on the Swan Coastal Plain since European settlement. Only 17 percent of remaining wetlands on the Swan Coastal Plain have high conservation significance and 14 percent are formally protected (EPA 2007). Waterways, wetlands, floodplains and catchments have been dramatically altered to allow for settlements, agriculture, water supplies and infrastructure development. Alterations of areas from their natural state inevitably results in detrimental changes to water quantity and quality. The majority of wetlands on the Swan Coastal Plain are not well documented and consequently there is little available information to determine condition.

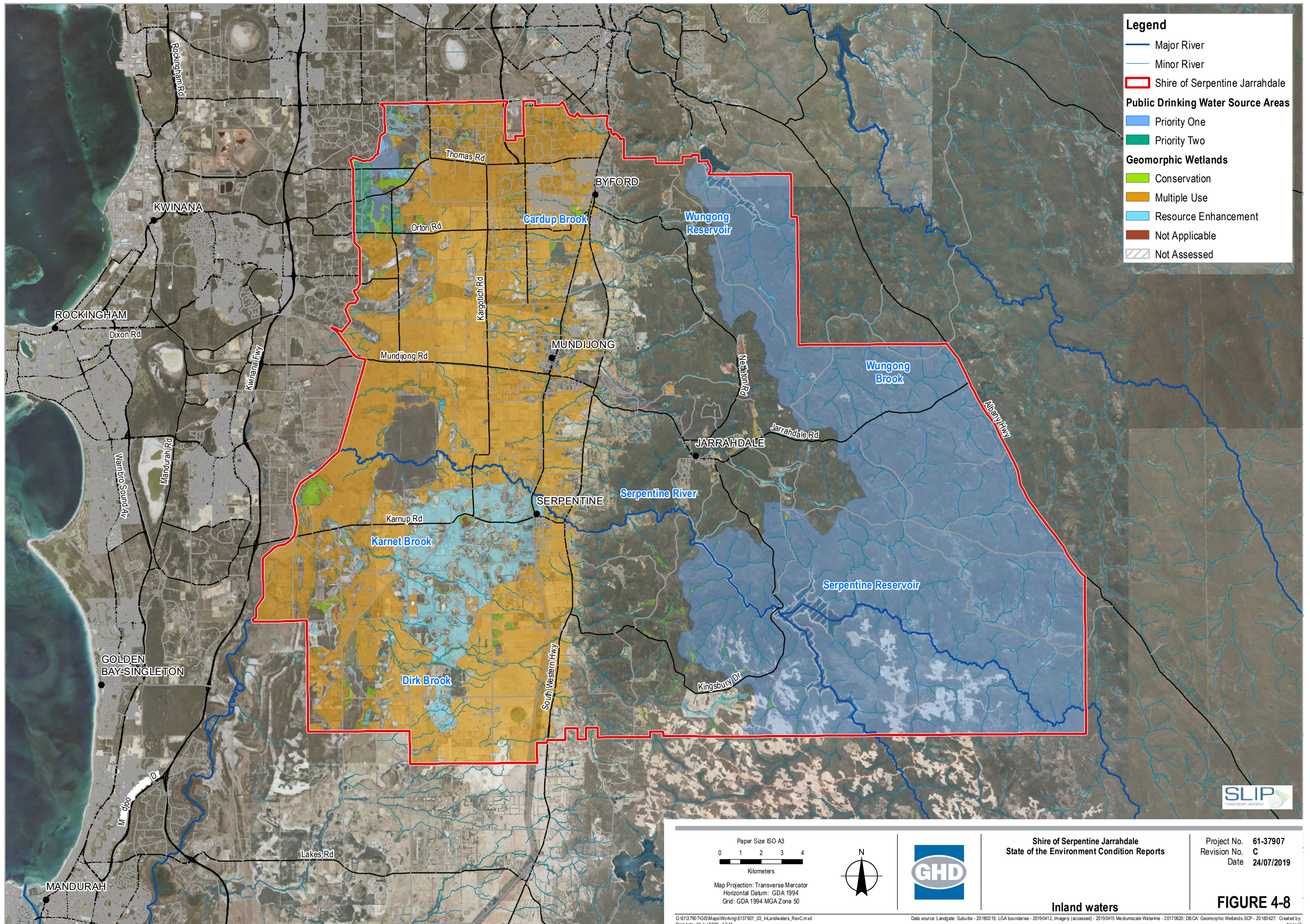
There are no wetlands of International Importance (RAMSAR sites) located within the Shire of Serpentine Jarrahdale. The Shire does contain rivers and other waterways that are located upstream from the Peel-Yalgorup System RAMSAR site.

According to the Geomorphic Wetlands dataset there are a total of 583 wetlands (including creeks, dampland, palusplain, sumpland, artificial lake, dryland, and floodplain) occurring within the Shire of Serpentine Jarrahdale. A wetland management category is assigned to a wetland based on the evaluation of its attributes, functions and values. It provides guidance on the nature of management and protection the wetland should be afforded (EPA 2008). The categories applied to the Swan Coastal Plain in Western Australia are conservation, resource enhancement and multiple use. There are 229 Conservation Category Wetlands (CCW) within the Shire (Table 5-3 and Figure 5-3).

Table 5-3 Total area mapped as Geomorphic Wetlands within the Shire of Serpentine Jarrahdale (GoWA 2019a)

Wetland Management Category	Total listed wetlands	Total Area
Conservation	229	1,359.85 ha
Multiple Use	183	26,076.84 ha
Resource Enhancement	165	3,778.30 ha
Not Applicable (no longer a wetland)	4	70.5 ha
Not assessed	6	592.19 ha

The main waterway in the Shire is the Serpentine River (Figure 5-3). A river condition assessment found that stretches of river are in good condition. Parts of the reach run through Serpentine National Park and Lowlands Nature Reserve. In these parts, the riparian vegetation is intact with a high proportion of native species. Survey work carried out in 2014 shows that the diversity of native fish and crayfish was good with six out of seven expected species being present in moderate abundances. The less common Swan River goby and cobbler are also present (Department of Water and Environmental Regulation (DWER) 2017).



Legend

- Major River
- Minor River
- ▭ Shire of Serpentine Jarrahdale

Public Drinking Water Source Areas

- ▭ Priority One
- ▭ Priority Two

Geomorphic Wetlands

- ▭ Conservation
- ▭ Multiple Use
- ▭ Resource Enhancement
- ▭ Not Applicable
- ▭ Not Assessed

<p>Paper Size ISO A3</p> <p>Kilometers</p> <p>Map Projection: Transverse Mercator Horizontal Datum: GDA 1994 Grid: GDA 1994 MGA Zone 50</p>			<p>Shire of Serpentine Jarrahdale State of the Environment Condition Reports</p>	<p>Project No. 61-37907 Revision No. C Date 24/07/2019</p>
<p>Inland waters</p>			<p>FIGURE 4-8</p>	

G:\6137907\GIS\Maps\Working\6137907_03_InLandwaters_RevC.mxd Print date: 24-Jul-2019 - 13:41 Data source: Landgate: Suburbs - 20180319, LGA boundaries - 20190412, Imagery (accessed) - 20190415 Mediumscale Waterline - 20170620, DBCA: Geomorphic Wetlands SCP - 20180427. Created by: bpn2

5.2.6 Species diversity

A total of 1,403 flora taxa comprising 1,177 native and 220 naturalised⁶ flora have been recorded within the Shire (DBCA 2007). The most common families include Fabaceae (157 species), Myrtaceae (104 species), Cyperaceae (93 species) and Proteaceae (92 species). The most common genera include *Acacia* (50 species), *Stylidium* (48 species), *Schoenus* (31 species) and *Drosera* (31 species) (DBCA 2007).

There are 622 fauna species comprising 611 native and 11 naturalised species previously recorded within the Shire (DBCA 2007). This total comprises 14 amphibians, 178 birds, 7 fish, 337 invertebrates, 40 mammals and 46 reptiles. Species of flora and fauna thought to reside within the Shire are listed in Appendix C. Two of the listed species are presumed extinct.

The Western Australian Museum records comprise specimen records, museum collections and observations from 1850 to present and therefore it is intended to act only as a general representation of the fauna in the area. However, specific species information is available for certain sites within the Shire. All three of the federally protected black cockatoo species, for example, have been recorded nesting in the Scrivener Road Gravel Reserve (Shire of Serpentine Jarrahdale 2019).

A total of 150 species of fungi have been recorded within the Shire, two of which are naturalised. 8 species of Protozoa have been recorded within the Shire, one of which is endemic to the area (DBCA 2007).

5.2.7 Conservation significant species

Threatened, Extinct and Specially Protected fauna or flora are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. Threatened species are assessed under both State (BC Act) and National (EPBC Act) legislation.

Possibly Threatened species that do not meet survey criteria, are otherwise data deficient, are rare but not Threatened or that have been recently removed from the Threatened species or other specially protected fauna lists for other than taxonomic reasons, are added to the DBCA Priority Fauna or Priority Flora Lists under Priorities 1, 2, 3 or 4. These categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened flora or fauna.

At the time of publishing this report, the Shire of Serpentine Jarrahdale is thought to contain 114 species of conservation significant flora and fauna. This total comprises 76 threatened or priority flora species and 38 threatened or priority fauna species of which can be broken down into 13 birds, 14 mammals (not including extinct species), three reptiles, five invertebrates and three other (aquatic) species. There are 5 species of fungi with priority 3 listing and 1 species of fungi categorised as priority 1 (DBCA 2007).

Conservation significant species known or presumed to be within the Shire are listed in Table 5-4.

⁶ Naturalised species are not native to an area but have become established and can reproduce there. Not all naturalised species become weeds or pests or have detrimental environmental or economic effects, but some do (DBCA 2013)

Table 5-4 Threatened and Priority flora and fauna known or likely to occur within the Shire of Serpentine Jarrahdale (DBCA 2007–, DotEE 2019)

Scientific Name	Common Name	Conservation status – BC Act / DBCA	Conservation Status – EPBC Act
Flora			
<i>Acacia horridula</i>	-	Priority 3	-
<i>Acacia lasiocarpa</i> var. <i>bracteolata long peduncle variant</i> (G.J. Keighery 5026)	-	Priority 1	-
<i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>	-	Priority 3	-
<i>Amanita carneiphylla</i>	-	Priority 3	
<i>Amanita fibrilloses</i>	-	Priority 3	
<i>Amanita kalamundae</i>	-	Priority 3	
<i>Amanita wadjukiorum</i>	-	Priority 3	
<i>Andersonia gracilis</i>	Slender Andersonia	Vulnerable	Endangered
<i>Andersonia</i> sp. Audax (F. Hort, B. Hort & J. Hort 3179)	-	Priority 3	-
<i>Andersonia</i> sp. Saxatilis (F. & J. Hort 3324)	-	Priority 1	-
<i>Angianthus drummondii</i>	-	Priority 3	-
<i>Anthocercis gracilis</i>	Slender Tailflower	Vulnerable	Vulnerable
<i>Aponogeton hexatepalus</i>	Stalked Water Ribbons	Priority 4	-
<i>Austrostipa jacobiana</i>	-	Critically Endangered	Critically Endangered
<i>Babingtonia urbana</i>	Coastal Plain Babingtonia	Priority 3	-
<i>Boronia tenuis</i>	Blue Boronia	Priority 4	-
<i>Bossiaea modesta</i>		Priority 2	-
<i>Caladenia huegelii</i>	Grand Spider Orchid	Critically Endangered	Endangered
<i>Calectasia cyanea</i>	Blue Tinsel Lily	Critically Endangered	Critically Endangered
<i>Calothamnus graniticus</i> subsp. <i>leptophyllus</i>	-	Priority 4	-
<i>Carex tereticaulis</i>	-	Priority 3	-
<i>Dillwynia dillwynioides</i>	-	Priority 3	-
<i>Diuris micrantha</i>	Dwarf Bee-orchid	Vulnerable	Vulnerable
<i>Diuris purdiei</i>	Purdie's Donkey Orchid	Endangered	Endangered
<i>Drakaea elastica</i>	Glossy-leaved Hammer Orchid	Critically Endangered	Endangered
<i>Drakaea micrantha</i>	Dwarf Hammer-orchid	Endangered	Vulnerable
<i>Drosera occidentalis</i>	Western Sundew	Priority 4	-
<i>Eleocharis keigheryi</i>	Keighery's Eleocharis	Vulnerable	Vulnerable
<i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)	-	Priority 3	-

Scientific Name	Common Name	Conservation status – BC Act / DBCA	Conservation Status – EPBC Act
<i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>	-	Priority 4	-
<i>Eucalyptus x balanites</i>	Cadda Road Mallee, Cadda Mallee	Critically Endangered	Endangered
<i>Grevillea crowleyae</i>	-	Priority 2	-
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Narrow curved-leaf Grevillea	Endangered	Endangered
<i>Grevillea flexuosa</i>	Zig Zag Grevillia	Vulnerable	Vulnerable
<i>Grevillea manglesii</i> subsp. <i>ornithopoda</i>	-	Priority 2	-
<i>Grevillea pimeleoides</i>	-	Priority 4	-
<i>Halgania corymbosa</i>	-	Priority 3	-
<i>Hemigenia platyphylla</i>	-	Priority 4	-
<i>Isopogon drummondii</i>	-	Priority 3	-
<i>Jacksonia gracillima</i>	-	Priority 3	-
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	-	Priority 2	-
<i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>	-	Priority 3	-
<i>Lasiopetalum pterocarpum</i>	Wing-fruited Lasiopetalum	Critically Endangered	Endangered
<i>Lepidosperma rostratum</i>	Beaked Lasiopetalum	Endangered	Endangered
<i>Lepyrodia heleocharoides</i>	-	Priority 3	-
<i>Levenhookia pulcherrima</i>	Beautiful Stylewort	Priority 2	-
<i>Meionectes tenuifolia</i>	-	Priority 3	-
<i>Millotia tenuifolia</i> var. <i>laevis</i>	-	Priority 2	-
<i>Paracaleana gracilicordata</i>	-	Priority 1	-
<i>Paracaleana granitica</i>	-	Priority 1	-
<i>Parsonsia diaphanophleba</i>	-	Priority 4	-
<i>Pimelea rara</i>	Summer Pimelea	Priority 4	-
<i>Pithocarpa corymbulosa</i>	Corymbose Pithocarpa	Priority 3	-
<i>Schoenus capillifolius</i>	-	Priority 3	-
<i>Schoenus pennisetis</i>	-	Priority 3	-
<i>Schoenus</i> sp. Waroona (G.J. Keighery 12235)	-	Priority 3	-
<i>Senecio leucoglossus</i>	-	Priority 4	-
<i>Stachystemon</i> sp. Keysbrook (R. Archer 17/11/99)	-	Priority 1	-
<i>Stackhousia</i> sp. Red-blotched corolla (A. Markey 911)	-	Priority 3	-
<i>Stylidium aceratum</i>	-	Priority 3	-
<i>Stylidium longitubum</i>	Jumping Jacks	Priority 4	-
<i>Styphelia filifolia</i>	-	Priority 3	-
<i>Synaphea odocoileops</i>	-	Priority 1	-

Scientific Name	Common Name	Conservation status – BC Act / DBCA	Conservation Status – EPBC Act
<i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)	Selena's Synaphea	Critically Endangered	Critically Endangered
<i>Synaphea stenoloba</i>	Dwellingup Synaphea	Critically Endangered	Endangered
<i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)	-	Endangered	Endangered
<i>Synaphea</i> sp. Serpentine (G.R. Brand 103)	-	Critically Endangered	Critically Endangered
<i>Tetraria australiensis</i>	Southern Tetraria	Vulnerable	Vulnerable
<i>Thysanotus anceps</i>		Priority 3	-
<i>Thelymitra dedmaniarum</i>	Cinnamon Sun Orchid	Critically Endangered	Endangered
<i>Thelymitra stellata</i>	Star Sun-orchid	Endangered	Endangered
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	Shy Featherflower	Vulnerable	Endangered
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	-	Priority 4	-
<i>Verticordia plumosa</i> var. <i>ananeotes</i>	Tufted Plumed Featherflower	Critically Endangered	Endangered
<i>Xanthoparmelia darlingensis</i>		Priority 1	
<i>Xanthoparmelia subimitatrix</i>		Priority 3	
Fauna			
Birds			
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	Endangered
<i>Cacatua pastinator</i> subsp. <i>pastinator</i>	Muir's Corella, Muir's Corella (Western Corella SW WA)	Conservation Dependent	-
<i>Calidris canutus</i>	Red Knot, Knot	Endangered	Endangered, Migratory
<i>Calidris ferruginea</i>	Curlew Sandpiper	Critically Endangered	Critically Endangered, Migratory
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo, Karrak	Vulnerable	Vulnerable
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo, Long-billed Black-Cockatoo	Endangered	Endangered
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo, Short-billed Black-Cockatoo	Endangered	Endangered
<i>Falco peregrinus</i>	Peregrine Falcon	Other specially protected fauna	-
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	Vulnerable
<i>Numenius madagascariensis</i>	Eastern Curlew, Far Eastern Curlew	Critically Endangered	Critically Endangered, Migratory

Scientific Name	Common Name	Conservation status – BC Act / DBCA	Conservation Status – EPBC Act
<i>Oxyura australis</i>	Blue-billed Duck	Priority 4	-
<i>Rostratula australis</i>	Australian Painted-snipe, Australian Painted Snipe	Endangered	Endangered
<i>Tyto novaehollandiae</i> subsp. <i>novaehollandiae</i>	Masked Owl (southwest)	Priority 3	-
Mammals			
<i>Bettongia penicillata ogilbyi</i>	Woylie, Brush-tailed Bettong	Critically Endangered	Endangered
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	Vulnerable	Vulnerable
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit	Critically Endangered	Critically Endangered
<i>Setonix brachyurus</i>	Quokka	Vulnerable	Vulnerable
<i>Falsistrellus mackenziei</i>	Western False Pipistrelle, Western Falsistrelle	Priority 4	-
<i>Hydromys chrysogaster</i>	Water-rat, Rakali	Priority 4	-
<i>Isoodon fusciventer</i>	Quenda, southwestern brown bandicoot	Priority 4	-
<i>Myrmecobius fasciatus</i>	Numbat, Walpurti	Endangered	Endangered
<i>Notamacropus eugenii</i> subsp. <i>derbianus</i>	Tammar Wallaby, Tammar	Priority 4	-
<i>Notamacropus irma</i>	Western Brush Wallaby	Priority 4	-
<i>Perameles eremiana</i>	Desert Bandicoot, walilya	Extinct	Extinct
<i>Petropseudes dahli</i>	Rock Ringtail Possum, Wogoit	Priority 3	-
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Vulnerable	Vulnerable
<i>Phascogale tapoatafa</i> subsp. <i>wambenger</i>	South-western Brush-tailed Phascogale, Wambenger	Conservation Dependent	-
<i>Potorous platyops</i>	Broad-faced Potoroo	Extinct	-
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum, ngwayir	Critically Endangered	Vulnerable
Reptile			
<i>Acanthophis antarcticus</i>	Southern Death Adder	Priority 3	-
<i>Ctenotus delli</i>	Dell's skink, Darling Range southwest Ctenotus	Priority 4	-
<i>Lerista lineata</i>	Perth Slider, Lined Skink	Priority 3	-
Invertebrates			
<i>Leioproctus douglasiellus</i>	A short-tongued bee	Endangered	Critically Endangered
<i>Neopasiphae simplicior</i>	A native bee	Endangered	Critically Endangered
<i>Euoplos inornatus</i>	Inornate trapdoor spider (northern Jarrah Forest)	Priority 3	-

Scientific Name	Common Name	Conservation status – BC Act / DBCA	Conservation Status – EPBC Act
<i>Idiosoma sigillatum</i>	Swan Coastal Plain shield-backed trapdoor spider	Priority 3	-
<i>Synemon gratiosa</i>	Graceful Sunmoth	Priority 4	-
Other			
<i>Westralunio carteri</i>	Carter's Freshwater Mussel, Freshwater Mussel	Vulnerable	Vulnerable
<i>Geotria australis</i>	Pouched Lamprey	Priority 3	-
<i>Glacidorbis occidentalis</i>	Jarrah forest freshwater snail, freshwater snail	Priority 3	-
Fungi			
<i>Amanita carneiphylla</i>		Priority 3	
<i>Amanita fibrilloses</i>		Priority 3	
<i>Amanita kalamundae</i>	(Kalamunda Lepidella)	Priority 3	
<i>Amanita wadjukiorum</i>		Priority 3	
<i>Xanthoparmelia darlingensis</i>		Priority 1	
<i>Xanthoparmelia subimitatrix</i>		Priority 3	

5.2.8 Invasive species

The DBCA and Australian Museum records (DBCA 2007) identified a total of 220 introduced (naturalised) flora species and 11 introduced fauna species previously recorded within the Shire of Serpentine Jarrahdale (Appendix C). Introduced fauna predate native fauna, compete for food and shelter, and cause damage to native plants and habitats by grazing, trampling and digging.

5.2.8.1 Weeds

Weeds displace native plants, particularly in disturbed sites, by out-competing the local species for light, nutrients and water. Changes to native plant communities by weed infestations consequently affect animal habitats. The Shire has identified a number of weed species for targeted management across the Shire. Weeds are identified for management due to legislative requirements and/or their highly invasive nature. Weeds that are managed by the Shire include:

- Cotton bush (*Gomphocarpus fruticosus*)
- Watsonia (*Watsonia* spp.)
- Baboon flower (*Babiana angustifolia*)
- Freesia (*Freesia alba x leichtlinii*)
- Love grass (*Eragrostis curvula*)
- Veldt grass (*Ehrharta calycina*)
- Bridal creeper (*Asparagus asparagoides*)
- Arum lily (*Zantedeschia aethiopica*)
- Tree Lucerne, tagasaste (*Chamaecytisus palmensis*)
- Black wattle (*Acacia decurrens*)
- Sydney golden wattle (*Acacia longifolia*)

- Victorian teatree (*Leptospermum laevigatum*)
- Olive (*Olea europaea*)
- River red gum (*Eucalyptus camaldulensis*)
- Water hyacinth (*Eichhornia crassipes*)
- Paterson's curse (*Echium plantagineum*)
- Blackberry (*Rubus* spp.)
- Lantana (*Lantana camara*)
- Giant reed, bamboo (*Arundo donax*)
- Bulrush (*Typha orientalis*)
- Morning glory (*Ipomoea indica*)
- Lavender (*Lavandula stoechas*)
- Evening primrose (*Oenothera* spp.)
- Nightshades (*Solanum* spp.)

The Shire's Weed and Pest Management Plan 2017 also includes a number of other weed species, which are not listed as they are not currently managed by the Shire.



5.2.8.2 Feral animals

Foxes and feral cats (declared pests) can severely reduce or eliminate native fauna by preying on them or competing for food and territory.

Rabbits are declared pests of agriculture and have a significant environmental impact through grazing and competition. While it was previously thought that foxes and feral cats preferentially feed on rabbits but shift to predate on native species when rabbit numbers are significantly reduced, this is now known to not be the case. Rabbits only make up about 5 percent of the fox diet, and their numbers do not significantly impact on the predatory habits of foxes (Shire of Serpentine Jarrahdale 2018).



A non-native and feral fish species, Pearl Cichlid, has been identified in the Byford area. These introduced fish species significantly threaten the local aquatic environment, damaging native fish and macroinvertebrate populations, and pose a threat to the downstream Peel Harvey Estuary (pers. coms. Shire of Serpentine Jarrahdale 2019).

Feral pigs are known to occur in the Shire. Pigs damage crops, predate on lambs and calves and degrade bushland through disturbance and spread of weeds and diseases.

The European honey bee (*Apis mellifera*) is an exotic species that was introduced into the Australian environment over 180 years ago. Honey bees were used to pollinate plants grown by early settlers for food - a task that was previously done by hand. Honey bees (managed hives) are now kept commercially for food and honey production, but feral bees have also become an increasing threat to native hollow-dwelling fauna, particularly black cockatoos, through competition for suitable hollows, and possibly also competition for nectar (Western Australian Museum 2019). Feral bees have been identified in a number of Shire reserves (Shire of Serpentine Jarrahdale).

5.2.9 Threatened and Priority Ecological Communities

Ecological communities are defined as naturally occurring biological assemblages or groups of plants and/or animals (or other living things such as microbes) that occur in a particular type of habitat (English and Blyth 1997). Together with their habitat, ecological communities form ecosystems.

Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The State BC Act provides for the Minister to list an ecological community as a TEC

(section 27) (under the categories of Critically Endangered, Endangered or Vulnerable), or as a collapsed ecological community (section 31). TECs may be at risk from threatening processes including land clearing, inappropriate fire regimes, inappropriate grazing, trampling, pollution, competition or predation from introduced animals, weed invasion, hydrological changes, salinity and diseases. Most TECs are either naturally restricted in distribution, or were once widespread but now occur only as remnants in cleared landscapes (DEC 2007). The legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

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

Based on searches of the DBCA TEC/PEC database and DotEE Protected Matters Database, there is a total of 18 TECs and PECs listed under the BC Act and/or EPBC Act or by DBCA known to occur within the Shire of Serpentine Jarrahdale, as listed in Table 5-5. TECs are also mapped as ESAs protected under the State EP Act.

Table 5-5 Threatened and Priority Ecological Communities known to occur within the Shire of Serpentine Jarrahdale (DBCA 2019, DotEE 2019)

Ecological Community	Conservation Status – BC Act / DBCA	Conservation Status – EPBC Act
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) TEC	Critically Endangered	Endangered
<i>Corymbia calophylla</i> – <i>Kingia australis</i> woodlands on heavy soils of the Swan Coastal Plain (SCP3a) TEC	Critically Endangered	Endangered
<i>Corymbia calophylla</i> – <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain (SCP3c) TEC	Critically Endangered	Endangered
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain (SCP20b) TEC	Endangered	-
Rich herb shrublands in clay pans (SCP08) TEC	Vulnerable	Critically Endangered
Shrublands on dry clay flats (SCP10a) TEC	Endangered	Critically Endangered
Southern wet shrublands, Swan Coastal Plain (SCP02) TEC	Endangered	-
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (SCP15) TEC	Vulnerable	-
<i>Corymbia calophylla</i> – <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain (SCP3b) TEC	Vulnerable	-
Herb rich saline shrublands in clay pans (SCP07) TEC	Vulnerable	Critically Endangered
Dense shrublands on clay flats (SCP09) TEC	Vulnerable	Critically Endangered

Ecological Community	Conservation Status – BC Act / DBCA	Conservation Status – EPBC Act
Banksia dominated woodlands of the Swan Coastal Plain IBRA Region PEC*	Priority 3	Endangered TEC (part)
<i>Banksia ilicifolia</i> woodlands (SCP22) PEC*	Priority 3	Endangered TEC (part)
<i>Casuarina obesa</i> association PEC	Priority 1	
<i>Eucalyptus haematoxylon</i> – <i>E. marginata</i> woodlands on Whicher footfills (SCP1a) PEC	Priority 3	
Granite communities of the northern Jarrah Forest PEC	Priority 3	
Litter-dependent invertebrate community PEC	Priority 2	
Low lying <i>Banksia attenuata</i> woodlands or shrublands (SCP21c) PEC*	Priority 3	Endangered TEC (part)

*A component of the Endangered *Banksia* woodlands of the Swan Coastal Plain EPBC listed TEC.

5.2.10 Dieback

Dieback disease, associated with *Phytophthora cinnamomi*, is present within the Shire. Dieback alters the forest environment by killing susceptible species such as Jarrah, *Banksia* and many species of understorey vegetation. It also alters hydrology, fauna habitat and visual resources as a result of vegetation death and can indirectly affect some species when the water table rises after transpiration decreases (CALM 2000). It affects more than 40 percent of plant species in the southwest, and more than half of the endangered ones, as well as many agricultural crops and garden plants.

The water mould is spread through the movement of plant materials and soil, particularly on feet and vehicles, and in free water and from root-to-root contact. In addition, it spreads downhill from infected areas high in the landscape. Dieback is considered one of the greatest threats to biodiversity. Areas remaining dieback free are considered to have a very high conservation value and preventing the introduction and spread of the disease is vital.

The spread of dieback can be limited through quarantine and hygiene measures such as education, exclusion, cleaning stations to avoid transport of infected soil, cleaning footwear and vehicles, and use of dieback free materials and soils. However there is currently no cure.

The DBCA has mapped areas of forest/vegetation subject to the risk of infection from dieback. Localised mapping of dieback free areas allows for the Shire to plan hygiene measures and treatment of vulnerable vegetation. The Shire has identified 10 reserves for targeted dieback treatment (Shire of Serpentine Jarrahdale 2018):

- Brickwood Reserve
- Old Rifle Range Reserve
- Oscar Bruns Reserve
- Bella Cumming Reserve
- Tonkin Street Flora Reserve
- King Road Pony Club
- Pony Place Reserve
- King Jarrah Circle Reserve
- Serpentine Sports Reserve
- Yangedi Road Airfield Reserve

5.3 Pressures

Biodiversity is under increased threat and has, overall, continued to decline. Many species and communities suffer from cumulative impacts of multiple pressures. Invasive species, particularly feral animals, are unequivocally increasing the pressure they exert on Australia's biodiversity, and habitat fragmentation and degradation continue in many areas. The impacts of climate change are also increasing, leading to changes in habitat condition.

We have identified five key pressures likely to impact the condition of biodiversity: population growth and urbanisation, climate change, hydrological change, invasive species and pathogens, and altered fire regimes. These are further discussed below.

5.3.1 Population growth and urbanisation

A growing population puts increasing pressure on biodiversity when residential areas encroach on natural systems. As Australia's population grows, additional urban land is required, or existing land is used more intensively. The conversion or degradation of natural ecosystems in urban areas has the most obvious and immediate impacts on biodiversity. Human settlements are often the entry point for introduced species, which are a major pressure on biodiversity.

The globally increasing trend of species extinctions can be attributed to natural or anthropogenic effects such as habitat loss, habitat degradation, habitat fragmentation, evolutionary changes and behavioural changes. Humans have the tendency to alter landscapes, for example the structure of native vegetation, occurrence of anthropogenic edges, the amount of landscape connectivity, and the structure and heterogeneity of modified areas (Fischer and Lindenmayer 2007). An increasing human population may lead to continued clearing which will result in loss of biodiversity and extinctions, with fragmented habitats becoming more susceptible to climate change, disease, and weed and introduced animal invasion.

Not all species are negatively affected by humans, for example some flora species benefit from ground disturbance (e.g. some orchids) and some fauna have adapted to use human structures for nesting/shelter (e.g. Brush-tail Possum). However, an increased population may not only lead to increased land clearing but may also lead to an increase of air, noise and light pollution, changed hydrological regimes, and predation from feral species (e.g. domestic cats) which may cause fauna to move away from their old range and increase competition for suitable habitat.

Urban development is a major driver of environmental change. Urban pressures associated with population growth are placing strain on the environmental features of remaining natural areas. The protection of key features such as threatened flora, fauna and ecological communities can be endangered by community demands for access and recreation.

Landscape modification and habitat fragmentation are key drivers leading to the extinction of species both in Western Australia and globally. Removal of large areas of native vegetation fragments the landscape, leaving behind small and unconnected stands of remnant vegetation. These fragmented vegetation patches may not be large enough to support some species that require sizeable areas to forage and those that are territorial. Vegetation fragmentation may also inhibit gene flow in flora and fauna communities which can cause the population to become more susceptible to disease and predation and become locally extinct.

Urban and peri-urban areas continue to directly encroach into surrounding natural ecosystems and may also cause indirect impacts by acting as a source of invasive species. Higher populations of people within the Shire has the potential to coincide with higher numbers of domestic animals which in turn can lead to increased predation and competition with native species. In particular, feral and domestic cats and dogs are known to kill millions of native animals every year, and domestic rabbits can escape and outcompete native fauna for food and shelter as well as destroying native trees and flora.

A greater number of people living within the Shire can also increase the spread of dieback through increased traffic through native areas, and fire regimes may be altered based on community concern. Higher populations also lead to an increase in water demand. Rivers and groundwater supplies across the south-west of Western Australia are under considerable pressure from climate change, as well as pressures associated with a growing population.

5.3.2 Climate change

Expected changes in temperature and the amount, season and severity of rainfall will place extreme pressure on ecosystems that are already under threat from many other factors. While it is expected that wet and dry periods and historic variations in weather patterns will continue, the gradual changes in temperature and rainfall will affect the ecological balance of remnant vegetation.

Australia's unique biodiversity, already under threat from a wide range of stressors, will face further impacts in the future as a result of the changing climate. Biodiversity is one of the most vulnerable sectors to climate change. The impacts of changing climate are increasingly clear, and include changes to ecosystem structure and composition, phenology (timing of lifecycle events), fire regimes and hydrology. The south-west region of Western Australia has been identified as one area which is significantly vulnerable to the impacts of climate change.

A number of threats associated with the effects of climate change are likely to impact the Shire's biodiversity. The key impacts include:

- Reduced rainfall
- Increased frequency of storm events
- Increased potential and frequency of bush fires
- Reduced water available for wetland ecosystems
- Less recharge to groundwater systems
- Damage and loss of vegetation
- Disruption to breeding patterns and species distribution
- Increased competition between agricultural, urban and environmental needs; and
- An overall loss of species.

5.3.3 Hydrological change

All ecosystems are dependant to some extent on water. Models of climate change are predicting lower rainfalls and different seasonal patterns. At the same time, groundwater levels are declining, and drainage of more areas for residential and other uses is likely.

Continuing decline in the water tables, combined with longer dry periods and greater evaporation, could lead to the death or degradation of many areas of remnant vegetation.

5.3.4 Invasive species and pathogens

Invasive species are the most frequently cited pressure affecting threatened species listed under the EPBC Act and/or BC Act. Introduced feral animals cause a range of pressures on biodiversity, such as predation and competition for food and/or habitats, can cause severe land degradation, soil erosion, poor water quality and the spread of weeds. Competition, habitat destruction and predation by pest animals threaten the survival of many of Australia's native plants and animals. Introduced animals within the Shire such as cats, foxes, rabbits, pigs, birds and bees inhabit the Shire's bushland, wetlands and natural areas as well as rural and agricultural land. Domestic animals such as dogs can also cause damage to the Shire's natural environment, particularly when exercised unleashed within natural areas. Dogs can chase and harass native fauna, often causing stress and harm to the animals. Predation of wildlife by domestic cats is also known to have serious impacts on the population of native mammals, reptiles and birds in natural areas.

Weeds (introduced plants) can displace native plants, harbour pests and diseases and create fuel loads for fire. Weeds also alter the structure and distribution of plant communities and can reduce biodiversity through a number of follow-on effects. Weeds become established in environments which have been disturbed or altered and are commonly introduced and distributed within bushland areas through dispersal of seeds by the wind, animals and birds, dumping of garden refuse, the use of machinery in natural areas and as a result of frequent fire events. Weeds are one of the key environmental threats to natural areas within the Shire of Serpentine Jarrahdale. Effective weed management is required to ensure that measures are taken to prevent, monitor and control the spread of weeds within the Shire.

The presence of pathogens such as *Phytophthora* sp. (dieback), and the spread of other diseases such as Armillaria root rot and Marri canker within the Shire, poses a serious risk to the biodiversity values of natural areas. Effective pathogen management is required to ensure that measures are taken to mitigate the effects and limit the spread of pathogens within the Shire.

5.3.5 Fire

Native vegetation within and surrounding urban areas is subject to frequent fires as a result of arson, accidental ignition and controlled burns. Frequent fires result in changes in vegetation structure, destroy leaf litter and can eliminate those species from bushland that require long fire intervals or are fire-sensitive. Fire-sensitive animals are those that have limited capacity to escape, or to find alternative food sources and shelter if fire temporarily removes habitat. Fire promotes weed growth that can further increase fuel load as well as displace native plants. Fire can also lead to degradation and erosion of soil, further exacerbating loss of biodiversity. Currently appropriate fire regimes for biodiversity are not well understood.

5.4 Responses

5.4.1 Implementation of the Local Biodiversity Strategy

The Shire has developed a Local Biodiversity Strategy to provide mechanisms for greater protection of local natural areas and a higher standard of local management of plants and

animals (biodiversity). The strategy focuses on local natural areas outside those areas already protected by the State and Commonwealth Governments. These are primarily on areas on private lands and local reserves.

Focussing on natural areas increases the protection of ecological communities within the Shire, ensuring that ecosystems and biological diversity, as well as the numerous benefits deriving from biodiversity, are conserved for future generations.

Extinction cascades are particularly likely to occur in landscapes with low native vegetation cover, low landscape connectivity, degraded native vegetation and intensive land use in modified areas, especially if keystone species or entire functional groups of species are lost (Fischer and Lindenmayer 2007).

The continued presence of the flora and fauna living in these fragmented remnants is dependent on the connectivity throughout the landscape. This enables access to habitat and food resources essential for the survival of species and the overall biodiversity of the region.

Much of the strategy relates to how the Shire will develop in the future and efforts to protect natural areas as part of development planning.

To halt the further loss of natural areas and conserve biodiversity, the Local Biodiversity Strategy includes four goals to retain, protect and manage Local Natural Areas:

Retention

Goal 1: Prevent the further loss of Local Natural Areas. This goal aims to retain at least 4,000 hectares of Local Natural Areas in the Shire.

Protection

Goal 2: Protect and manage a portion of each basic type of vegetation and ecosystem typical of the Shire. Approximately 1,690 hectares of Local Natural Area would be protected to meet this goal.

Goal 3: Protect specific ecological features and processes including rare species, threatened ecological communities, wetland vegetation and ecological linkages throughout the Shire.

Management and restoration

Goal 4: Manage and restore Local Natural Areas and revegetate new areas to increase native fauna habitat.

The strategy identifies a number of targets and actions to achieve the goals. Table 5-6 provides a summary of the status of actions implemented as part of the Local Biodiversity Strategy.

Table 5-6 Local Biodiversity Strategy Actions, 2009

No.	Action	Status
Strategy establishment and public awareness raising		
1	Consult the Department for Planning and Infrastructure, the Department of Environment and Conservation, and other relevant State Government agencies, on appropriate	Complete – consultation has taken place with relevant agencies

No.	Action	Status
	mechanisms for achieving local biodiversity targets.	Note – support through the WALGA Local Biodiversity Program ceased in 2014 as the program closed
2	Incorporate the goals, targets and actions of the Local Biodiversity Strategy into the Shire's Local Planning Strategy as it is developed.	Ongoing – the Local Biodiversity Strategy has informed the development of the draft Local Planning Strategy and will be considered in the final version
3	Prepare a simple guide to inform the community of the Local Biodiversity Strategy once it is finalised	Complete - leaflet prepared, distributed and available on Shire website
4	Establish a system to manage information collected on Local Natural Areas. Ensure information is collected using the Natural Area Initial Assessment (NAIA) templates and entered into an inventory.	Partially completed – information collected but not entered into an inventory
Retention and protection of natural areas		
5	Assess all native vegetation to identify those areas that meet the definition of natural area, and those areas that are better described as 'other native vegetation'.	Ongoing – the process of assessment has not yet covered all areas of native vegetation
6	Investigate developing an amendment to the Scheme to introduce a special control area over all significant natural areas, the proposed Natural Area Special Control Area.	Ongoing – investigated and options discussed; Significant Tree Register implemented; further amendments planned
7	Make any necessary changes to the Scheme to allow for subdivisions for conservation and cluster-style subdivisions with the support of the WA Planning Commission.	Partially Completed – investigated but no changes implemented
8	As part of the Shire's Local Planning Strategy, progress opportunities for subdivisions for conservation in large rural lots and smaller rural lots. Develop criteria and opportunities for innovative subdivision in the rural zone to protect natural areas. This will include a desktop analysis of the size of natural areas on Rural Zoned Land, and field assessment for interested landowners.	Ongoing – case studies have been reviewed

No.	Action	Status
9	Conduct formal review of the existing Conservation Zone initiative to enable its possible expansion to other natural areas of high significance.	Ongoing – reviewed and criteria established, two more properties zoned for Conservation
10	Investigate options for delivery of a Stewardship Program, tailored to landholders in the Shire and the Strategy's targets. The program could be linked to a grants program.	Completed and ongoing
11	Subject to a resolution to establish a Stewardship Program above, develop partnerships to arrange delivery of the program.	Completed and ongoing
12	For rural lots less than 40 hectares, the Shire should trial at least one strata cluster subdivision for conservation, possibly using a cluster-style subdivision approach.	Ongoing
13	For rural lots greater than 40 hectares, the Shire should trial at least one subdivision for conservation.	Ongoing
Policies and practices		
14	Investigate preparation of a Local Planning Policy (LPP) ¹⁴ for Biodiversity Conservation. The LPP should cover all development which has the potential to impact on the Strategy's targets	Complete
15	Trial the LPP in a number of development settings where a significant impact on natural areas may occur (For example, urban structure planning, rural subdivision, and special rural subdivision).	Ongoing – the LPP has been used to support planning recommendations for developments affecting natural areas.
16	Allocate resources to implement the LPP, particularly the verification of ecological assessments.	Ongoing – opportunistic assessments as the occasion arises.
17	Raise developer's awareness of the LPP's requirements.	Complete – leaflet prepared, distributed and available on Shire website.
18	Negotiate with urban developers of the future Mundijong/Whitby area to secure Local Biodiversity targets through the District Structure Plan, for example, by including	Ongoing – targets inform structure plans and appropriate

No.	Action	Status
	statutory provisions for protection and buffering of natural areas.	management plans are required at subdivision stage.
Protection and management of local reserves		
19	Assess all reserves with natural areas (28 reserves) using the NAIA templates.	Complete
20	Determine management priorities using information collected through NAIA templates, and develop a 5-year management strategy for Council reserves. In the interim, continue to use existing information and biodiversity targets to carry out priority management actions.	Complete and ongoing through implementation of 10-year management strategy for Shire reserves
Medium Term Priorities (Year 2012 – 2015)		
21	Review and update Local Natural Area mapping & statistics.	Partially Completed – opportunistic reviews inform updates of mapping and statistics.
22	Review the Stewardship Program and Incentives schemes strategies in the concept of a 5 year rolling plan.	Partially Complete – Healthy Habitats is active and its priorities and services regularly reviewed.
23	Report to the community on progress of the implementation of the Local Biodiversity Strategy. Use this as an opportunity to raise awareness of the Shire's high biodiversity.	Ongoing – achievements are highlighted and publicized.
24	Re-prioritise management of all reserves in the context of a 5-year rolling plan.	Ongoing – through implementation of ten-year management plan for Shire reserves.
25	Prepare strategic local reserves financial plan for management and improvements to be undertaken in the context of a 5-year rolling plan.	Complete and ongoing – the ten-year management plan has a fully budgeted action plan.
26	Consider rationalisation of low value natural area reserves to generate funds or allow for trade-offs for protection or management of other sites.	Partially Complete – assessments of reserves in this context have occurred and are considered in reserve management.

No.	Action	Status
27	Carry out changes to vested purposes of reserves to incorporate 'conservation' where appropriate.	Partially Complete – a list of appropriate reserves has been developed for an omnibus amendment.
28	Identify unvested reserves or Special Purpose reserves with high biodiversity values. Seek State Government support for their reclassification to Class A reserves with a Conservation purpose	Ongoing – consultation occurs on a regular basis with the management authorities for a number of high value reserves.

The Strategy also identifies a number of incentives to encourage protection of local natural areas on private property, including:

- Development based incentives;
- A stewardship program (non-financial incentives);
- Grants program;
- Rate-relief linked to conservation zoning.

The Shire's Local Biodiversity Strategy is over 10 years old and there have been significant achievements. A review of the Strategy was undertaken by the Shire in July 2019 and includes development of updated targets and actions which will be endorsed by Council.

5.4.1.1 Stewardship program

The Shire identified a stewardship program as a key mechanism for improving management and protection of local natural areas through the development of its Local Biodiversity Strategy and associated Biodiversity Incentives Strategy. The Shire therefore launched the Healthy Habitats program – a stewardship program for conservation of biodiversity on private property – in partnership with Landcare SJ in 2009. Achievements of Healthy Habitats to date include:

- 26 members
- 492 hectares of bushland included in the program
- On ground projects since 2012
 - 8 hectares of revegetation
 - Weed control measures applied to 212 hectares
 - 7 Cockatubes installed
 - Dieback treatment applied to 144 hectares
 - 130 hectares protected by feral animal control
 - 5.25 hectares of bushland fenced.

Implementation of the program includes funding private land care initiatives through provision of grants. Healthy Habitats has delivered \$42,000 in grant funding. Projects have also been delivered using \$78,000 in landholder/other contributions and \$77,000 in in-kind contributions.

5.4.1.2 Rate relief and increasing the conservation reserve

The Shire has implemented a rate-relief scheme in the conservation zone. Areas zoned Conservation in Town Planning Scheme No.2 are rated at half the rate of Rural Zoned land (i.e. 50 percent rate reduction) where the original zoning of the land is Rural. Where original zoning is not Rural, rate relief will be assessed on a case-by-case basis. Landowners with areas of high conservation value can also seek advice on environmental planning and management from the Shire Environmental Officers and Landcare SJ Inc.

There are currently 5 properties zoned Conservation in TPS2 (Figure 5-4) and a further twelve properties zoned Special Use – Conservation to which the rate reduction applies. The sections of Lowlands currently zoned Conservation in TPS2 are included in the draft Local Planning Scheme No.3 (LPS3) as Conservation Reserves and are currently in State Government ownership.

Once LPS3 has been gazetted, the area of conservation reserve will increase, further improving protection of biodiversity within the Shire (refer to Figure 5-4).

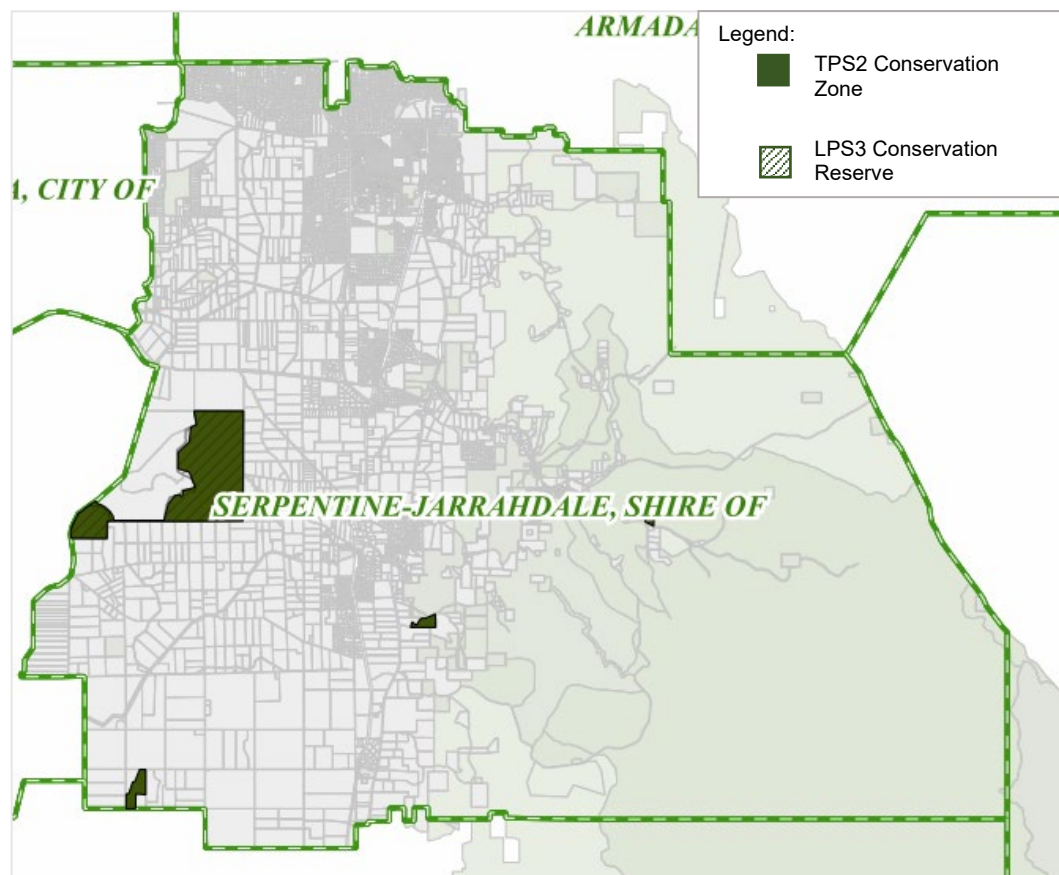


Figure 5-4 Lots zoned Conservation in TPS2 and Conservation Reserve in LPS3 (Source Intramaps 2019)

5.4.1.3 Natural Assets Management Plan

The Natural Assets Management Plan was developed in 2016 to prioritise management of natural areas in local reserves and allocate funds. The plan includes botanical survey information for natural areas and is a tool used in ongoing management.

5.4.2 Local planning framework

Development requirements in the special residential and special rural zones of TPS2 include analysis of physical characteristics of land (including but not limited to vegetation cover) and allow Council to serve notices on landowners or subdividers to preserve trees or plant trees if there is insufficient vegetation.

Council may also to serve notices on landowners or subdividers to preserve trees in the rural living A, rural living B and farmlot zones. Existing vegetation and natural land forms are to be retained where possible in the Townscape Policy Precinct.

In addition to the abovementioned requirements, TPS2 includes provisions for preserving trees and plantings. Approval is required by the Council to remove, destroy or damage any tree of a certain size (as specified in clause 7.12.3 of TPS2). The Council may also:

- Declare areas for tree preservation and serve notices to landowners to protect trees (implementation through the Significant Tree Register)
- Impose conditions as part of development approvals for trees to be planted on a site that is considered deficient in tree cover (if reasonable in the context of the proposed development).

The above provisions allow the Shire to protect trees from development where possible. As discussed in Section 1.4.1.3, the conservation zone is also used to protect private land of high conservation value.

The Metropolitan Region Scheme (MRS) and TPS2 are also used to reserve land. There are a number of reserves within the Shire utilised for protection of conservation values. Reserves are vested for management in agencies such as the Shire. This vesting process includes establishment of a reserve purpose. To improve protection of natural area reserves the Shire can consider updating vested purposes of reserves to incorporate 'conservation' where appropriate (incomplete action of the Local Biodiversity Strategy).

In addition, the following local planning policies (LPP) have been adopted by the Shire to guide assessment of development and land use proposals that impact on biodiversity, encouraging the retention of natural areas and consideration of the environment.

- LPP 2.7 – Bio-diversity planning policy
- LPP 4.13 – Revegetation policy
- LPP 4.16 – Landscape and vegetation policy
- LPP 4.18 – Street trees policy

5.4.3 Climate change

The Shire has developed a Climate Change Strategy and Local Action Plan consistent with Federal and State Government documents. Climate change mitigation strategies will help reduce the pressure of climate change on local biodiversity; however, the only immediate response is to limit pressures on biodiversity from other causes (Shire of Serpentine Jarrahdale, 2016). More detailed information on climate change is provided as part of Theme 1: Atmosphere.

5.4.4 Hydrological change

Climate change, over-use of groundwater and bauxite mining are significant threats to hydrological balance. As more areas are developed for residential use there will be other

major changes (Shire of Serpentine Jarrahdale 2016). Practices such as implementing water sensitive urban design in new urban developments and climate change mitigation will help limit the impacts of hydrological change on local biodiversity. More detailed information on management of water resources in the Shire is provided as part of Theme 3: Inland Waters.

5.4.5 Invasive species and pathogens

The Shire of Serpentine Jarrahdale has developed a Weed and Pest Management Plan to assist in the control of weeds, pest animals and diseases within the Shire. The Plan focuses primarily on natural area reserves, providing a description of the environmental values, management issues and past control actions for each area, and recommends control methods for common weeds, pest animals and diseases within the Shire.

Weeds, pest animals and diseases within the Shire are generally managed by Operations and the Natural Reserves Coordinator from specific budgets for weed control and dieback management, with (in some areas) additional management and revegetation by Landcare SJ Inc. (Ordinary Council Meeting 26 March 2018). The control of weed species is problematic as it relies on the cooperation of private land owners as reinfestation can rapidly occur from untreated areas. State and Federal legislation can oblige land managers to control weeds, pest animals or diseases. At the State level, once a plant or animal has been listed as a Declared Pest, land managers must control the pest on their land.

5.4.5.1 Control of weeds

Weed control methods are of three main types: physical, chemical and biological. Physical methods involve the removal of the weed by physical or mechanical means, such as cutting, hand pulling, digging, mowing, tilling or burning. Chemical methods involve the use of herbicides. Biological methods involve the introduction of a weed's natural enemies, such as insects, pests, fungi or diseases.

Physical or mechanical weed control is often not appropriate for natural areas, as considerable off-target damage can occur. Hand pulling or digging can be useful for small infestations, particularly in highly sensitive areas or of herbicide-resistant weeds, and is most often carried out by Friends groups (not discussed in this document). Cutting and removal of woody weeds is often used in combination with chemical control (herbicide treatment of the cut stump).

Chemical weed control is generally considered to be the most effective and cost effective form of weed control, and usually causes the least environmental damage and disturbance. Herbicides can be selective (targeting a particular group of plants, such as grasses or broad-leaves) or nonselective, and can either destroy or reduce the growth of treated weeds. Use of herbicides in natural areas requires a skilled operator to eliminate or minimise off-target damage. Potential disadvantages include development of herbicide resistance in target species, damage to non-target species and the broader environment (including soil residue and water contamination), and toxic effects on animals (including humans).

Biological control is the introduction of a weed's natural enemies, usually insects or diseases. Biological control can reduce the impact and spread of a weed, but not eliminate it. A significant investment (financial and temporal) is required, and control agents often take up to ten years to have a noticeable impact, but can be practical and effective. Not all weeds have control agents that would be safe for release, as great care must be taken to avoid off-target effects. The development and release of biological control agents is the

responsibility of other levels of government, as a regionally coordinated approach is required.

Weeds have been treated in:

- Brickwood Reserve
- Old Rifle Range Reserve
- Oscar Bruns Reserve
- Rainforest Reserve
- Mundijong Oval Reserve
- Bella Cumming Reserve
- Tonkin Street Flora Reserve
- Manjedal Brook Reserve
- King Road Pony Club
- Darling Downs Trail Network Reserves
- Korribinjal Brook Reserve, Scrivener Road Reserve
- Clem Kentish Reserve
- Old Serpentine School Reserve
- Tallagandra Reserve
- Beenyup Brook Reserves
- Yangedi Road Airfield Reserve
- Beenyup Brook Reserve
- Paterson Street Reserve
- Cardup Brook Reserves
- Unspecified reserves
- Road reserves

Weed control is undertaken specifically to target individual species of weeds in certain locations to protect biodiversity values at those sites.

5.4.5.2 Control of feral animals

Rabbits, foxes and feral cats are known to occur within the Shire. Community baiting sessions are coordinated by Landcare SJ, from whom cage traps can also be hired.

Rabbits have been controlled by the Shire and Landcare SJ in:

- Brickwood Reserve
- Bella Cumming Reserve
- King Road Pony Club
- Serpentine Sports Reserve
- Serpentine River East Reserve
- Yangedi Road Airfield Reserve
- Unspecified reserves

Foxes have been controlled by the Shire and Landcare SJ in:

- Brickwood Reserve
- Bella Cumming Reserve
- Tonkin Street Flora Reserve
- King Road Pony Club
- Serpentine Sports Reserve
- Serpentine River East Reserve
- Yangedi Road Airfield Reserve

- Unspecified reserves

Feral cats (in conjunction with control of other feral animals) have been controlled in:

- Brickwood Reserve
- King Road Pony Club
- Serpentine Sports Reserve

(Shire of Serpentine Jarrahdale 2018).

Feral pigs are known to occur within the Shire and control was undertaken by Landcare SJ to control numbers on private property in Keysbrook in November 2018 (Landcare SJ 2019). Control has not been undertaken on Shire reserves.

The DPIRD's Aquatic Biosecurity Section undertook an eradication program to remove the fish, Pearl Cichlid, in April 2019 to protect the local aquatic environment, native fish and macroinvertebrate populations, and reduce the threat downstream in the Peel Harvey Estuary (pers. coms. Shire of Serpentine Jarrahdale 2019).

Whilst conducting field work on the black cockatoos, the WA Museum has come across large numbers of feral bee hives that have taken over tree hollows. This has meant a reduction in the number of suitable hollows left for the obligate hollow-nesting species including cockatoos and other birds e.g. small parrots, Sacred Kingfisher and mammals e.g. possums and bats. A number of black cockatoo chicks, honeyeaters and owls were found dead in these hollows, often stung or engulfed by swarming feral bees (WA Museum 2017). Feral bees are known to be present in Shire reserves and may be reducing the number of nesting hollows available to native species. Partnerships to address this issue could be investigated.

5.4.5.3 Control of diseases and health issues

Phytophthora dieback has a greater impact on Banksia woodlands and Jarrah forest than on other ecosystems, so the Shire has focussed its dieback mapping and control program on reserves containing these vegetation types. Private land treatment has occurred through funding leveraged by the Healthy Habitats program. The Shire's dieback treatment program covers Brickwood Reserve, Old Rifle Range Reserve, Oscar Bruns Reserve, Bella Cumming Reserve, Tonkin Street Flora Reserve, King Road Pony Club, Pony Place Reserve, King Jarrah Circle Reserve, Serpentine Sports Reserve, Yangedi Road Airfield Reserve and unspecified reserves, each of which is treated on average every three years (Shire of Serpentine Jarrahdale 2018).

Other diseases such as Armillaria and Marri canker are known to occur in the Shire but there is no known cure (Shire of Serpentine Jarrahdale 2018).

Mistletoe has been an issue throughout old Byford for some time. It has been controlled in Old Rifle Range Reserve (funded by a State NRM grant received in 2010), unspecified reserves and road reserves.

5.4.6 Fire

Following the event of a fire, natural areas are vulnerable to invasive weed species. Active management of these areas is vital following a fire, to ensure native species are not competing with weeds for nutrients, space and water. Fire management is a key responsibility for local government. Planning for fire management and the implementation

of prevention, preparedness and recovery strategies ensure that the risk to lives, property and the natural environment are reduced.

The majority of the Shire of Serpentine Jarrahdale has been declared as bushfire prone by the Fire and Emergency Services Commissioner, and State Planning Policy 3.7 (SPP 3.7) provides essential guidance on how the Shire can best protect its community and infrastructure from this natural hazard. SPP 3.7 introduces challenges in relation to other priorities such as conservation of bushland and providing high amenity urban areas and public open space, which includes the provision of vegetation and shade for visual and microclimatic purposes. The Shire has developed a Bushfire Risk Management Plan. This plan will assist in managing this challenge through actively communicating risk and associated appropriate treatments across all tenures. Where biodiversity is an identified issue and a community concern, increased community pressure has influenced fuel reduction treatments (through increasing weed reduction and reducing prescribed burning frequency) that accommodate local biodiversity concerns (Bushfire Risk Management Plan 2018-2023).

The Shire has also identified prescribed burning priorities within its local natural area reserves. Where possible, burning is undertaken with follow-up weed control to improve biodiversity and reduce fuel loadings from weeds and grasses post-burn (Shire of Serpentine Jarrahdale 2018).

5.4.7 Urban and Rural Forest Strategy

The Shire developed an Urban and Rural Forest Strategy to guide actions to maintain and improve tree canopy and vegetation within the Shire's community now and into the future. The strategy focuses on land outside State Forest, the conservation reserve and the conservation zone.

A diverse urban forest provides habitat and a local food source for insects and fauna. Mature trees can provide hollows or branches for fauna to live, breed, hunt, forage or shelter. Wildlife depend on trees for a reliable seasonal food supply to obtain nectar, pollen, exudate (sap), fruit, seeds, leaves, wood and litter. Endemic species of birds, bats, native bees and pygmy and other possums will be attracted to and supported by native vegetation and trees.

The strategy includes a number of goals, strategies and actions for maintaining and where possible increasing canopy cover. Maintenance of the tree canopy will help support local biodiversity.

5.4.8 Street tree and verge planting

There are many economic, environmental and social benefits to tree canopy cover, including increasing biodiversity. The Shire offers free street trees to increase tree canopy across the Shire.

The Free Verge Plant Program operates in partnership between Landcare SJ, the Roadside Care Volunteers, and the Shire of Serpentine Jarrahdale. Residents can receive plants up to four times (conditions apply) to plant on their verge. Plants are redeemed at the Australian Native Nursery where nursery staff assist landholders to choose appropriate native seedlings according to verge conditions, including soil type, weed burden and whether powerlines are present. This program increases the presence of native flora which in turn helps support native fauna species.

5.4.9 Funding

The Shire is committed to maintaining and improving local biodiversity. This is demonstrated by funding allocations (Table 5-7).

Table 5-7 Budget allocations relevant to biodiversity protection 2018-19 (Shire of Serpentine Jarrahdale, 2019)

Project	Budget allocation (2018-19)	Budget allocation (2019-20)
Contribution to Landcare SJ (plus in-kind)	\$227,000 (contribution + in-kind)	\$200,000
Environment	\$15,000	\$15,000
Free verge plants	\$6,000	\$6,000
Weed control	\$120,000	\$95,000
Natural area management	\$7,000	\$7,000
Peel Harvey Biosecurity group	\$20,000	\$45,000

5.4.10 Summary of responses

Response	Potential actions
5.4.1 Implementation of the Local Biodiversity Strategy	<p>Implement updated actions from the Local Biodiversity Strategy Review 2019</p> <p>Continue implementation of the Healthy Habitats program</p> <p>Continue rate relief in the conservation zone</p>
5.4.2 Local planning framework	<p>Continue to utilise the local planning framework to improve retention and protection of local biodiversity</p>
5.4.5 Invasive species and pathogens	<p>Continue to implement the Weed and Pest Management Plan</p> <p>Continue to support Landcare SJ</p> <p>Continue to support weed and pest control initiatives implemented by State Government</p>
5.4.6 Fire	<p>Continue active management of natural area reserves following fire</p> <p>Continue to implement SPP 3.7 and the Bushfire Risk Management Plan</p> <p>Continue prescribed burning activities</p>
5.4.7 Urban and Rural Forest Strategy	<p>Implement the Urban and Rural Forest Strategy</p>
5.4.8 Street tree and verge planting	<p>Continue support for the street tree and free verge plants programs</p>
5.4.9 Funding	<p>Continue to provide funding to support initiatives that retain and protect local biodiversity</p>

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Theme Five: Human Settlements



6. Theme Five: Human Settlements

6.1 Overview

Built environments affect the residents that live within them, and the natural environment they exist within; therefore it is important to balance the needs of both. We need to ensure that our cities (or settlements) maintain their liveability for residents (urban amenity, housing, transport, air and water quality), while delivering efficiencies that reduce their impact on the natural environment.

Developing sustainable communities is one of the five strategic goals of the State Planning Strategy 2050, which defines sustainable communities as:

‘Communities that are planned, built, or modified to promote sustainable living. Places where people want to live and work, now and in the future; that meet the diverse needs of existing and future residents, are sensitive to their environment, their economy and contribute to a high quality of life.’

The State Planning Strategy notes that there will need to be increased focus when planning for sustainable communities as a result of urbanisation, decreasing affordability, ageing population and socio-economic differences.

State Planning Policy (SPP) No. 3 Urban Growth and Settlement identifies that the majority (90 percent) of the population in Western Australia live in towns and cities (WAPC, 2006). At the 2016 Census, the majority (78.5 percent) of Western Australians lived in the greater Perth area (ABS, 2018), which includes the Shire of Serpentine Jarrahdale. The Perth and Peel regions are envisaged to grow considerably, reaching a population of 3.5 million by the year 2050.

Expansion of the greater Perth area has resulted in actual or planned expansion of existing settlements. This consumes historically rural land and increases consumption of resources. Into the future, sustainable growth will be essential as greater demands are placed on the State’s resources, social and physical infrastructure, services and natural environment (WAPC, 2018).

There are four key settlements within the Shire:

- Byford
- Mundijong/Whitby
- Serpentine
- Jarrahdale

This theme examines how population growth in the four key settlements responds to the natural environment; in particular retention of natural areas, water sensitive urban design, flood mitigation, fire response planning, transport planning and sustainable built form. Understanding these elements will help the Shire to understand if and how these settlements are developing in a sustainable manner and where there are opportunities for further action.

6.2 Strategic alignment

The growth and development of settlement areas is guided by four key strategic documents.

6.2.1.1 Perth and Peel @ 3.5 Million

The South Metropolitan Peel sub-region is envisaged to experience significant growth between 2011 and 2050 (Perth and Peel @ 3.5 Million, 2018). The Shire's population is expected to increase by approximately 95,000 people with an additional 35,800 dwellings by the year 2050 (South Metropolitan Peel Sub-regional Planning Framework, 2018). The Shire's urban infill (within established urban areas) dwelling target is 1,370 by the year 2050.

Based on this, the majority of the Shire's expected dwelling growth will occur in new areas. This will have an impact on the built and natural environment.

6.2.1.2 Strategic Community Plan 2017-2027

The vision for the Shire is '*City living offering a rural lifestyle with abundant opportunities for a diverse community*'. The country lifestyle, natural environment and sense of community are what the community value most about living in the Shire. The strategic plan recognises the importance of maintaining the character of the area whilst facilitating growth, in particular the outcome and strategy below:

'Outcome 2.1 - A diverse, well planned built environment

2.1.1 Actively engage in the development and promotion of an effective planning framework'

Future growth in the Shire will need to be mindful of facilitating well-planned growth whilst maintaining the character and lifestyle that is valued in the locality, contributing to the overarching objectives of the Shire's Strategic Community Plan as they relate to People, Place and Prosperity.

6.2.1.3 SJ2050

SJ2050 examines how and where the Shire will accommodate the anticipated growth proposed for the region in a manner consistent with the community's values. It develops the vision and objectives that will guide the Shire's future development and a spatial plan (Figure 6-1) to indicate how and where future development will be focussed. The plan indicates that by 2050, Byford and Mundijong will each have a population of 50,000 people and Serpentine will grow to a population of 10,000.

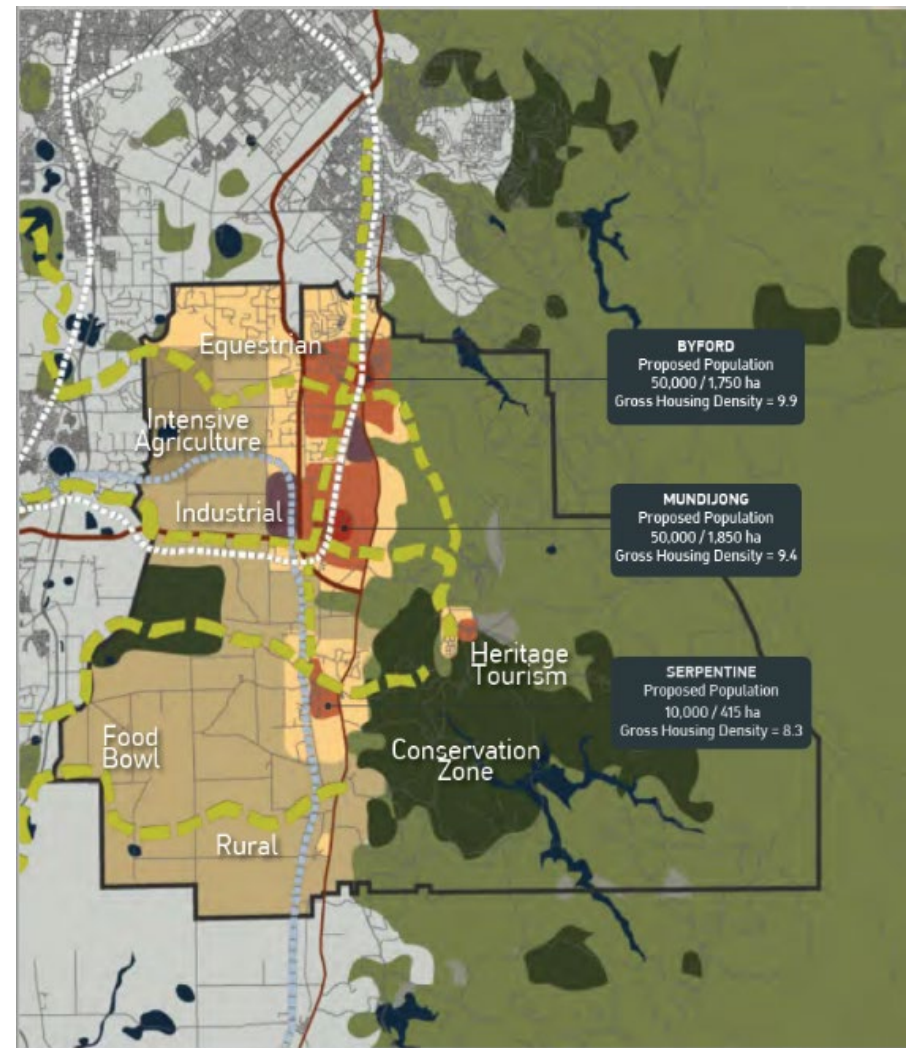


Figure 6-1 SJ2050 Spatial Framework

6.3 Policy and regulatory framework

6.3.1 Planning and Development Act 2005

The *Planning and Development Act 2005* (PD Act) establishes the Western Australian Planning Commission and provides for an efficient and effective land use planning system which promotes sustainable use and development of land. The PD Act is supported by state planning policies which is the highest level of planning policy control and guidance.

Under the PD Act, local governments are responsible for planning their local communities by ensuring appropriate planning controls exist for land use and development. They do this by preparing local planning schemes and strategies.

6.3.1.1 Metropolitan Region Scheme

The Metropolitan Region Scheme (MRS) defines the future use of land and provides the legal basis for planning in the Perth metropolitan region, dividing it into broad zones and reservations. Local government town planning schemes are required to provide detailed plans for their part of the region, consistent with the MRS. (Department of Planning, Lands and Heritage, 2019). An extract from the MRS is provided in Figure 6-2.

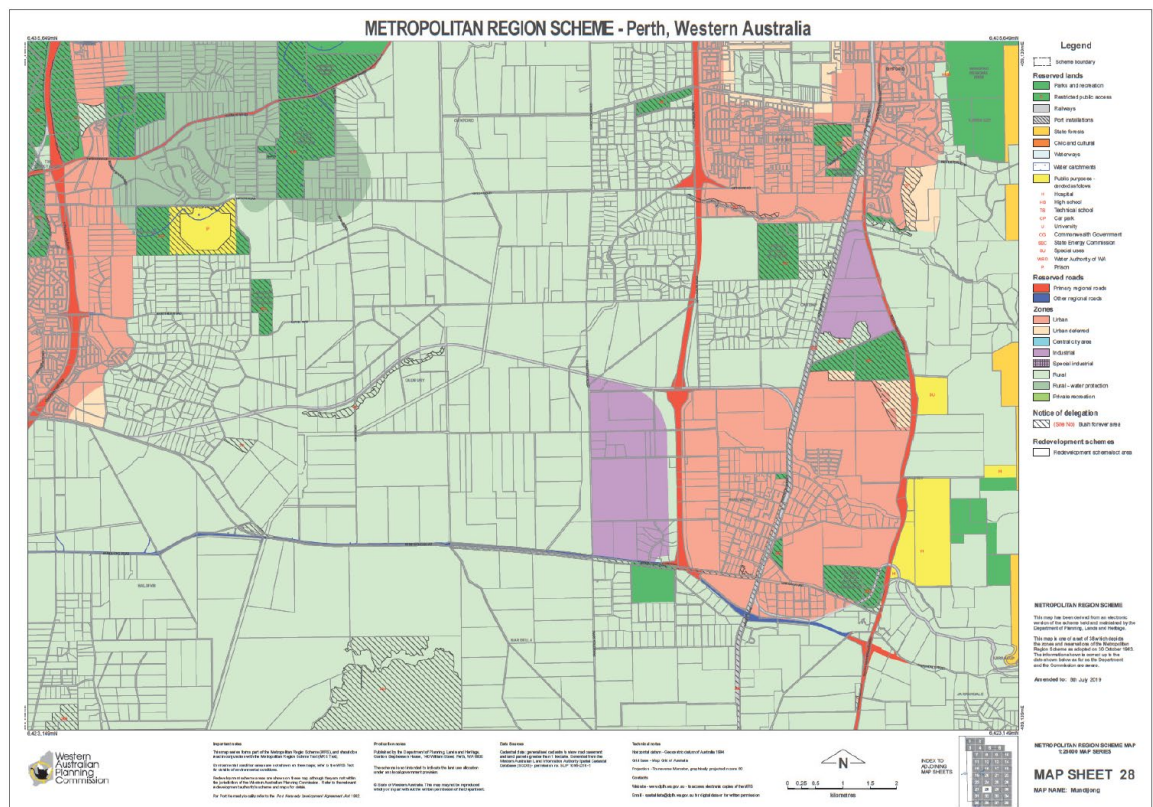


Figure 6-2 Extract from the Metropolitan Region Scheme: Map Sheet 28: Mundijong (DPLH, 2019)

6.3.1.2 State Planning Policies

The PD Act is supported by state planning policies which are the highest level of planning policy control and guidance. All the state planning policies will to some degree influence and guide land use and development within or surrounding human settlements. Those of particular relevance to the Shire's human settlements are:

- State Planning Policy 2.0 Environment and natural resources policy
- State Planning Policy 2.1 Peel-Harvey coastal plain catchment
- State Planning Policy 2.3 Jandakot Groundwater Protection
- State Planning Policy 2.4 Basic raw materials
- State Planning Policy 2.5 Rural planning
- State Planning Policy 2.7 Public drinking water source
- State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region
- State Planning Policy 2.9 Water resources
- State Planning Policy 3.0 Urban growth and settlement Mar 2006
- State Planning Policy 3.1 Residential design codes Mar 2018
- State Planning Policy 3.2 Aboriginal settlements May 2011
- State Planning Policy 3.4 Natural hazards and disasters Apr 2006
- State Planning Policy 3.5 Historic heritage conservation May 2007
- State Planning Policy 3.6 Development contributions for infrastructure Nov 2009
- State Planning Policy 3.7 Planning in bushfire prone areas
- State Planning Policy 4.1 State industrial interface
- State Planning Policy 4.2 Activity centres for Perth and Peel
- State Planning Policy 5.2 Telecommunications
- State Planning Policy 5.3 Land use planning in the vicinity of Jandakot Airport
- State Planning Policy 5.4 Road and rail transport noise and freight considerations in land use planning
- State Planning Policy 7.0 Design of the Built Environment
- State Planning Policy 7.3 Residential Design Codes Volume 1
- State Planning Policy 7.3 Residential Design Codes Volume 2 - Apartments

6.3.1.3 Town Planning Scheme No.2

Local planning schemes set out the way land is to be used and developed, classify areas for land use and include provisions to coordinate infrastructure and development within the local government area. Town Planning Scheme No.2 (TPS2) is the local planning scheme for the Shire. The TPS2 was originally gazetted on 4 August 1989, however, has been amended a number of times since then. The Town Planning Scheme map for the Cardup locality is provided in Figure 6-3.

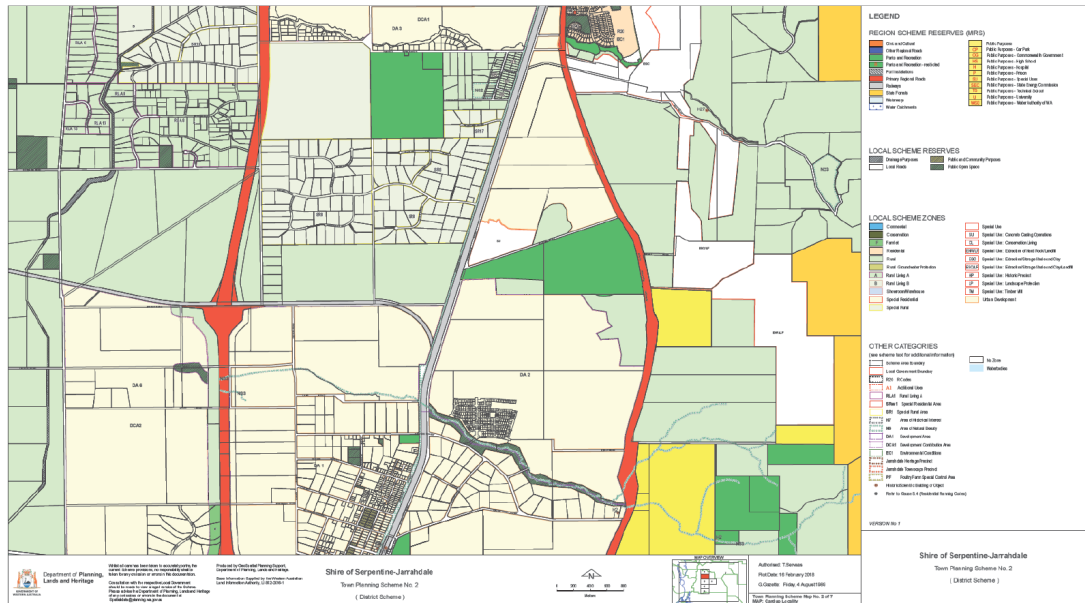


Figure 6-3 Town Planning Scheme No.2 Cardup Locality Map (DPLH, 2018)

6.3.1.4 Draft Shire of Serpentine Jarrahdale Local Planning Strategy 2018

Local Planning Strategies provide the vision for the future development within local governments. The Shire has a draft local planning strategy (LPS) that was endorsed by Council in December 2018 but is still being considered by the Western Australian Planning Commission (WAPC) and may be subject to further changes.

The Shire’s population is projected to increase significantly over the next 30+ years. The LPS notes that projected population growth can be accommodated within planned urban areas. Concentrating development in planned areas helps to support the Shire’s desire to maintain its rural character, whilst providing for the most efficient services provision for urban expansion. These planned areas are shown in Figure 6-4 and are focussed around Byford and Mundijong-Whitby.

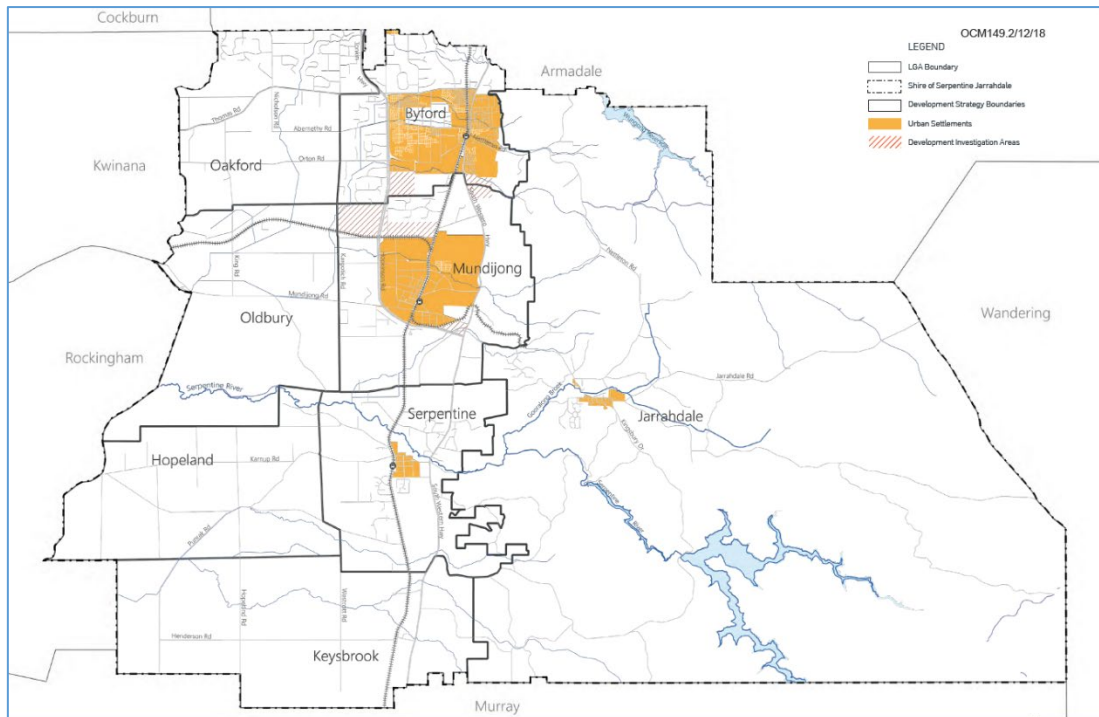


Figure 6-4 Settlement areas (Source: Draft LPS 2018)

6.3.1.5 Local Planning Policies

The Shire has adopted Local Planning Policies (LPP) that supplement the Town Planning Scheme and regulate land uses in the local government area. Some policies relate to only particular areas, whereas others apply to the entire Shire.

Of particular importance in the establishment of sustainable settlements are:

- LPP 2.3 Development Standards for Development Applications
- LPP 2.4 Water Sensitive Design
- LPP 2.7 Bio-Diversity Planning Policy
- LPP 4.13 Revegetation Policy
- LPP 4.16 Landscape and Vegetation Policy
- LPP 4.18 Street trees Policy

There are also location-specific design guidelines that incorporate sustainable design, for example, the Glades Village Centre Local Planning Policy requires that all commercial buildings within the Village Centre shall satisfy a range of sustainability criteria by achieving a minimum 4 star 'Green Star' rating (Green Building Council of Australia).

6.3.1.6 Structure plans

Structure Plans provide a more detailed level of planning, aligning with TPS2 and the LPS. District Structure Plans (DSP) provide broad level guidance over larger areas. Local Structure Plans provide a greater level of detail compared to DSP and are generally required prior to future subdivision and development.

6.3.1.7 Development control and operational policies

Development control and operational policies guide decision making in relation to subdivision and development. Policies apply to subdivision and development generally, for residential uses, rural uses, industrial and commercial uses and reserved land.

6.3.2 National Construction Code

The National Construction Code (NCC) is a uniform set of technical provisions for the design, construction and performance of buildings throughout Australia. It is published and maintained by the Australian Building Codes Board, on behalf of and in collaboration with the Australian Government and each State and Territory Government.

The NCC is made up of the:

- The Building Code of Australia (BCA), being Volumes One and Two and
- The Plumbing Code of Australia, being Volume Three

The NCC includes Building Code of Australia residential building energy efficiency standard of 5 stars set in 2006.

6.3.3 Waste Avoidance and Resource Recovery Act 2007

The *Waste Avoidance and Resource Recovery Act 2007* requires local governments to provide or enter into a contract for the provision of waste services.

6.4 Condition

The Shire of Serpentine Jarrahdale is experiencing significant population growth: 108 percent between 2006 and 2016 (ABS, 2018). By the year 2050, the Shire is expected to be home to an additional 100,000 people (SoSJ, 2016) with most growth being accommodated in the settlements of Byford and Mundijong-Whitby and some within Serpentine and Jarrahdale.

73 percent of the Shire's population currently resides in these four settlement areas, with increased population growth experienced in these settlements collectively in the last ten years (Table 6-1). Census boundaries changed for Mundijong-Whitby between 2006 and 2016, therefore it is not possible to accurately measure change in this area for this timeframe.

Table 6-1 Population data for the Shire's settlements

Location	2006 Census	2016 Census	Population growth
Byford	3,335	14,908	347.02%
Mundijong	-	1,232	-
Serpentine	1,856	2,317	24.84%
Jarrahdale	956	1,192	24.69%
Whole of Shire	12,889	26,833	108.19%

The condition of each settlement area will be discussed in relation to how it responds to its environmental setting, particularly the following topics.

Retention of natural areas

Tree canopy and vegetation is important within urban areas to provide shade countering the heat island effect (refer to Theme 1: Atmosphere), reduce air pollution, reduce stormwater volumes, reduce energy demand, support local biodiversity and retain local character. It is therefore important to retain tree canopy and natural areas within the four settlement areas.

Water sensitive urban design

Water Sensitive Urban Design (WSUD) is an important element of the design and development of built-up areas. WSUD is defined as:

A design philosophy that provides a framework for managing water-related issues in urban areas. WSUD incorporates the sustainable management and integration of stormwater, wastewater and water supply into urban design. WSUD principles include incorporating water resource management issues early in the land use planning process. WSUD can be applied at the lot, street, neighbourhood, catchment and regional scale. (Department of Water, 2004-2007).

Flood mitigation

As described in Theme 3 – Inland Waters, there are many brooks and rivers that pass through the Shire which when coupled with soil type and geology results in a flood risk to development located within close proximity to these waterways. Flooding can have a

detrimental impact on settlements resulting in damage to infrastructure, private homes and businesses, and affecting access and movement throughout an area. Understanding the impacts of flooding and how it can be mitigated is essential in built-up areas and areas identified for urban expansion.

Fire response planning

Western Australia is prone to bushfires, which can have significant adverse impacts on our natural and built environment and our population. In December 2015, the Planning in Bushfire Prone Areas Bushfire Policy Framework introduced a suite of reforms to help protect lives and property against the threat of bushfires throughout Western Australia. This included the release of SPP 3.7 Guidelines for Planning in Bushfire Prone Areas.

The intent of this policy is to implement effective, risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure.

97 percent of the Shire of Serpentine-Jarrahdale has been declared bushfire prone by the Fire and Emergency Services Commissioner and SPP 3.7 provides essential guidance on how the Shire can best protect its community and infrastructure from this natural hazard. Integration of bushfire mitigation and protection measures into the Shire's planning instruments is required (Shire of Serpentine Jarrahdale 2018).

Local topography, climate, vegetation cover and human behaviour influence bushfire risk and occurrence within the Shire.

Transport planning

Sustainable transport is an important consideration when establishing sustainable communities. Public transport connections improve connectivity to the wider area and lessen reliance on private vehicles. Bike paths and walkability are important in encouraging lower car use for short trips.

Sustainable built form

Improving the sustainability of the Shire's built form helps minimise negative societal and environmental impacts from building and development.

Understanding each settlement in an environmental context will help development and land use to continue in a coordinated and sustainable manner.

6.4.1 Byford

Byford was founded in 1906 and initially known as the town of Beenyup. Originally a rural townsite, Byford has developed into one of Perth's outer metropolitan suburbs. The suburb is well known for being family friendly area, having been ranked fourth in Australia in the 'Top 100 Family Friendly Suburbs' report prepared by RP Data in 2014 (Shire of Serpentine Jarrahdale).

Byford is the Shire's largest settlement, accounting for 55.6 percent of the Shire's total population in 2016. Couple families with children make up 52.2 percent of Byford's family composition and 13.8 percent are one parent families (ABS 2018). Byford has experienced significant population and dwelling growth between 2006 and 2016 (Table 6-2).

Table 6-2 Byford population and dwelling data (data source: ABS 2018)

Byford	2006 Census	2016 Census	Growth
Population	3,335	14,908	347.02%
Dwelling numbers	1,137	5,168	354.53%

6.4.1.1 Existing development

The settlement pattern reflects the historically rural base within the Shire and the low densities to accommodate a small population. The strip commercial area along South Western Highway is reflective of the townsite's history, to maximise visibility and access (SoSJ and Urbis 2015).

Byford serves as the retail hub of the Shire and includes cafes, restaurants, grocery and specialty shops and a tavern. The primary commercial centre is concentrated around the Abernethy Road and South Western Highway intersection with a local retail centre at The Glades Byford.

The settlement of Byford is characterised by low density (predominantly R20) residential dwellings, typically single storey. The residential area west of South Western Highway has been developed in a traditional grid pattern, reflective of the subdivision pattern within the local structure plan. The residential area to the east of the highway reflects the 'Garden City' layout pattern with circular road layouts (SoSJ and Urbis 2015).

The Byford Trotting Complex is centrally located within Byford, surrounded by residential houses. The Byford Trotting Complex enables horse stabling and residential land uses within the same area. The lots are larger than older residential lots to accommodate more rural uses. This is reflective of the historical use of the area and is a mechanism that encourages retention of local character and sense of place.

The fringes of Byford and a number of larger lots remain undeveloped, however are all proposed for future development as indicated by the urban development zoning under the Shire's TPS2.

The housing structure is predominantly separate houses (98.4 percent) with semi-detached, row or terrace houses and townhouses only accounting for 1.5 percent of dwellings (ABS 2018).

6.4.1.2 Retention of natural areas

A significant amount of vegetation was cleared in Byford for rural purposes.

The Shire's Urban and Rural Forest Strategy highlights the reduction in tree canopy that has occurred over time. Of all urban areas, Byford has the lowest total tree canopy (Table 6-3). There are areas with high levels of tree retention, however this is likely to reflect that residential development has yet to take place.

The public realm, particularly road reserves and multiple use corridors, in Byford has seen some success in ability to retain trees which assists in maintaining the character of the locality. Newer housing lots, however, often have limited ability to retain trees due to fill requirements and size (Figure 6-5).

Table 6-3 Percentage vegetation cover in urban land use areas (Shire of Serpentine Jarrahdale 2018)

Precinct	% Vegetation coverage – urban areas						
	Grass	0 – 3 m	3 – 8 m	8 -15 m	>15 m	Total vegetation	Total canopy*
Shire	7.1	11.4	6.2	6.9	2.7	34.3	15.8%
Byford	5.3	9.3	5.3	5.2	1.3	26.5	11.9%
Mundijong Whitby	7.0	10.8	5.9	6.8	2.7	33.2	15.4%
Serpentine	10.6	15.0	7.0	7.3	2.5	42.4	16.9%
Jarrahdale	6.2	14.1	10.7	15.2	16.3	62.5	42.2%

* Sum of area with vegetation >3m



Figure 6-5 Byford town centre – vegetated road reserves

There are pockets of Metropolitan Region Scheme (MRS) Parks and Recreation reserve and local public open space reserve throughout the settlement. The largest area of natural vegetation is the MRS Parks and Recreation reserve of Brickwood Reserve. This area is also identified as Bush Forever site No. 321. Bush Forever areas are also identified over parts of the Railway reserve (site No. 350) and in the south eastern corner of Byford on land reserved for MRS Parks and Reserve and zoned Urban Deferred (Site No. 271).

Significant vegetation exists around the Beenyup Brook multiple-use corridor and along the rail reserve (Figure 6-6).

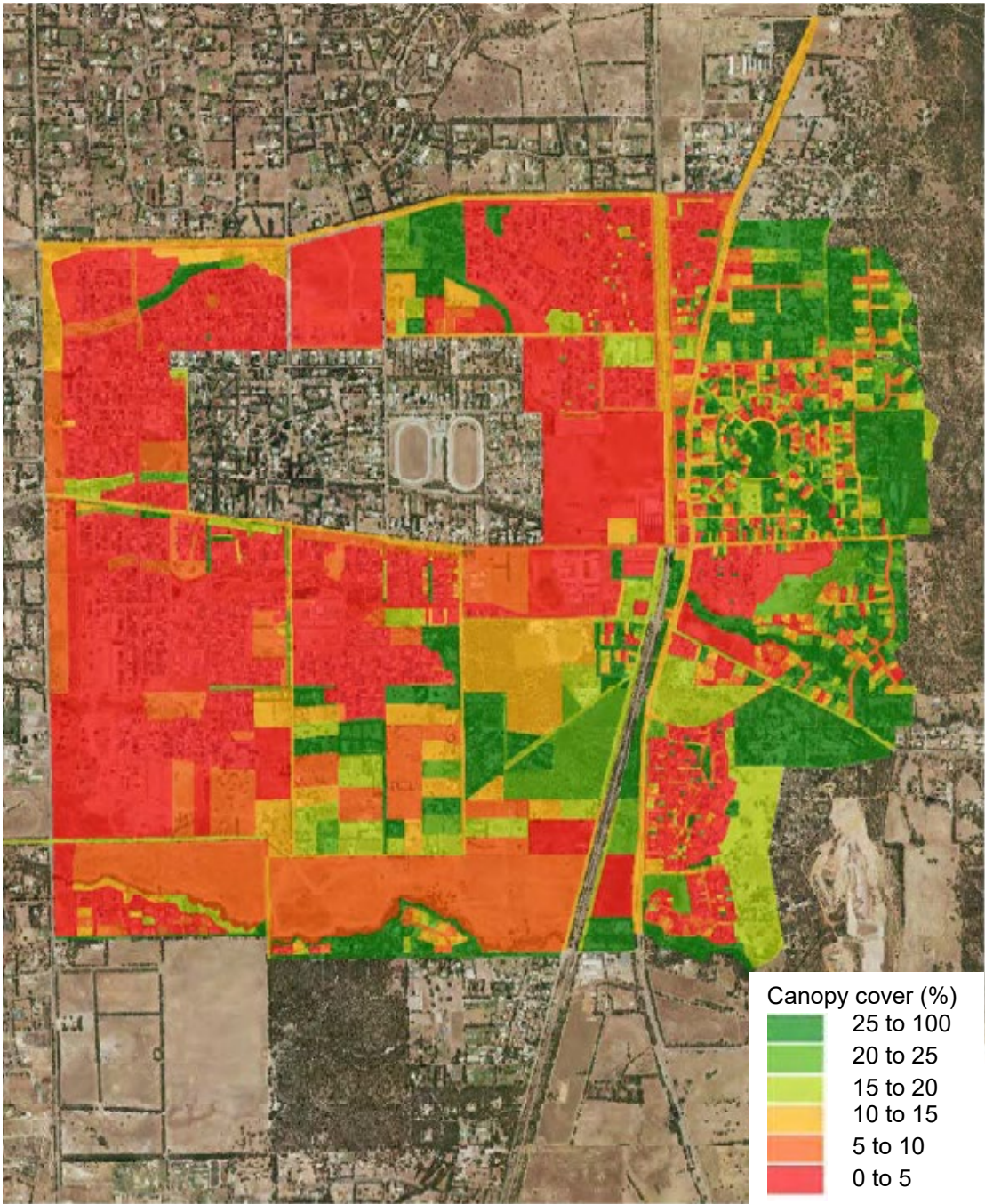


Figure 6-6 Urban canopy cover Byford (Shire of Serpentine Jarrahdale)

6.4.1.3 Flood mitigation and water sensitive urban design

The 1 in 100 (1%) AEP floodplain for the Byford settlement is shown in Figure 6-7.



Figure 6-7 1 in 100 (1%) AEP floodplain for Byford (Data source: National Maps, DWER-020)

Due to the low-lying nature of the area, much of the development areas in Byford have been subject to fill with imported sand to achieve clearance from groundwater.

Newer urban areas have been developed under the guidance of *Better Urban Water Management* therefore include multiple use corridors with drainage swales to manage stormwater quality and quantity.

Urban areas established prior to the establishment of water sensitive urban design philosophy in planning policy and stormwater management practices have not been retrofitted.

6.4.1.4 Bushfire risk

Despite being largely built-up, a significant portion of Byford is identified as being within a bushfire prone area (Figure 6-8). Bushfire risk may in certain circumstances be reduced through the development process with appropriate justification and approval from DFES.

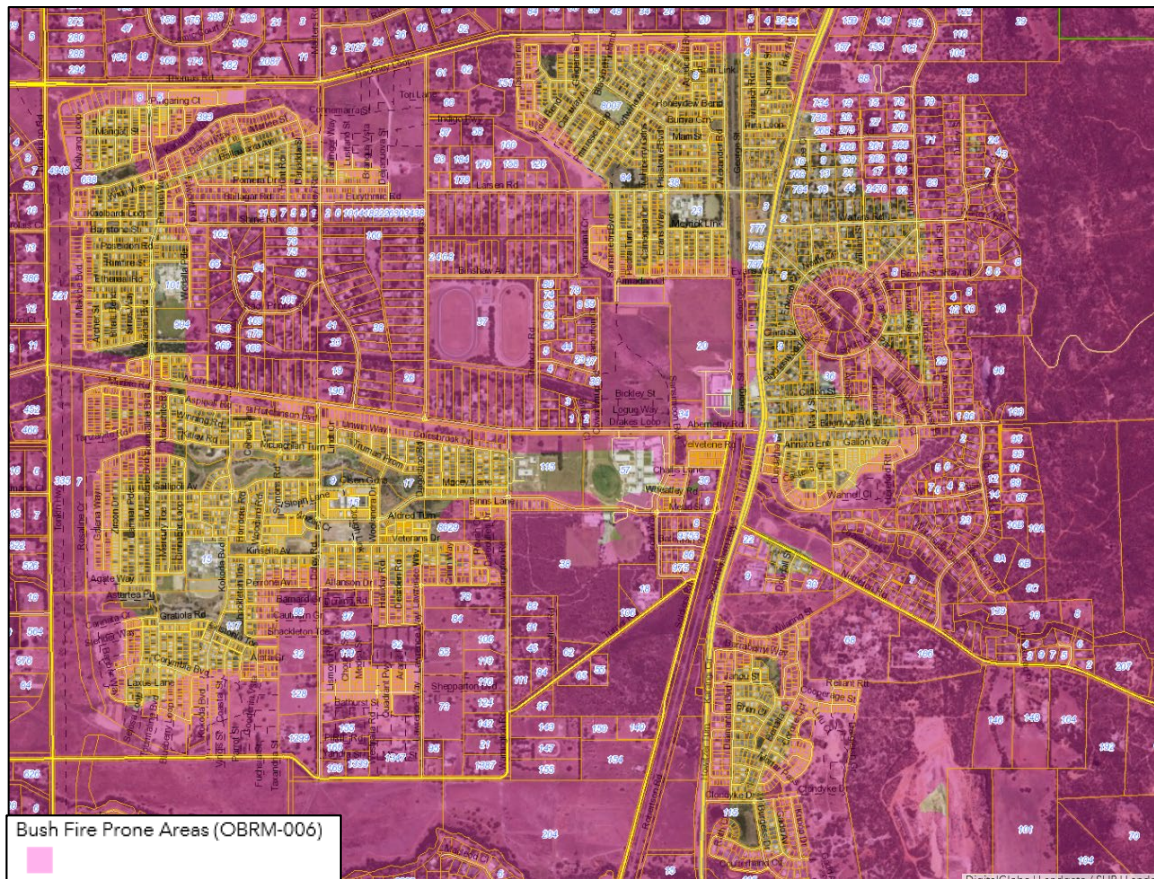


Figure 6-8 Bushfire prone areas in Byford (source: DFES 2019)

6.4.1.5 Waste generation

The Shire provide waste collection – weekly general waste collection and fortnightly recycling collection. The Shire’s 2017/2018 Annual Report provides waste collection data for that year on a Shire-wide basis, however data is not available for specific settlements. Notwithstanding this, the percentage of dwellings distributed across the Shire, based on the 2016 Census, has been used to extrapolate the waste data on a settlement basis (Table 6-4). It should be noted that as the Census data only relates to dwelling count, figures relating to commercial waste will not be accurate.

Table 6-4 Waste data for the Shire and Byford

Annual Report (2017/2018)	Whole of Shire	Byford
Percentage dwelling count (%)	100	54
Green Waste (tonnes)	676	363
Hard waste (large items that cannot fit in a regular bin) (tonnes)	1,142	614
General waste (household and commercial waste) (tonnes)	7,916	4,254*
Recycled reusable waste (tonnes)	2,461	1,323

Annual Report (2017/2018)	Whole of Shire	Byford
Waste to land-fill (tonnes)	8,836	4,748
Waste bins annually (collected)	516,528	277,582
Recycle bins annually (collected)	522,312	280,690
Commercial waste bins annually (collected)	17,952	N/A*
Commercial recycle bins annually (collected)	4,464	N/A*

*Data with commercial waste

6.4.1.6 Transport planning

An existing railway reserve runs through Byford and is used for freight and passenger access from Perth to Australind. Passengers can also access places such as Armadale and Bunbury using this service by booking advanced tickets.

South Western Highway is identified as a Primary Regional Road reserve under the MRS. A primary regional road reserve has also been identified along the western side of Byford for the future Tonkin Highway extension. Integrator arterial roads are proposed through Byford.

Byford is the most accessible settlement within the Shire by public transport. All four bus routes link Byford to the Armadale Station (bus route numbers 215, 252, 253, 254). In addition, a passenger rail service to Byford is proposed.

Figure 6-9 illustrates the bus routes through Byford. The frequency of bus services varies and are most available on Monday to Friday (Table 6-5 and Table 6-6).

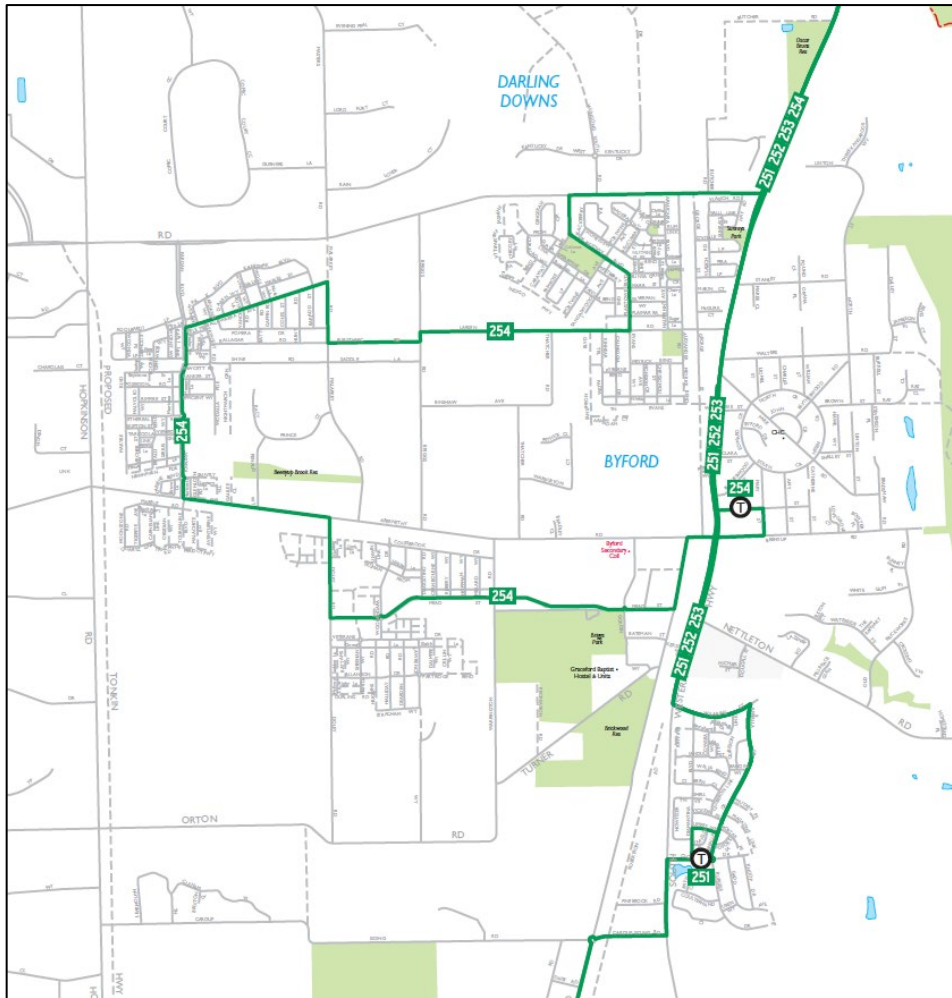


Figure 6-9 Bus routes through Byford (Source: Transperth 2019)

Table 6-5 Bus routes to Armadale through Byford (source: Transperth, 2019)

Bus route No.	Number of services		
	Monday-Friday	Saturday	Sunday & Public.H.
251	4	4	No service
252	9	2	No service
253	3	1	No service
254	21	11	5
TOTAL	37	18	5

Table 6-6 Bus routes to Byford (source: Transperth, 2019)

Bus route No.	Number of services		
	Monday-Friday	Saturday	Sunday & Public.H.
251	2	3	No service
252	9	3	No service
253	4	1	No service
254	21	11	5
TOTAL	36	18	5

The Draft Walking and Cycling Plan for the Shire indicates that the only DoT registered shared paths in Byford are a short section of Thomas Road (near South Western Highway) and a short section on George Street. There is also bicycle route data that suggest there are on-road routes on Thomas Road, Abernethy Road, Hopkinson Road, South Western Highway, and several roads in the northernmost part of the Shire, north of Thomas Road.

In most instances the residential areas have good quality footpaths on one side of the street to enable walkability. Footpaths are provided in the commercial centre adjacent to the road, however car use appears to be the primary mode of movement as indicated through large areas of car parking in the front setback.

6.4.1.7 Sustainable built form

Recent development in Byford has been largely guided by Liveable Neighbourhoods and the R-codes. Whilst these documents include some provisions for sustainable development and design, they do not mandate exemplary sustainable design. Housing construction since 2006 has been in accordance with the residential building energy efficiency standard of 5 stars. Older parts of Byford, however, pre-date these requirements.

The Glades at Byford is an award-winning sustainably designed community, having received the following awards (LWP Property Group, 2019):

- Certification in community, water and ecosystems in the Urban Development Institute of Australia's (UDIA) EnviroDevelopment program
- HIA Greensmart Residential Development of the year (2011)
- Australian Water Association, Resource Management Award for innovative water management design (2012)
- Environmental Excellence Award at the UDIA WA Awards for Excellence (2015)

6.4.2 Mundijong-Whitby

Mundijong was originally established as rural village, providing a stop on the Australind to Perth railway line (SoSJ and Masterplan 2010).

Mundijong-Whitby is proposed to be one of the Shire's larger settlements and will include the historical Mundijong settlement and the area of Whitby on the eastern side of the railway line. Currently, the settlement accounts for 4.6 percent of the Shire's total population (2016 census). Mundijong experienced a decline in population and dwelling

numbers between 2006 and 2016, however the physical area of the state suburb of Mundijong reduced between 2006 and 2016, which may account for this recorded decline.

6.4.2.1 Existing development

The Mundijong-Whitby settlement has two distinctive areas. The current settlement area of Mundijong is concentrated in the area bounded by Mundijong Road, Paterson Street (Figure 6-10), Keirnan Street and Adonis Street/Baskerville Road. Mundijong has a traditional grid settlement pattern reflective of the original rural village with a commercial main street along Paterson Street. Paterson Street includes a post office, supermarket, tavern and Shire offices.



Figure 6-10 Mundijong main street (Paterson Street)

East of the railway line, a large majority of the area is yet to be subdivided and developed, with the exception of the new residential area of Whitby. Whitby is anticipated to become a large town in the future.

The residential character of Mundijong reflects the historical rural character of the area, with large front gardens and well established trees. Houses are typically single storey. Beyond the residential area, the settlement is predominantly made up of rural residential lots.

The 2016 Census identifies that 100 percent of dwellings in Mundijong were separate houses.

6.4.2.2 Retention of natural areas

Canopy cover in Mundijong is similar to that throughout the Shire, which reflects the rural character of the locality. The areas currently used for rural purposes have been cleared of most vegetation. The majority of the new residential area of Whitby has been cleared to facilitate development of the area (Figure 6-11 and Table 6-7).

Table 6-7 Percentage vegetation cover in urban land use areas (Shire of Serpentine Jarrahdale 2018)

Precinct	% Vegetation coverage – urban areas						
	Grass	0 – 3 m	3 – 8 m	8 -15 m	>15 m	Total vegetation	Total canopy*
Shire	7.1	11.4	6.2	6.9	2.7	34.3	15.8%
Byford	5.3	9.3	5.3	5.2	1.3	26.5	11.9%
Mundijong Whitby	7.0	10.8	5.9	6.8	2.7	33.2	15.4%
Serpentine	10.6	15.0	7.0	7.3	2.5	42.4	16.9%
Jarrahdale	6.2	14.1	10.7	15.2	16.3	62.5	42.2%

There are three areas reserved for MRS Parks and Recreation within the Mundijong-Whitby settlement area. All three of these areas are registered as Bush Forever (site Nos. 350, 360 and 362)

The Shire's TPS2 identifies a public open space local reserve along the Mandejal Brook Reserve. Whilst most of the area remains undeveloped, the area is largely cleared of native vegetation. This is likely due to the rural nature of the area

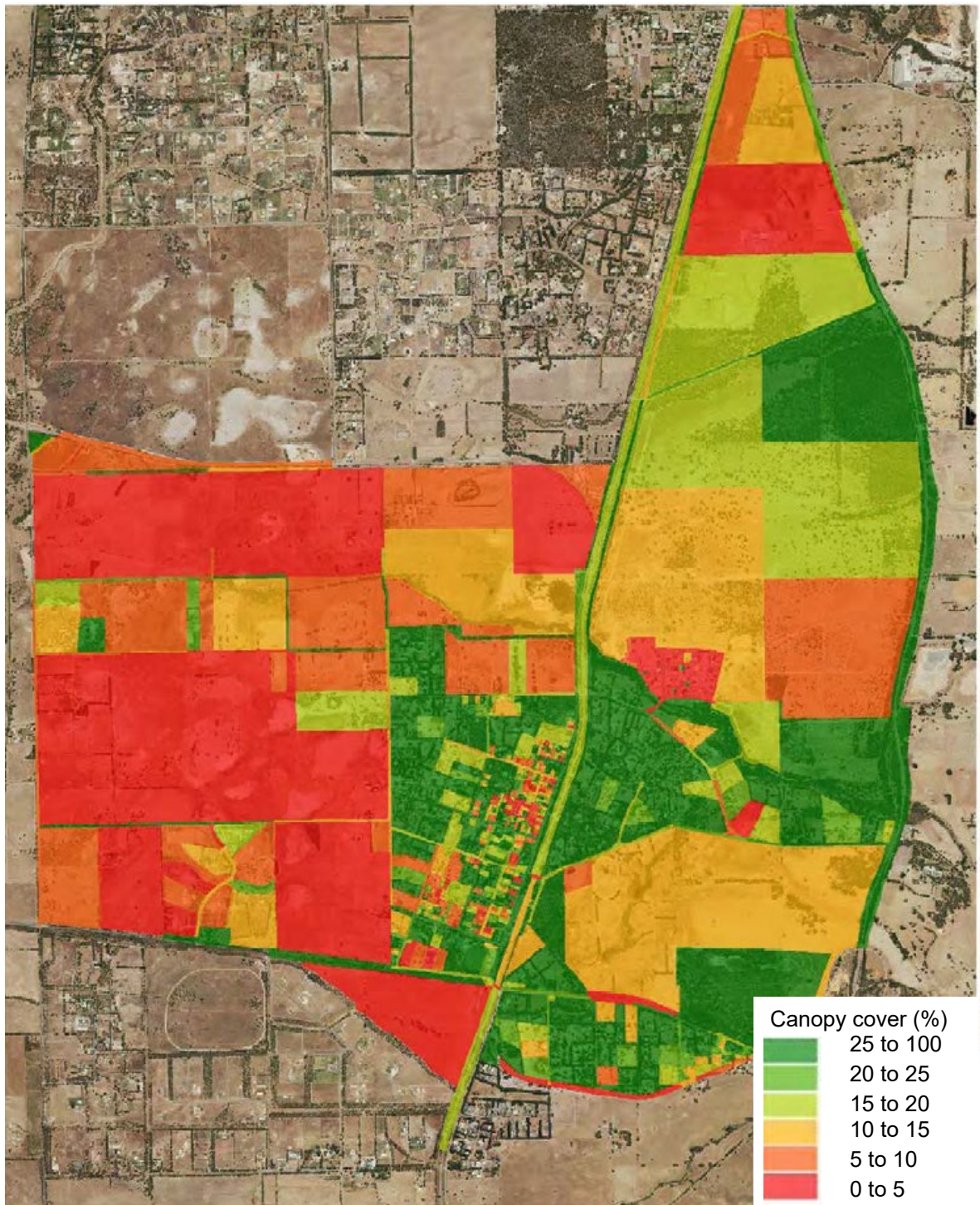


Figure 6-11 Urban canopy cover – Mundijong-Whitby (Shire of Serpentine Jarrahdale 2018)

6.4.2.3 Flood mitigation and water sensitive urban design

As described in Theme 3: Inland Waters, there are many brooks and rivers that pass through the Shire which results in a flood risk to development located within close proximity to these waterways. The 1 in 100 (1%) AEP floodplain for the Mundijong area is shown in Figure 6-12.



Figure 6-12 1 in 100 (1%) AEP floodplain for Mundijong (Data source: National Maps, DWER-020)

A Mundijong-Whitby District Water Management Strategy (2010), Mundijong-Whitby Water Strategy (2012) and Whitby Local Water Management Strategy have been prepared.

6.4.2.4 Bushfire risk

The majority of Mundijong is located within a designated bushfire prone area (Figure 6-13). The exception are the urban areas adjacent to Paterson Street and the newly developed area of Whitby.

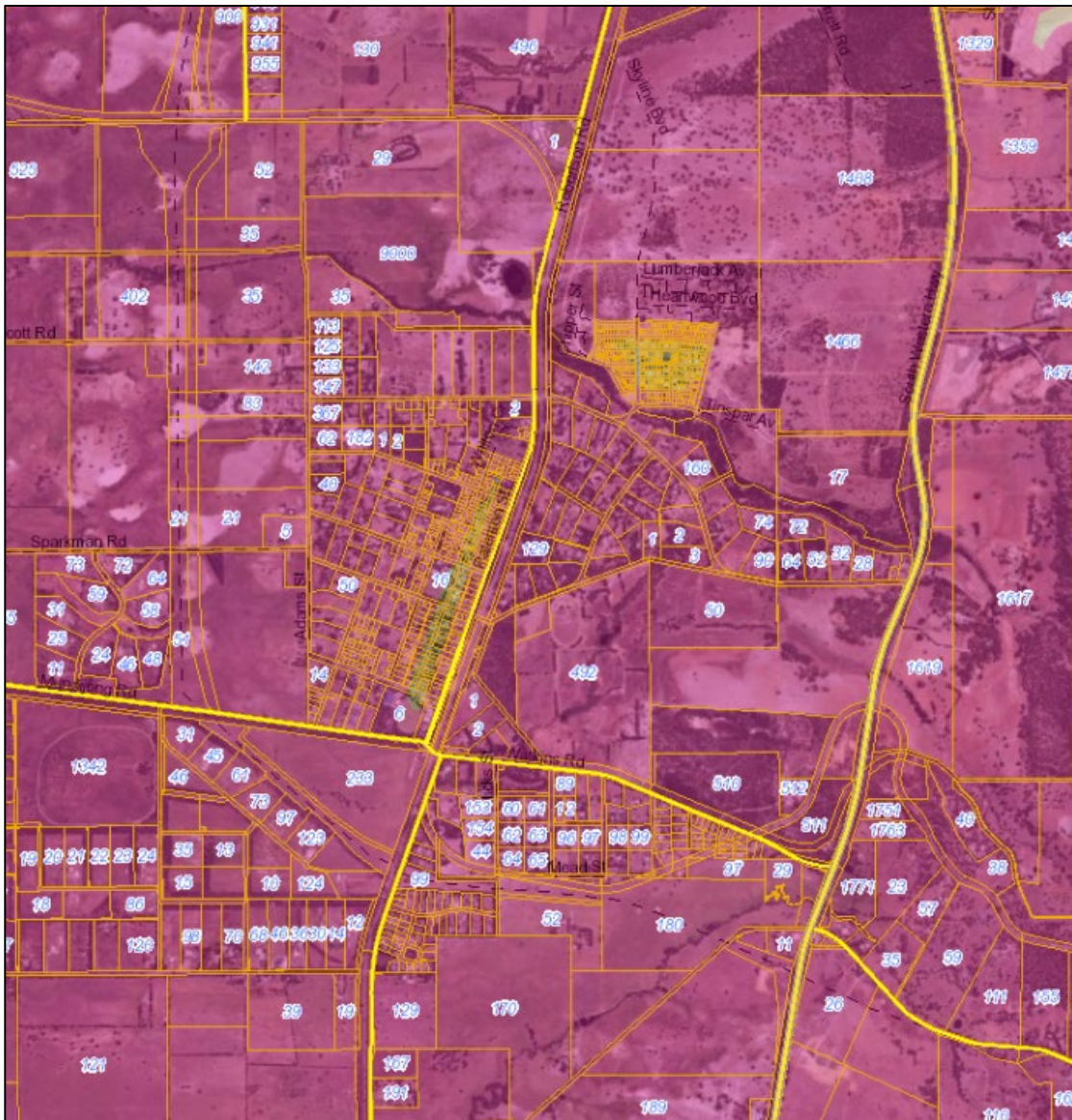


Figure 6-13 Bushfire prone areas in Mundijong (Source: DFES 2019)

6.4.2.5 Waste generation

The Shire provides waste collection – weekly general waste collection and fortnightly recycling collection. The Shire’s 2017/2018 Annual Report provides waste collection data for that year on a Shire-wide basis, however data is not available for specific settlements. Notwithstanding this, the percentage of dwellings distributed across the Shire based on the 2016 Census has been used to extrapolate the waste data on a settlement basis (Table 6-8). It should be noted that as the Census data only relates to dwelling count, figures relating to commercial waste will not be accurate.

Table 6-8 Waste data for the Shire and Mundijong-Whitby

Annual Report (2017/2018)	Whole of Shire	Mundijong-Whitby
Percentage dwelling count (%)	100	4
Green Waste (tonnes)	676	30
Hard waste (large items that cannot fit in a regular bin) (tonnes)	1,142	50
General waste (household and commercial waste) (tonnes)	7,916	347*
Recycled reusable waste (tonnes)	2,461	108
Waste to land-fill (tonnes)	8,836	387
Waste bins annually (collected)	516,528	22,624
Recycle bins annually (collected)	522,312	22,877
Commercial waste bins annually (collected)	17,952	N/A*
Commercial recycle bins annually (collected)	4,464	N/A*

*Data with commercial waste

6.4.2.6 Transport planning

An existing railway line runs through Mundijong providing freight and passenger access from Perth to Australind. Passengers can also access places such as Armadale and Bunbury using this service by booking advanced tickets.

An MRS Primary Regional Roads reserve is designated over the South Western Highway and the future Tonkin Highway extension. Mundijong Road is currently identified as an MRS Other Regional Road reserve; however, through the Mundijong settlement it becomes a local road reserve. Future planning proposes modifications to the reserve classification and extensions to the road network south of Mundijong.

There are two bus services (route Nos. 252 and 253) that run through Mundijong to and from Armadale Station (Figure 6-14). Bus services to Mundijong-Whitby are infrequent, with services decreasing significantly over the weekend (Table 6-9 and Table 6-10). There are no current plans for passenger rail to Mundijong-Whitby.

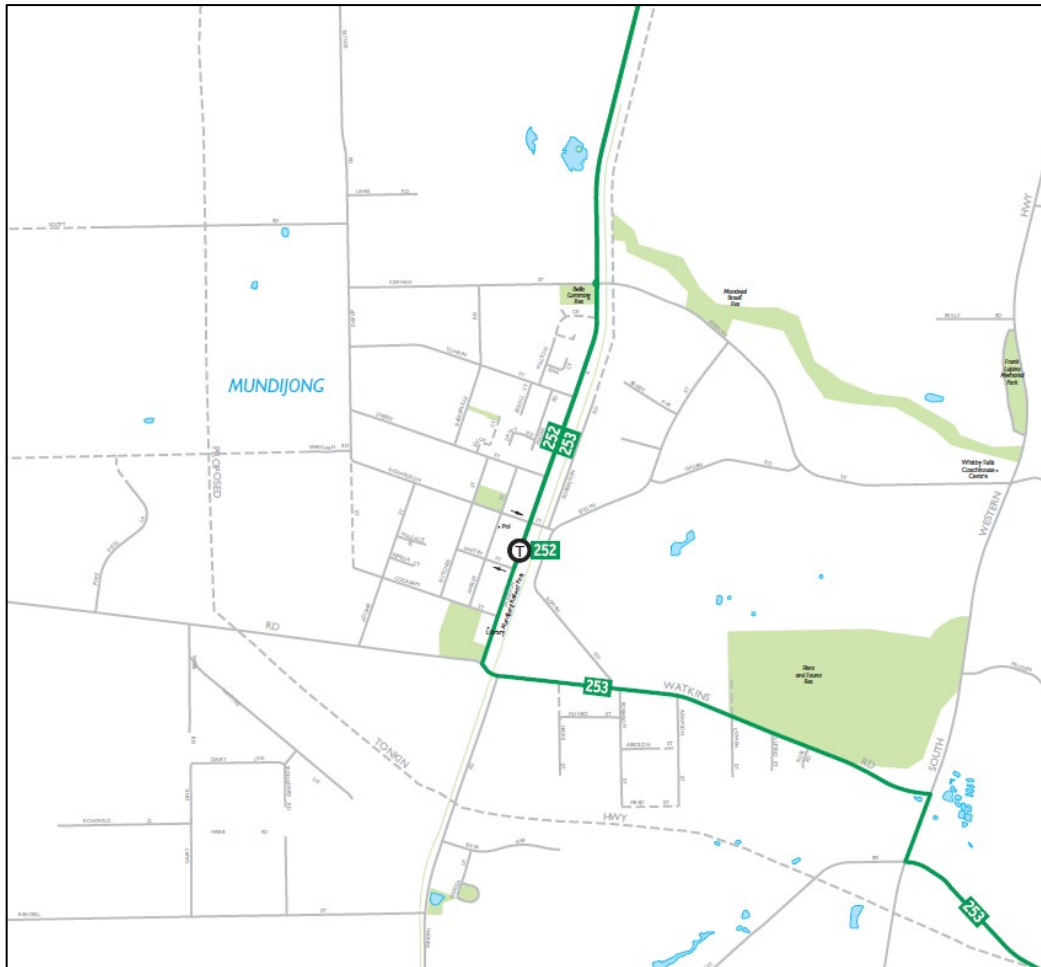


Figure 6-14 Bus routes through Mundijong-Whitby (Source: Transperth 2019)

Table 6-9 Bus routes to Armadale through Mundijong (source: Transperth, 2019)

Bus route No.	Number of services		
	Monday-Friday	Saturday	Sunday & Public.H.
252	9	2	No service
253	3	1	No service
TOTAL	12	3	0

Table 6-10 Bus routes to Mundijong (source: Transperth, 2019)

Bus route No.	Number of services		
	Monday-Friday	Saturday	Sunday & Public.H.
252	9	3	No service
253	4	1	No service
TOTAL	13	4	0

The Draft Walking and Cycling Plan for the Shire indicates that the only DoT registered shared path in Mundijong-Whitby is a section along Paterson Street.

Footpaths are provided on one side of the street throughout the new residential area of Whitby. Access to footpaths throughout Mundijong varies, with some of the smaller residential streets not having footpath access.

6.4.2.7 Sustainable built form

With the exception of new development in the Whitby locality, for the most part the current housing stock within Mundijong-Whitby pre-dates sustainability design and construction requirements set out in Liveable Neighbourhoods and the Building Code of Australia residential building energy efficiency standard of 5 stars, reflecting the rural history of the area.

6.4.3 Serpentine

The Serpentine settlement is concentrated around Karnup Road, east of the Serpentine railway stop on the Perth to Australind railway line. Whilst the urban settlement area is much smaller in size compared to Byford and Mundijong, Serpentine is currently the Shire's second largest settlement, accounting for 8.6 percent of the Shire's total population in 2016.

Serpentine has experienced population and dwelling growth between 2006 and 2016 (Table 6-11).

Table 6-11 Serpentine population and dwelling data (data source: ABS 2018)

Serpentine	2006 Census	2016 Census	Growth (%)
Population	1,856	2,317	24.84%
Dwelling numbers	696	817	17.39%

6.4.3.1 Existing development

Development in the Serpentine settlement is concentrated around Richardson Street and Karnup Road. The settlement includes some community uses and a general store, however much of the area is characterised by residential dwellings. The character of the area reflects the rural nature of the area, with large established trees and large vegetated gardens.

The majority of dwellings in Serpentine are separate houses (99.1 percent).

To the west and south of the settlement are large areas of rural living and special rural areas.

6.4.3.2 Retention of natural areas

The Serpentine settlement is well vegetated (Figure 6-15), with large established trees in both the public and private realm.

There are no reserved areas in the Serpentine settlement, however there are areas adjacent to the settlement (between the settlement and railway reserve) reserved as MRS Parks and Recreation. This area is also identified as Bush Forever (site No. 375).

The percentage of total canopy in Serpentine is higher than that of the Shire as a whole (Table 6-12).

Table 6-12 Percentage vegetation cover in urban land use areas (Shire of Serpentine Jarrahdale 2018)

Precinct	% Vegetation coverage – urban areas						
	Grass	0 – 3 m	3 – 8 m	8 -15 m	>15 m	Total vegetation	Total canopy*
Shire	7.1	11.4	6.2	6.9	2.7	34.3	15.8%
Byford	5.3	9.3	5.3	5.2	1.3	26.5	11.9%
Mundijong Whitby	7.0	10.8	5.9	6.8	2.7	33.2	15.4%
Serpentine	10.6	15.0	7.0	7.3	2.5	42.4	16.9%
Jarrahdale	6.2	14.1	10.7	15.2	16.3	62.5	42.2%



Figure 6-15 Urban canopy cover - Serpentine (Shire of Serpentine Jarrahdale 2018)

6.4.3.3 Flood mitigation and water sensitive urban design

The 1 in 100 (1%) AEP floodplain for the Serpentine area is shown in Figure 6-16. Settlement expansion for Serpentine is planned away from areas at risk of flooding.



Figure 6-16 1 in 100 (1%) AEP floodplain for Serpentine (Data source: National Maps, DWER-020)

6.4.3.4 Bushfire risk

The majority of the Serpentine settlement is located within a bushfire prone area with the exception of some the lots in the centre of the settlement (Figure 6-17).

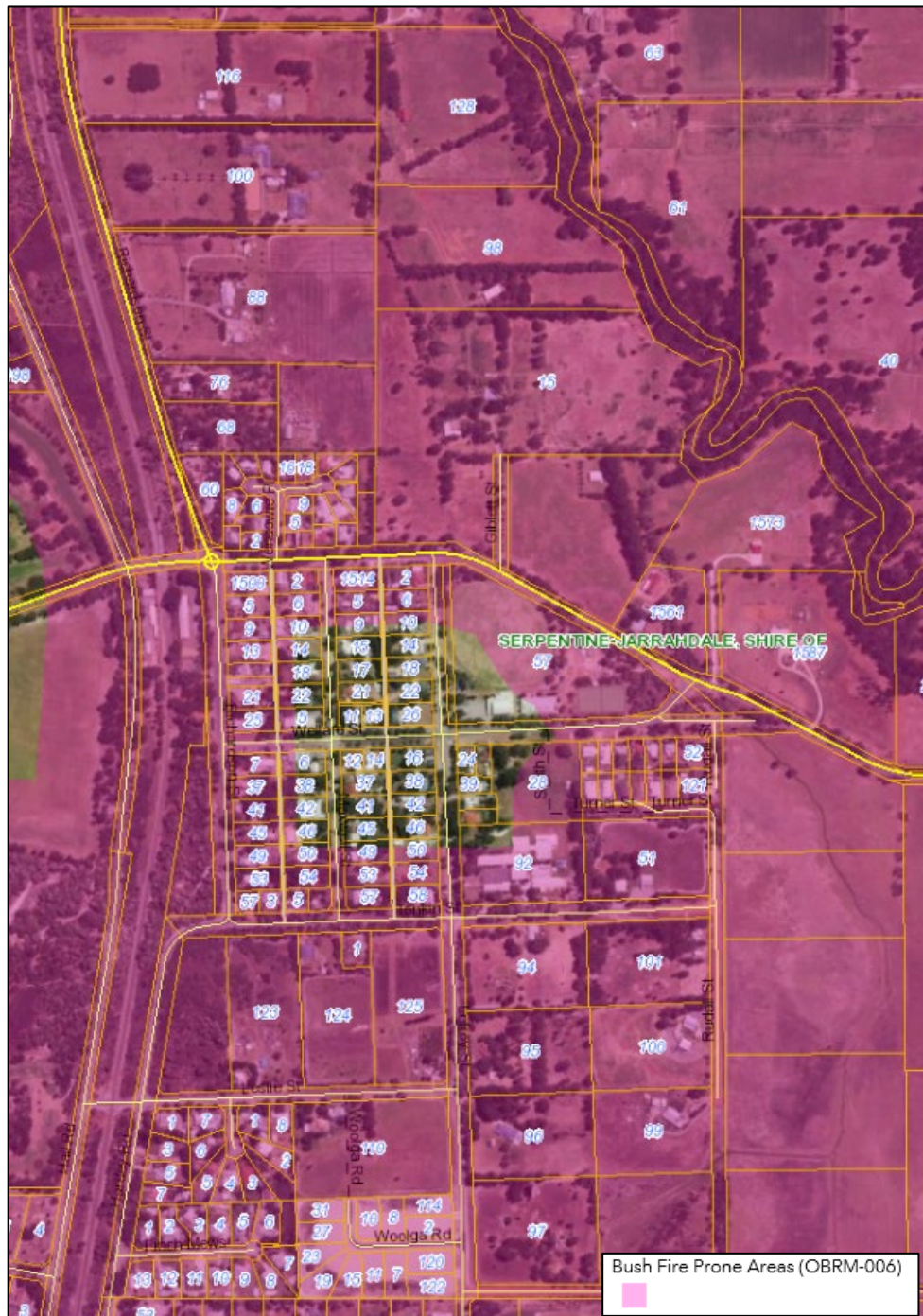


Figure 6-17 Bushfire prone areas in Serpentine (Source: DFES 2019)

6.4.3.5 Waste generation

The Shire provide waste collection – weekly general waste collection and fortnightly recycling collection. The Shire’s 2017/2018 Annual Report provides waste collection data for that year on a Shire-wide basis, however data is not available for specific settlements. Notwithstanding this, the percentage of dwellings distributed across the Shire, based on the 2016 Census, has been used to extrapolate the waste data on a settlement basis (Table

6-13). It should be noted that as the Census data only relates to dwelling count, figures relating to commercial waste will not be accurate.

Table 6-13 Waste data for the Shire and Serpentine

Annual Report (2017/2018)	Whole of Shire	Serpentine
Percentage dwelling count (%)	100	9
Green Waste (tonnes)	676	57
Hard waste (large items that cannot fit in a regular bin) (tonnes)	1,142	97
General waste (household and commercial waste) (tonnes)	7,916	673*
Recycled reusable waste (tonnes)	2,461	209
Waste to land-fill (tonnes)	8,836	751
Waste bins annually (collected)	516,528	43,905
Recycle bins annually (collected)	522,312	44,397
Commercial waste bins annually (collected)	17,952	N/A*
Commercial recycle bins annually (collected)	4,464	N/A*

*Data with commercial waste

6.4.3.6 Transport planning

There are limited public transport services available in Serpentine. The railway line that runs through Byford and Mundijong continues south past Serpentine and provides freight and passenger access to Australind. Passengers can access places such as Armadale and Bunbury from Serpentine using this service by booking advanced tickets.

There are no MRS regional roads through the settlement, however the South Western Highway is located to the east. The proposed extension of Tonkin Highway is envisaged to pass through/adjacent to Serpentine.

There are footpaths present throughout the settlement, however the width and quality vary depending on the street. Some residential streets do not have footpath access, reflecting the rural history of the area.

6.4.3.7 Sustainable built form

The majority of the current housing stock within Serpentine pre-dates sustainability design and construction requirements set out in Liveable Neighbourhoods and the Building Code of Australia residential building energy efficiency standard of 5 stars.

6.4.4 Jarrahdale

Jarrahdale is an historic area and was the location of the first major timber milling operation in Western Australia.

Jarrahdale is the Shire's smallest settlement accounting for 4.4 percent of the Shire's total population in 2016. Jarrahdale has experienced population and dwelling growth between 2006 and 2016 (Table 6-14).

Table 6-14 Jarrahdale population and dwelling data (data source: ABS 2018)

Jarrahdale	2006 Census	2016 Census	Growth (%)
Population	956	1,192	24.69%
Dwelling numbers	405	456	12.59%

6.4.4.1 Existing development

Jarrahdale is a predominantly residential settlement with some commercial uses along Jarrahdale Road. Most of the land zoned for urban uses is developed with the exception of the area north east of Jarrahdale and Millars Roads, which is cleared but contains very little development.

The residential housing stock includes weatherboard cottages and fibro houses, with some newer brick constructions. Despite the varying age of the housing stock, the character of the area has a rural feel resulting from the established trees and red gravel verges.

98 percent of dwellings in Jarrahdale were identified as separate houses, 1 percent as semi-detached, row or terrace house and townhouse and 1 percent as other dwelling (ABS 2018).

6.4.4.2 Retention of natural areas

The Jarrahdale settlement is located amongst areas of State Forest and MRS Parks and Recreation reserve. Within the settlement there is a small area of public open space local reserve. The settlement has been cleared in parts to enable development, however there are areas of dense vegetation surrounding the settlement.

The percentage of total canopy in Jarrahdale is the highest in the Shire (Figure 6-18 and Table 6-15).

Table 6-15 Percentage vegetation cover in urban land use areas (Shire of Serpentine Jarrahdale 2018)

Precinct	% Vegetation coverage – urban areas						
	Grass	0 – 3 m	3 – 8 m	8 -15 m	>15 m	Total vegetation	Total canopy*
Shire	7.1	11.4	6.2	6.9	2.7	34.3	15.8%
Byford	5.3	9.3	5.3	5.2	1.3	26.5	11.9%
Mundijong Whitby	7.0	10.8	5.9	6.8	2.7	33.2	15.4%
Serpentine	10.6	15.0	7.0	7.3	2.5	42.4	16.9%
Jarrahdale	6.2	14.1	10.7	15.2	16.3	62.5	42.2%

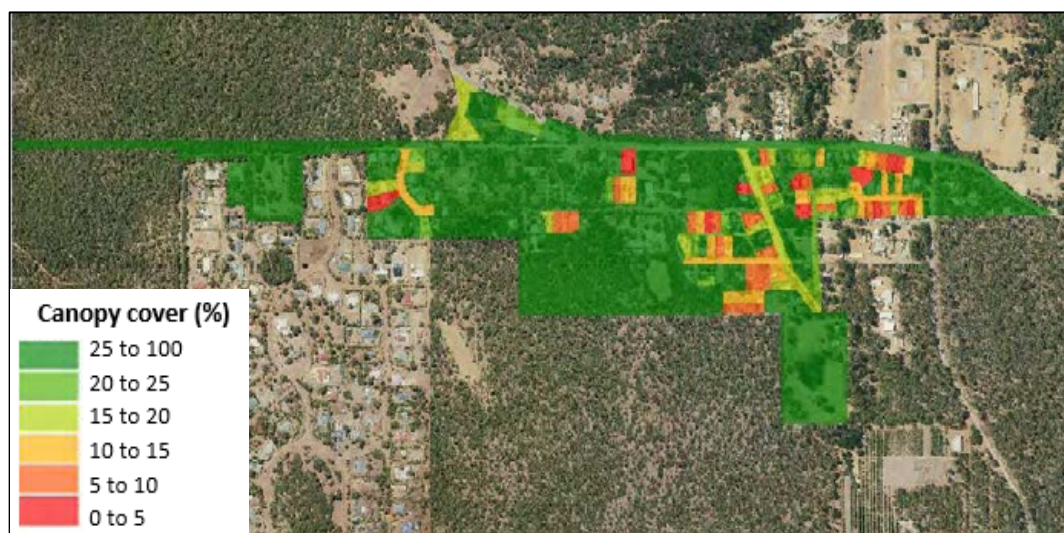


Figure 6-18 Urban canopy cover - Jarrahdale (Shire of Serpentine Jarrahdale 2018)

6.4.4.3 Flood mitigation and water sensitive urban design

There are no parts of the Jarrahdale townsite that are impacted by the 1 in 100 (1%) AEP floodplain (source: National Maps, DWER-020).

6.4.4.4 Bushfire risk

The entire settlement of Jarrahdale is located within a bushfire prone area (Figure 6-19).

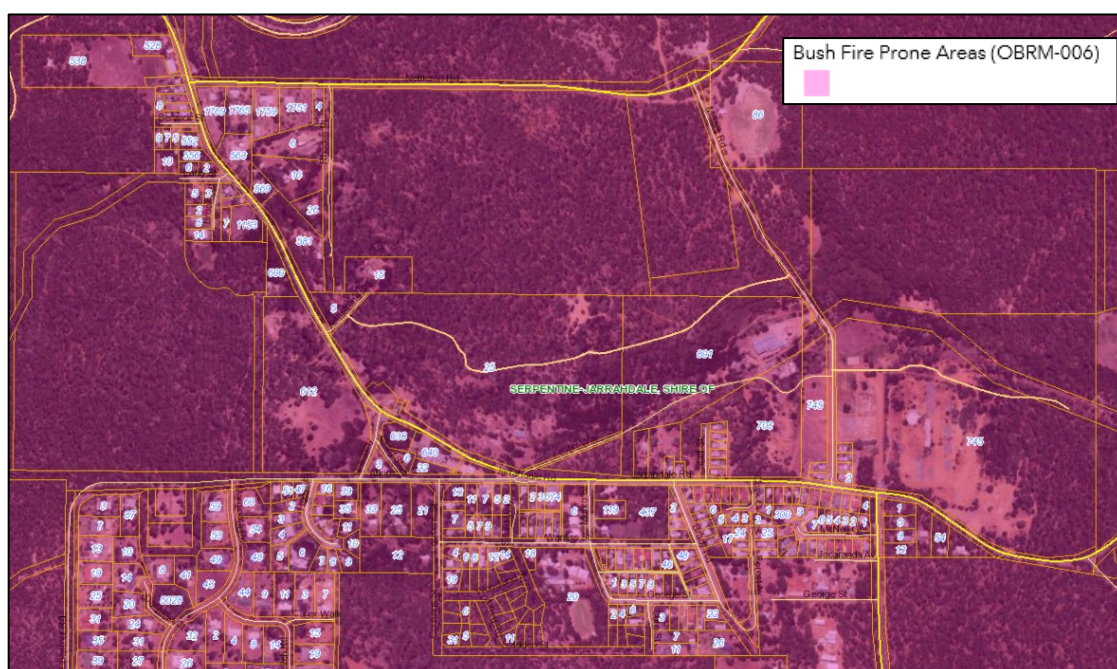


Figure 6-19 Bushfire prone areas in Jarrahdale (Source: DFES 2019)

6.4.4.5 Waste generation

The Shire provide waste collection – weekly general waste collection and fortnightly recycling collection. The Shire’s 2017/2018 Annual Report provides waste collection data for that year on a Shire-wide basis, however data is not available for specific settlements. Notwithstanding this, the percentage of dwellings distributed across the Shire, based on the 2016 Census, has been used to extrapolate the waste data on a settlement basis (Table 6-16). It should be noted that as the Census data only relates to dwelling count, figures relating to commercial waste will not be accurate.

Table 6-16 Waste data for the Shire and Jarrahdale

Annual Report (2017/2018)	Whole of Shire	Jarrahdale
Percentage dwelling count (%)	100	5
Green Waste (tonnes)	676	32
Hard waste (large items that cannot fit in a regular bin) (tonnes)	1,142	54
General waste (household and commercial waste) (tonnes)	7,916	375*
Recycled reusable waste (tonnes)	2,461	117
Waste to land-fill (tonnes)	8,836	419

Annual Report (2017/2018)	Whole of Shire	Jarrahdale
Waste bins annually (collected)	516,528	24,483
Recycle bins annually (collected)	522,312	24,758
Commercial waste bins annually (collected)	17,952	N/A*
Commercial recycle bins annually (collected)	4,464	N/A*

*Data with commercial waste

6.4.4.6 Transport planning

There are no MRS regional roads through Jarrahdale. All roads through the settlement area are identified as local road reserves. There is no passenger rail service.

There is one bus route (route No. 253) that travels to and from Jarrahdale (Figure 6-20). The frequency is low and it appears to cater for workers as Monday to Friday services are only available towards Armadale in the morning and towards Jarrahdale in the afternoon. Only one service is available on Saturday (Table 6-17 and Table 6-18).

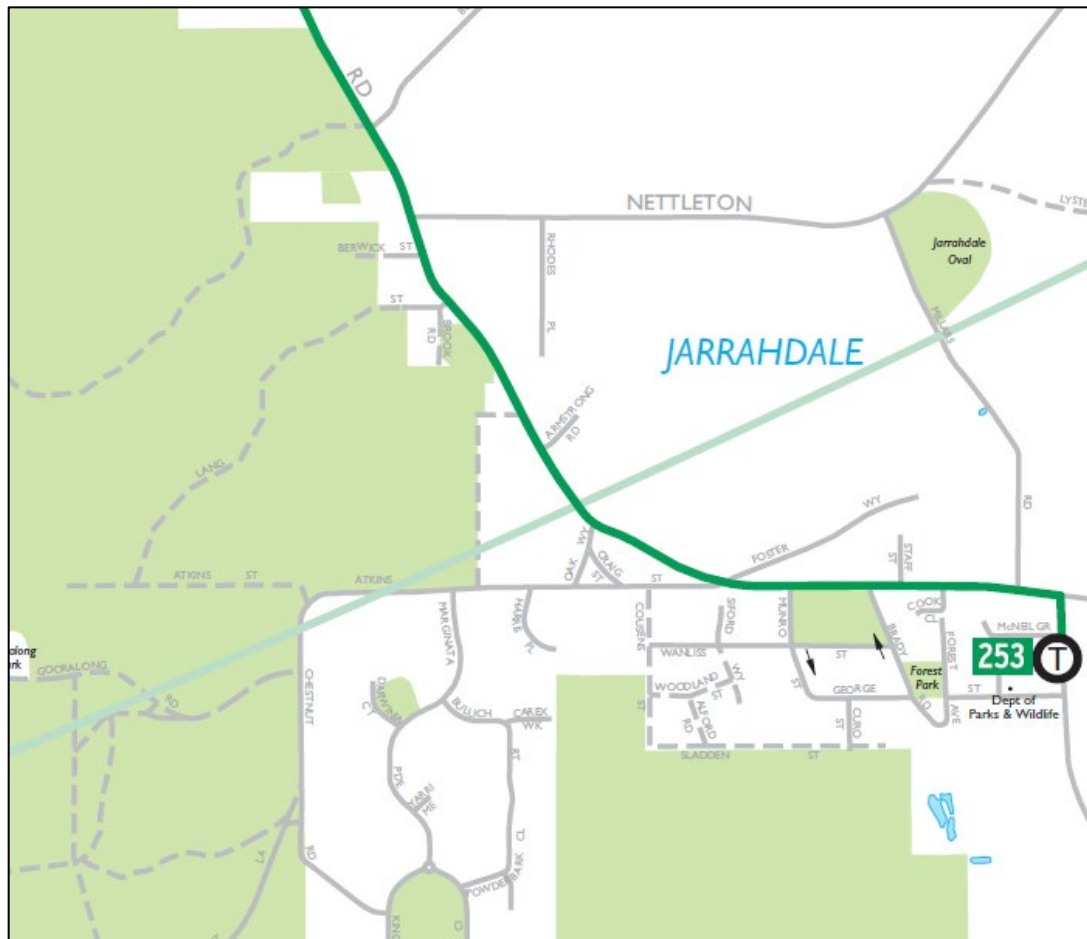


Figure 6-20 Bus routes through Jarrahdale (Source: Transperth 2019)

Table 6-17 Bus routes to Armadale from Jarrahdale (source: Transperth, 2019)

Bus route No.	Number of services		
	Monday-Friday	Saturday	Sunday & Public.H.
253	3	1	No service

Table 6-18 Bus routes to Jarrahdale (source: Transperth, 2019)

Bus route No.	Number of services		
	Monday-Friday	Saturday	Sunday & Public.H.
253	4	1	No service

Footpath access throughout Jarrahdale is generally limited with only certain streets having footpath access.

6.4.4.7 Sustainable built form

The current housing stock within Jarrahdale pre-dates sustainability design and construction requirements set out in Liveable Neighbourhoods and the Building Code of Australia residential building energy efficiency standard of 5 stars.

6.5 Pressures

6.5.1 Urbanisation and population growth

The Shire is expected to experience significant population growth, reaching approximately 100,000 people by 2050 (SJ2050). Population growth in the Shire will be targeted in the settlements of Byford, Mundijong and Serpentine. In addition, by the year 2050, it is estimated that there will be an additional 35,800 dwellings in the Shire (South Metropolitan Peel Sub-regional Planning Framework, 2018).

Byford and Mundijong are expected to experience the greatest level of growth. As these settlements grow, they will evolve into outer suburbs of Perth, rather than the traditional rural villages they once were. This substantial change has the potential to alter the settlement function and character.

6.5.1.1 Building and development trends

Housing affordability in Perth, and more broadly in Australia, is an ongoing issue. There is increasing pressure for cheap land and housing to be provided. Whilst most of the Shire's settlement areas have a lower median house and land price compared with Perth metropolitan area (Table 6-19 and Table 6-20), affordability will continue to be an issue in the future for many prospective home owners and renters.

Table 6-19 Median house prices (Source: Reiwa 2019)

Suburb	Median house price*	Growth percentage (last 12 months)
Byford	\$381,500	-4.60%
Mundijong	\$375,000	-9.60%
Serpentine	\$560,000	-1.80%
Jarrahdale	\$470,000	19.30%
Perth Metro Area	\$500,000	

*based on data from 1 July 2018 - 30 June 2019

Table 6-20 Median land prices (Source: Reiwa 2019)

Suburb	Median land price*
Byford	\$174,000
Mundijong	\$0**
Serpentine	\$255,000
Jarrahdale	\$290,000
Perth Metro Area	\$250,000

*based on data from 1 July 2018 - 30 June 2019

** no sales volume data recorded

Housing affordability affects the ability to obtain high quality development that integrates with the rural character of the Shire. There is the potential for project homes that meet the minimum requirements for sustainability, on subdivided lots that are typically completely cleared of vegetation.

6.5.1.2 Accessibility

As an area becomes more urbanised, there is typically an expectation that there will be greater provision of services and amenities to service the local population including:

- Adequate essential services – power, water, gas, telecommunications, waste water disposal, waste disposal
- Public transport
- Social infrastructure (libraries, sporting facilities, parks, leisure areas etc.)

As the population increases and urban development expands in the settlements, there will be a need to increase the capacity and reach of essential services. Many of these services are currently supplied using non-renewable resources, therefore a greater demand for services will put increasing pressure on these resources.

Perth is a car dominant city and the Shire is no exception. 68.3 percent of people in the Shire use a car to travel, as the driver, to work (ABS, 2018), which is higher than the Perth Significant Urban Area (64.1 percent), WA (63.3 percent) and Australia (61.5 percent). In the absence of adequate frequent public transport, residents and workers rely on private car use. As the population increases in this area and it becomes more urbanised, there will likely be increased car use. This places pressure on the local atmosphere and road infrastructure.

6.5.1.3 Environment

Development of new suburbs generally results in significant land clearing, resulting in a loss of vegetation, potentially impacting fauna habitat and flora species.

Increased urbanisation will also result in increased hard, impermeable surfaces, including roofs, roads, driveways and footpaths. These surfaces will impact on the drainage network and potentially nutrient runoff. This could place increasing pressure on drainage networks and the health of wetlands and waterways. Increased hard surfaces also results in an increase in heat island effect. This will create greater demand for cooling through air conditioner use, increasing use and pressure on power supply.

6.5.1.4 Character

As the settlements become more urbanised, there will likely be a shift in character of the area. Areas once occupied by large rural lots with unobstructed views will be replaced with urban development. The rural character of the Shire is highly valued by the community, therefore there will be increasing pressure to manage development in a manner that preserves this character.

6.5.2 Climate change

Climate change will have an impact on the population and urban expansion, particularly for bushfire risk and flood risk. There will also be increased use of resources such as water and energy, however these are discussed in more detail in other themes.

6.5.2.1 Bushfire risk

Warmer climatic conditions that result from climate change will increase the risk of bushfire events. The majority (97 percent) of the Shire, including many grassland areas around Mundijong and Byford, is a designated bushfire prone area (Shire of Serpentine Jarrahdale, 2018). This will have implications for the future cost of planning and development. Future development areas in the vicinity of retained bushland, particularly in Serpentine and Jarrahdale, will be impacted by bushfire risk. Demonstration that increased development reduces the bushfire risk may help reduce building cost implications, however this will need to be balanced with the retention of vegetation for aesthetic, character, shade and biodiversity values.

6.5.2.2 Flood risk

Climate change is expected to generate more frequent or extreme weather events which may result in heavy rainfall. Heavy rainfall may result in greater flooding, impacting urban areas and infrastructure. This places greater pressure on drainage networks.

6.5.2.3 Environment

Climate change can result in extreme weather events, including drought and flooding, which can impact on livestock and food production in agricultural areas. This creates

greater pressure on other agricultural areas and the ability to provide sufficient and affordable food sources for the population. Whilst this pressure is not limited to the settlement areas, it will have implications for the growing population in the Shire and the broader Perth population.

6.6 Responses

This section has been divided into two parts:

- Existing policy responses: this highlights what policy and programs the Shire is already implementing or undertaking to address environmental matters. In many instances these policies and programs apply Shire-wide. Where specific provisions in the settlement areas have been prescribed, such as in local structure plans (LSP) or the scheme, these have been noted.
- Additional responses: this outlines opportunities for the Shire to investigate for the future to address environmental matters.

6.6.1 Existing policy responses

6.6.1.1 Retention of natural areas

The Shire identifies public open space reserves in local planning schemes, district and local structure plans which can be used to protect stands of remnant vegetation and significant trees. The Shire should continue to maintain areas of public open space reserves.

The Shire's TPS2 includes provisions for preserving trees and plantings. Approval is required by the Council to remove, destroy or damage any tree of a certain size (as specified in clause 7.12.3 of TPS2). The Council may also:

- Declare areas for tree preservation and serve notices to landowners to protect trees (implemented through the Significant Tree Register)
- Impose conditions as part of development approvals for trees to be planted on a site that is considered deficient in tree cover (if reasonable in the context of the proposed development).

The Shire has a number of documents designed to protect and manage natural areas, including:

- Local Biodiversity Strategy.
- Reserve Management Plans (currently nine available on the Shire's website).
- Natural Assets Management Plan.
- Urban and Rural Forest Strategy.

The Shire should continue to implement these strategies and plans and any of the key recommendations of these plans within the settlement areas and wider Shire area.

The Shire has street tree and verge plant programs to increase vegetation on street verges. Whilst these programs are not about retaining natural areas, they support the increase in vegetation throughout the Shire. The Shire should continue to support these programs.

Healthy Habitats is a biodiversity stewardship program that has been running since 2009 as a partnership between the Shire of Serpentine Jarrahdale and Landcare SJ Inc. The program offers support to landholders with privately owned bushland, including information and advice tailored to each property about how to best look after it. There are currently 27

properties that are members of the program, representing 500ha of natural areas being actively managed for conservation by the landowners. The Shire should continue to support this program.

6.6.1.2 Flood mitigation and water sensitive urban design

Better Urban Water Management and the *Stormwater Management Manual for Western Australia* are two key state wide documents used to manage stormwater and water sensitive urban design and to implement SPP 2.9. The Shire should continue to implement the principles and requirements of these documents within the settlement areas.

The Shire has LPP 2.4 Water Sensitive Urban Design Guidelines which applied to all rezonings, structure plans, detailed area plans, subdivisions and development proposals throughout the Shire to ensure the Shire utilises best management practices in relation to WSUD. The Shire should continue to implement the provisions of this policy in planning decision making.

The Shire has street tree and verge plant programs to increase vegetation on street verges. An increase in vegetation cover improves infiltration in the local area. The Shire should continue to support these programs.

The Shire participates in the *Switch Your Thinking* program which includes ways to encourage water-wise behaviours in residential and business developments. The Shire should continue to support this project and encourage more residents and businesses to take part in the program.

Byford responses

In 2008 the Department of Water (currently Department of Water and Environmental Regulation) prepared the Byford townsite drainage and water management plan. The summary plan within the document identifies the 100 Year ARI Floodways which are not to be developed or obstructed. The management plan notes that the town centre is proposed in an area at substantial risk of flooding. It will be important for future local structure plans to address flooding in this area. The management plan notes the key objectives for urban water use relate to:

- Efficient use of water resources in newly-developing urban form.
- Ensuring opportunities for future generations.

A floodplain management plan was prepared by SKM for the Byford catchment. It recommends some key planning measures for floodplain management relating to raised floor levels, design of residential streets, incorporation of best practice WSUD in new urban areas, construction of waterways and design of new drainage corridors.

The management plan includes a list of best management practice principles to reduce flood risk on housing and infrastructure, as well as treating stormwater. In summary these are:

- Implementing controls near the source to treat stormwater and mitigate pollutants.
- Using structural and non-structural best management strategies.
- Applying best management practices on a residential lot scale, commercial lot scale, street scale, estate scale and area scale.

Mundijong responses

A Mundijong-Whitby District Water Management Strategy (2010), Mundijong-Whitby Water Strategy (2012) and Whitby Local Water Management Strategy have been prepared, however are not publically available through the Shire or Department of Water.

Serpentine responses

The draft Serpentine Townsite LSP identifies areas for drainage, however there is no supporting documentation available publically to provide more detailed information on the drainage conditions in Serpentine.

Jarrahdale responses

There are no LSPs applicable in Jarrahdale that include information on drainage.

6.6.1.3 Bushfire risk

SPP3.7 and associated guidelines provide a strong framework for integration of bushfire risk into planning and development. The Shire should continue to implement the requirements of SPP3.7. For existing urban areas that do not trigger consideration under SPP3.7, a key response to bushfire risk is the implementation of Shire of Serpentine Jarrahdale Shire Bushfire Risk Management Plan 2018-2023. Significant additional information can be found on the Shire's website which provides guidance on total fire bans and firebreak requirements on private property.

Additional responses to bushfire risk are provided in location-specific management plans, as shown below.

Byford responses

The following LSPs provide requirements for bushfire management:

- The Glades, Byford LSP states that a 'Fire Management Plan is to be prepared to identify potentially affected areas and outline the necessary fire management requirements to be implemented (via Detailed Area Plans).'
- Lot 6, 27 Abernethy Road, Byford LSP states that subdivision and future development should be in accordance with an approved Fire Management Plan.
- The L1, L3 and L128 South Western Highway, Byford LSP requires the preparation of a Fire and Emergency Management Plan prior to subdivision. The plan also requires a 21m setback from the 4m wide fire access track. All development is subject to bushfire risk and threat analysis.
- Lot 806 South Western Highway, Byford LSP requires the preparation of a Fire Management Plan.
- Lots 61 and 62 Thomas Road and Lots 59 and 60 Briggs Road, Byford LSP requires all development and subdivision applications to be accompanied by a fire and emergency management plan.
- The Brook at Byford LSP includes the preparation of a Fire Management Plan for Lot 2 Nettleton Road, Byford.
- Stanley Road Byford LSP includes a Bushfire Management Plan. However as this predates the updated SPP3.7, bushfire assessment is to be undertaken as part of a subdivision application.

Mundijong responses

The following LSPs provide requirements for bushfire management:

- The draft Mundijong DSP acknowledges the need for the preparation of a detailed Bushfire Hazard Assessment and application of Bushfire Management Plans in accordance with SPP3.7, however this does not appear to be available.
- The DSP also states that the preparation of all LSPs within the DSP area are to include a Bushfire Hazard Assessment and/or Bushfire Management Plan and all development investigation areas should also consider bushfire hazard.
- Lot 50 Cockram Street & Lot 119 Sparkman Road LSP notes that the site is predominantly cleared and generally not in close proximity to bushland. Fire breaks will be required as per the LSP and at the time of subdivision there may be a need for a Fire and Emergency Management Plan.
- The Mundijong Precinct E1 - Taylor Road/Adam Street, Mundijong LSP states that prior to development the preparation of a Fire and Emergency Management Plan is required.

Serpentine responses

The following LSP provides requirements for bushfire management.

- A Bushfire Management Plan was prepared for Lot 791 Walker Road Serpentine and BAL mapping was undertaken.

Jarrahdale responses

The Shire has recently constructed five 215,000L Potable Static Water Supplies (tanks) and refurbished two existing 225,000L tanks in the Jarrahdale townsite following successful grants from Royalties for Regions/Peel Development Commission. This provides the townsite with water supplies in the event of a fire and provides a backup source of potable water.

6.6.1.4 Waste generation

The Shire is currently preparing a Waste Management Strategy. Once developed, the Shire should continue to implement any recommendations from the Waste Management Strategy that reduce waste production and improve recycling and reuse rates.

The *Switch Your Thinking* program encourages reduced waste through the *Rewards for Residents* program – specifically discounts on KeepCups, compost bins and worm farms. Other projects *Switch Your Thinking* that encourage waste reduction include the modern cloth nappy library trial and responsible cafes. The Shire should continue to support the *Switch Your Thinking* program to encourage waste reduction.

6.6.1.5 Transport planning

DoT, Main Roads WA, PTA and the WAPC have prepared *Perth and Peel @3.5 million – The Transport Network* (2018) which responds to the population growth predicted in *Perth and Peel @3.5 million*. It acknowledges that as the population grows there is increasing demand on services and resources, and that Perth's transport network will require changes. The transport network encompasses public transport, aviation, freight, marine transport and road.

The Shire should continue to advocate for the implementation of these key transport recommendations within the *Perth and Peel @3.5 million – The Transport Network*.

Transport assessments are required under Draft Liveable Neighbourhoods for all structure plan proposals. Not only is the assessment to look at projected traffic volumes, but also consider pedestrian and cyclist movement and safety through intersections. The Shire should continue to implement the requirements of Liveable Neighbourhoods as part of the preparation of structure plans.

There are major road and freight rail networks through the Shire. These routes and their noise impacts need to be considered when undertaking land use planning as per SPP 5.4 Road and rail transport noise and freight considerations in land use planning. Any future noise-sensitive development in the vicinity of existing or future road, rail or freight handling facility, or new infrastructure in the vicinity of existing or future noise-sensitive land use, will need to consider the provisions of the policy. The Shire should continue to implement the requirements of this policy.

At the local scale, implementation of the Shire of Serpentine Jarrahdale Draft Cycling and Walking Plan will be a key response to achieve greater sustainability in movement.

Byford responses

Within the South Metropolitan Peel sub-region there are a number of plans proposed for public transport, roads, freight and aviation, walking and cycling. The framework outlines the following specifically for Byford:

- Public transport
 - Extension of passenger rail from Armadale to Byford through METRONET.
 - Proposed high-frequency transit corridor from Byford to Mundijong and further to Jarrahdale.
- Roads
 - Proposed integrator arterial road linkages between Byford and Mundijong.
 - Proposed Tonkin Highway extension.
 - Proposed east-west integrator arterial roads between Tonkin Highway and South Western Highway.
- Walking and cycling
 - Off-road cycling routes along South Western Highway and Tonkin Highway.
 - Strategic on-road cycling routes along Mundijong Road and Thomas Road.

Mundijong responses

Perth and Peel @3.5 million – The Transport Network outlines the following proposed projects specifically for Mundijong:

- Public transport
 - Proposed high-frequency transit corridor from Byford to Mundijong and further to Jarrahdale.
- Roads
 - Proposed integrator arterial road linkages between Byford and Mundijong.

Proposed Tonkin Highway extension.

Proposed primary distributor along Mundijong Road.

Proposed east-west integrator arterial roads between Tonkin Highway and Soldiers Road.

- Freight and aviation

Realignment of freight railway through Mundijong.

Intermodal freight terminal at Mundijong.

Investigation of freight road extension on Mundijong Road.

- Walking and cycling

Off-road cycling routes along South Western Highway and Tonkin Highway.

Strategic on-road cycling routes along Mundijong Road and Thomas Road.

Serpentine responses

Perth and Peel @3.5 million – The Transport Network outlines the following proposed projects specifically for Serpentine:

- Walking and cycling

Off-road cycling routes along South Western Highway.

Jarrahdale responses

Perth and Peel @3.5 million – The Transport Network does not propose any project through Jarrahdale, however the Mundijong Road Primary Distributor is proposed to be extended towards Jarrahdale.

6.6.1.6 Sustainable built form

Draft Liveable Neighbourhoods includes requirements for lot design, including lot solar orientation. The Shire should continue to implement Liveable Neighbourhoods through the preparation of structure plans to encourage sustainable lot layout and design.

Residential design in WA is guided by State Planning Policy 7.3 – Residential Design Codes (R Codes) (volumes 1 and 2). The policy includes development provisions which encourage sustainable design. The Shire should continue to implement the R Codes and ensure that developments adequately address the sustainable built form requirements.

The National Construction Code includes the Building Code of Australia residential building energy efficiency standard of 5 stars set in 2006. This ensure a minimum energy efficiency in new residential dwellings.

The *Switch Your Thinking* program provides incentives for improving household sustainability. The program offers two key incentives which can be incorporated into residential development to improve the sustainable built form, those being discounts on rainwater tanks and solar panels.

Byford responses

The following LSPs provide requirements for sustainable design:

- The Byford Town Centre LSP includes the requirement for the town square to be orientated north to maximise solar access.

- Consideration of building orientation in the preparation of detailed area plans for Lot 9 Abernethy Road LSP, Marri Park Estate LSP and Lots 6, 27 Abernethy Road LSP.
- Requirements for glazing for solar access and energy efficiency requirements as per the Building Code of Australia in LPP3.6 The Glades Village Centre.

Mundijong responses

The following LSPs provide requirements for sustainable design:

- The Draft Mundijong DSP states that all LSPs, local development plans, subdivisions and development shall consider the efficient use and reuse of water, and climate responsive design, energy and water efficiency, and increased use of renewable energy.
- Consideration of building orientation in the preparation of local development plans within the Mundijong Precinct E1 Taylor Road/Adams Street LSP.
- Consideration of development and lot layout that maximises opportunities for energy efficient design in the Whitby Precinct A LSP.

Serpentine responses

There are no LSPs that provide requirements for sustainable design in Serpentine.

Jarrahdale responses

The following LSPs provide requirements for sustainable design:

- Encouraging use of solar energy, use of timber produced from sustainably managed forests, and consideration of solar orientation in LPP 3.1 McNeil Grove Design Guidelines.
- Consideration of passive solar design, energy efficiency, water efficiency, building materials in LPP3.2 Woodlot Subdivision Jarrahdale Design Guidelines.

6.6.2 Additional responses

6.6.2.1 Retention of natural areas

The TPS2 includes a conservation zone. This zone identifies land that has high conservation significance (including private land). The zone is intended to assist land owners to protect and manage conservation values. The zone includes the provision for the preparation of management plans for land in the zone which are to - *identify setbacks, buffer zones, and the required conservation management practices and other measures as deemed necessary to achieve a satisfactory standard of protection relative to the significance of conservation values present.*

This zone demonstrates the Shire's commitment to preserving land of high conservation value in addition to those that are reserved under the scheme or region scheme. Notwithstanding this, there are very few areas where this zoning has been applied, and specifically there are no areas of conservation zone in the four settlement areas of Byford, Mundijong/Whitby, Serpentine and Jarrahdale. As part of the scheme review, the Shire could investigate whether any lots can be rezoned to Conservation zone, particularly in the settlement areas.

In addition, it is recommended that the Shire consider local planning policy that provides policy expectations for retention of trees and remnant vegetation through design of new urban developments.

6.6.2.2 Waste

There may be opportunities for increased recycling and waste collection. For example, the introduction of a container deposit scheme (to be rolled out in 2020) may result in an increased desire for facilities for collection of recyclables. The Shire should consider the likelihood of this and make any updates to TPS2 or local planning policies to facilitate this use. A model local planning policy for container deposit scheme infrastructure has been developed by the Department of Planning, Lands and Heritage. The Shire can consider adoption of this policy.

6.6.2.3 Transport planning

The Shire should consider opportunities through the local planning framework and structure plans to ensure future neighbourhoods have accessibility between residences and community and retail services, enabling walking and cycling as a meaningful mode choice for daily and local trips.

6.6.2.4 Building and development

Engagement with community and developers should be undertaken to identify the desirability and acceptability of local policy requirements that exceed the Building Code of Australia residential building energy efficiency standard of 5 stars.

There is opportunity to engage with local builders to include leading practice sustainable designed houses in display villages through project partnerships with the Shire, and development incentives.

Education programs targeting new residents and home builders for sustainable design of new housing is a key opportunity to promote the benefits of sustainable design.

Maintaining the rural character of the Shire is paramount to the community, however there is also a desire to provide affordable housing and living opportunities. The risk with providing affordable housing is that the quality of the built product is cheap and provides the minimum sustainability requirements. There could be an opportunity to encourage higher quality design with sustainability elements incorporated into individual developments, as well as the public realm. This could be promoted as a “tree change” lifestyle with greener environments (both physically with more trees and vegetation and sustainably through sustainable design).

6.6.2.5 Planning framework review

The Shire also has a large suite of district and local structure plans. Structure plans guide subdivision and development of specific areas. In the case of the Shire, most of these areas are undeveloped and form part of new development areas. The Regulations outline the minimum requirements for structure plans. Whilst structure plans are to include *‘the key attributes and constraints of the area covered by the plan including the natural environment, landform and the topography of the area;’* there are no statutory requirements relating to the retention, preservation and management of the environment or sustainability requirements. There could be an opportunity to include supplementary provisions in the scheme to provide more stringent requirements relating to the environment and sustainability.

As part of the Shire’s scheme review, a review of all local planning policies should be undertaken to ensure they include appropriate provisions relating to sustainable development and where there is an opportunity, incorporate additional requirements.

6.6.3 Summary of responses

Response	Potential actions
5.4.1 Existing policy responses	<p>Continue to implement local planning framework to ensure:</p> <ul style="list-style-type: none"> • Protection of local biodiversity • Flood mitigation • Incorporate of WSUD • Bushfire risk mitigation • Improve sustainability of built form • Provision of sustainable transport options <p>Continue to participate in <i>Switch Your Thinking</i></p>
5.4.2 Additional responses	<p>Continue to support the conservation zone</p> <p>Investigate any updates to the local planning framework that will be required to support the container deposit scheme</p> <p>Investigate opportunities to improve accessibility between residential and retail areas</p> <p>Investigate potential for a local planning policy that achieves built form that exceeds BCA requirements</p> <p>Investigate opportunities for educational opportunities to improve sustainability of residential housing</p> <p>Review planning framework to determine further opportunities to improve the sustainability of the Shire as it develops</p>

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Theme Six: Heritage



7. Theme Six: Heritage

7.1 Overview

“Heritage is something that we have inherited from the past and is something that is valued enough today to leave for future generations” – National Trust, 2019.

Heritage can incorporate both the tangible and the intangible. It is present in many forms such as landmarks, places, buildings and contents, spaces, views and the stories associated with them. Western Australia’s heritage links and overlaps with natural, indigenous, maritime, movable and intangible heritage.

The Shire of Serpentine Jarrahdale has strong heritage values connected to the natural environment, indigenous heritage and European settlement. This chapter therefore discusses indigenous heritage, natural heritage and historic places with intergenerational value (cultural heritage).

7.1.1 Strategic alignment

Heritage values of the Shire contribute to the local connection to place and overall character of the area. It is an important aspect of the Shire that attracts visitors and residents. This has been recognised in the Shire’s Strategic Community Plan 2017-2027.

Protection of heritage supports the achievement of the Place SJ2050 vision outcome:

Our Shire will ensure the preservation of local arts, culture, and history, sharing stories and knowledge for generations to come.

It also aligns with the SJ2050 core values, particularly:

Place – Restoring and celebrating the local heritage and history

Place – Promoting the area’s unique sense of place and identity

7.2 Aboriginal Heritage

Long before European settlement, Noongar Aborigines of the Whadjuk and, probably, Bindjareb tribes hunted and camped in the woodlands between modern-day Perth and Pinjarra. Like most Noongars of the south-west, they used fire sticks to burn parts of the forest and, over thousands of years, the scrub fires created some areas of open forest and patches of grassland.

7.2.1 Native Title

The Shire is located within the Gnaala Karla Boodja region and the recognised traditional owners are the Gnaala Karla Boodja people, one of the six groups collectively recognised as the Noongar traditional owners of the South West under the South West Native Title Settlement. The ownership has been recognised in the *Noongar (Koorah, Nitja, Boordahwan) (Past, Present, Future) Recognition Act 2016*.

A Native Title Settlement Agreement with the Gnaala Karla Boodja people was signed in 2015, which surrenders any existing native title rights in exchange for a negotiated package of benefits including formal recognition of the Noongar people as traditional owners, land, investments and the establishment of Noongar Regional Corporations. Traditional owners are expected to be more closely involved in land use planning and management upon

commencement of the Settlement. The land within the Gnaala Karla Boodja region will provide cultural and economic development opportunities for the Noongar Regional Corporations representing the recognised Noongar groups.

It will be the responsibility of the Department of Planning, Lands and Heritage and the South West Land and Sea Council/ Noongar Boodjar Trust to identify land that may be eligible for allocation. The selection and assessment process for land identified is underway.

7.2.2 Statutory Framework

7.2.2.1 Aboriginal Heritage Act 1972

The *Aboriginal Heritage Act 1972* provides for the identification and protection of significant Aboriginal objects and sites throughout Western Australia. The *Aboriginal Heritage Act, 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

7.3 European Heritage

European cultural heritage includes heritage areas, buildings and structures, historic cemeteries and gardens, man-made landscapes and historic or archaeological sites.

European heritage is important as it supports urban and rural amenity by providing familiarity and the presence of landmarks, it underpins our 'sense of place', and it enhances the quality of our built environment generally.

Conservation of European heritage can aid economic prosperity by contributing to the attractiveness of the living and working environment, and encouraging investment in a locality or region from homeowners, investors and tourists. The avoidable loss of buildings through demolition and neglect is a waste of economic as well as environmental resources (State Planning Policy 3.5 – Historic Heritage Preservation, Western Australian Planning Commission, 2007).

7.3.1 Local historic heritage

The Shire has evolved from humble beginnings, dating back to 1840 when Thomas Peel established the Serpentine Farm (now Lowlands Nature Reserve) on his land grant on the banks of the Serpentine River.

Prior to the Serpentine Road Board being gazetted in 1896, the area was governed by the Canning Road Board. Upon the formation of the Serpentine Road Board, which held its first meeting in 1897, the new Road Board controlled a corridor about 18.5km wide extending from Albany Highway to the coast. (Coy, N.J. *The Serpentine*, 1979).

In 1902, the Jarrahdale Road Board was formed and the two Road Boards, Serpentine and Jarrahdale, functioned independently for almost a decade. In 1913 the Serpentine and Jarrahdale Road Boards combined to become the Serpentine Jarrahdale Road Board. Land west of the Serpentine River system was transferred to the Rockingham Road Board. (Coy, N.J. *The Serpentine* 1979). In July 1961, the Serpentine Jarrahdale Road Board was transformed into the Shire of Serpentine Jarrahdale when seven Road Board members were sworn in as Shire Councillors (Coy, N.J. *The Serpentine*, 1979).

With its good soils and access to markets, the Shire of Serpentine Jarrahdale was a very stable farming and orchard area with other industries based on its natural resources. There was, and still is, timber processing based on local forest products and brickworks based on local shale and clay. In the late seventies these were supplemented by Alcoa's bauxite mining with a crushing plant in Jarrahdale, all of which provided local employment. Today small holdings and a rural lifestyle have seen the development of equestrian establishments.

A steady growth in the value of rural production together with recognition by local government of the Shire's food production capacity, the need for protection of good agricultural land, and the necessity for value added enterprises, have all added to the Shire's reputation as a 'food bowl'.

The Shire of Serpentine Jarrahdale has a strong sense of history based on the original families to settle in the area, from the early Peel settlers, the group settlement families, and later generations. While the Darling Range escarpment will always hold its appeal, the Shire and the community recognise the cultural significance of the built heritage of the area.

Established in the 1800s, Jarrahdale was the site for the first major timber milling in Western Australia. The Jarrahdale townsite was classified as an historic town in 1997.

7.3.2 Statutory framework

The identification, conservation and protection of places and areas of state heritage significance are provided for in the *Heritage of Western Australia Act 1990*. The *Heritage of Western Australia Act 1990* provides for the compilation of the state heritage register by the Heritage Council and Heritage Minister.

Any development to a state-registered place requires approval from the responsible planning authority, usually the Western Australian Planning Commission (WAPC) or a local government, on the advice of the Heritage Council.

The identification of places and areas of local heritage significance is also provided for in the *Heritage of Western Australia Act 1990*, which requires all local governments to identify heritage places in local government inventories (formerly 'municipal inventories').

The Shire has identified places of natural beauty, historic buildings and objects of historical or scientific interest in Town Planning Scheme No.2 (TPS2) together with specific scheme provisions. This provides these sites and places with further statutory protection, through requirements for heritage-related approvals or referrals. Other listings, such as on the historical municipal inventory, are unofficial or quasi-official designations, often arising from local, community-based or thematic surveys.

Section 7.5 describes specific heritage sites identified within the Shire.

7.4 Natural Heritage

Located approximately 45 kilometres from the Perth CBD, Serpentine Jarrahdale is set against the picturesque backdrop of the Darling Scarp, within the Peel region of Western Australia.

Home to the Serpentine Falls and Serpentine Dam, residents and visitors enjoy the picturesque environment with bushwalks through the forested hinterland of the Darling Range. Forested hills and wetlands are complemented by areas of pristine wilderness, an abundance of wildflowers and wildlife.

Coastal flats are dominated by rural residential properties with a mix of natural vegetation and cleared grazing land supporting a vibrant equine industry.

Protection of significant trees is recognised as an opportunity to maintain the rural character of the Shire.

7.4.1 Statutory framework

TPS2 includes provisions for preserving trees and plantings. Approval is required by the Council to remove, destroy or damage any tree of a certain size (as specified in clause 7.12.3 of TPS2). The Council may also:

- Declare areas for tree preservation and serve notices to landowners to protect trees (implemented through the Significant Tree Register)
- Impose conditions as part of development approvals for trees to be planted on a site that is considered deficient in tree cover (if reasonable in the context of the proposed development).

Natural heritage is also protected through reservation under the TPS2 in local reserves, reservation under the Metropolitan Region Scheme (MRS) and inclusion in the conservation zone.

In addition, the Shire has prepared local planning policy (LPP) 4.3 Landscape Protection Area Policy. The policy identifies areas along the Darling Scarp where the Shire aims to protect and enhance the landscape character and visual amenity of the Darling Scarp. LPP 4.3 includes provisions to protect the landscape character including:

1. Consideration of the location of development
2. Visual intrusiveness of the development
3. Colours and materials
4. Preservation and enhancement of natural features and vegetation
5. Building appearance
6. Rezoning and subdivision

7.5 Condition

7.5.1 Aboriginal Heritage

There are twenty three (23) Aboriginal Sites within the Shire registered under the *Aboriginal Heritage Act 1972* (the Act); this list is provided in Appendix D and shown on Figure 7-1.

There are a further sixty four (64) sites classified as other heritage places that either do not meet Section 5 of the Act (33 sites) or are sites where information has been received but an assessment to determine if Section 5 of the Act has been met has not been undertaken (31 sites) (Aboriginal Heritage Inquiry System, Department of Planning, Lands and Heritage June 2019).

The most well-known registered site is the Serpentine River. The Serpentine River, the surrounding hills and the wetlands of the coastal plain provided the Noongars with fresh water, fish and other food resources such as tortoises, lizards and birds (Department of Biodiversity, Conservation and Attractions 2019). Fish traps were constructed on the river, downstream from the falls, and where it flows through a chain of small lakes on its journey

to the Peel Inlet. Each year, at the start of the winter rains, tribal groups from the north, east and south would gather near Barragup to catch the fish that were driven downstream by the fast flowing waters (historical website reference (Department of Biodiversity, Conservation and Attractions 2009)).

7.5.1.1 Place names

Aboriginal culture is reflected throughout the Shire, for example, a number of local places names are linked to Noongar words.

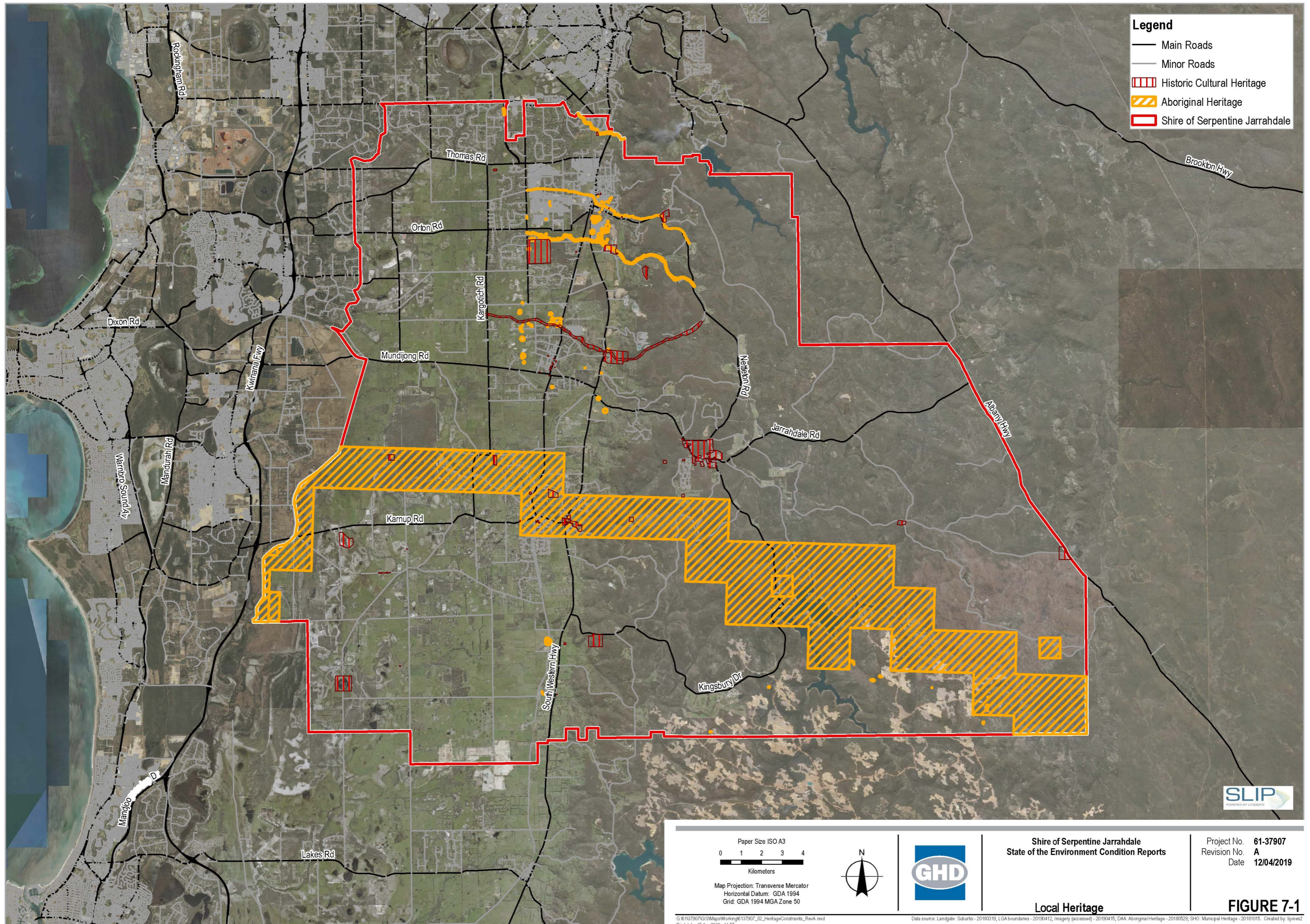
Cardup An Aboriginal name said to mean "place of the racehorse goanna"(Kurda)

Karrakup Derived from "Karrak" the Noongar word for red-tailed black cockatoo

Mardella A variant of the Aboriginal name of the nearby Medulla Brook

Mundijong Aboriginal name for the area

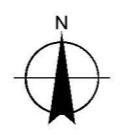
Beenyup Original name for Byford, meaning "place of water"



Legend

- Main Roads
- Minor Roads
- ▨ Historic Cultural Heritage
- ▨ Aboriginal Heritage
- ▭ Shire of Serpentine Jarrahdale

Paper Size ISO A3
 0 1 2 3 4
 Kilometers
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 50



Shire of Serpentine Jarrahdale
 State of the Environment Condition Reports

Project No. 61-37907
 Revision No. A
 Date 12/04/2019

Local Heritage

FIGURE 7-1

G:\6137907\GIS\Map\Working\6137907_02_HeritageConstraints_RevA.mxd Print date: 15 Apr 2019 - 11:57 Data source: Landgate: Suburbs - 20180319, LGA boundaries - 20190412, Imagery (accessed) - 20190415, DAA: Aboriginal Heritage - 20180529, SHO: Municipal Heritage - 20181015. Created by: bjones2

7.5.2 European Heritage

7.5.2.1 State Heritage Register

There are five (5) places currently on the State's Register of Heritage Places:

1. Serpentine General Store
2. Turner Cottage
3. Spencer's Cottage
4. Mill Manager's Residence
5. Whitby Falls Hostel (Figure 7-2)



Figure 7-2 Whitby Falls Hostel (Conservation Plan, Griffiths Architects 2013)

A further 25 places have been nominated for inclusion on the State Register, however, the assessments are still underway (Figure 7-1). Three sites have undergone preliminary review and do not warrant assessment for listing on the State's Register of Heritage Places.

7.5.2.2 Heritage List

Sites of historic, architectural, scientific, scenic or other value are provided statutory protection under the TPS2.

The sites are listed in Appendix 7 of TPS 2 and include:

- | | | | |
|-----|---|-----|---|
| 1. | Whitby Falls | 19. | Mundijong Railway Station
(Figure 7-3) |
| 2. | Whitby Falls Coach House | 20. | Keysbrook Farm House |
| 3. | Old Serpentine School | 21. | Old Bolinda Vale Farmhouse |
| 4. | Turner Cottage | 22. | St Stephens Church |
| 5. | Carralong Cottage | 23. | Lake View |
| 6. | Lowlands – including Thomas
Peels House | 24. | Millrace Farmhouse |
| 7. | Jarrahdale Timbertown | 25. | Wungong Farm Cottage |
| 8. | Former Catholic Convent and
Church | 26. | Bateman Homestead |
| 9. | Bucklands Cottage | 27. | Lazenby's Old Farmhouse |
| 10. | Chestnuts | 28. | Burnbrae Orphanage |
| 11. | Jarrahdale Tavern | 29. | Ye Old Serpentine Inn |
| 12. | Bishop Hale's Cottage | 30. | Old Cheese Factory |
| 13. | Stone Ruins | 31. | Yangedi Swamp |
| 14. | Gooralong Park and remains
of Flour Mill | 32. | Red Gum Patch |
| 15. | Baldwins Cottage | 33. | Manjedal Brook |
| 16. | Mundijong Tavern | 34. | Italian Prisoner of War Camp |
| 17. | Old Mundijong Hotel | 35. | Ivan Elliot's Shearing Shed |
| 18. | The Nook | 36. | Jarra Road Swamp |
| | | 37. | Flora Roads |



Figure 7-3 Mundijong Station (#19 on the Heritage List) (J. Austin, railheritagewa.org)

7.5.2.3 Municipal Inventory

There are 72 places listed on the Shire of Serpentine Jarrahdale's Municipal Inventory, 2000. The municipal inventory provides management categories for each site listed. Management categories have guided inclusion of sites in the Town Planning Scheme, development application decisions, development/design policies and referrals for sites to be included on the State Register.

The Shire's Municipal Heritage Register was reviewed and updated in 2000 to determine any changes to the places compared to 1995 when the inventory was initially prepared. The Municipal Heritage Register has not been reviewed since this time.

A full list of heritage sites, including those listed on the Municipal Inventory, is provided in Appendix E.

7.5.2.4 List of Classified Places

This list is maintained by the National Trust of Australia (WA), a non-profit, community-based organisation involved in heritage identification, education, promotion, interpretation, advocacy and management of heritage sites across WA. There are 29 places listed on the National Trust's List of Classified Places within the Shire (Appendix E).

7.5.3 Natural Heritage

Natural Heritage is protected within National Parks and conservation reserves. As detailed in Theme 4: Biodiversity, over 48,600 hectares of native vegetation (representing natural heritage) is protected in conservation reserves, state forest, regional parks, national parks and Bush Forever. This will further increase with the gazettal of Local Planning Scheme No.3 which includes a greater number of conservation reserves (Lowlands Nature Reserve).

The Serpentine National Park encompasses an area of 4,387 hectares and was proclaimed in 1957. This park protects the Serpentine Falls and Serpentine Dam, has Aboriginal Heritage values and is an important tourist destination.

The 37,477 hectares of native vegetation within areas zoned State forest are reserved for purposes including conservation, which provides some protection to natural heritage. Management activities within State forest and National Park areas must also protect and conserve Noongar culture and heritage (Conservation Commission of Western Australia, 2013).

There are four Shire reserves vested for the purpose of conservation/protection of flora and fauna (Shire of Serpentine Jarrahdale, 2009). This recognises the natural heritage values of these areas within the reserve purpose. In addition to this, 36 reserves are also managed for their conservation values and to protect the natural areas and habitat they provides.

Following the release of the Urban and Rural Forest Strategy, the Shire is updating and revising its Significant Tree Register. Residents who are aware of a tree in the Shire of Serpentine Jarrahdale that they think is special or significant can nominate it for assessment against the criteria for inclusion on the Shire's Significant Tree Register. Currently, 48 trees or patches have been nominated for inclusion on the register.

7.5.3.1 *Natural Beauty*

The rural character and natural beauty within the Shire is highly valued by its community. These areas are not always protected by National Parks or conservation reserves. Natural beauty in the Shire is protected and celebrated using the following mechanisms:

- Maintaining rural zonings
- Implementing LPP4.3 Landscape Protection Area Policy
- Implementing LPP4.13 Revegetation Policy
- Implementing LPP4.16 Landscape and Vegetation Policy
- Providing and promoting walk trails.

7.5.4 **Arts, Culture and Heritage Advisory Committee**

The Arts, Culture and Heritage Advisory Committee was established in November 2017 to provide advice to Council on matters of Arts, Culture and Heritage. The objectives for the committee are:

- To develop a Shire of Serpentine Jarrahdale Public Art Policy and to make recommendations to Council relating to its implementation.
- To develop a Shire of Serpentine Jarrahdale Local Heritage Strategy.
- To develop a Style Guide for signage.
- To liaise with stakeholders on matters relating to Arts, Heritage and Culture.
- To provide input and advice regarding the allocation of funds for arts, culture and heritage activities for the Shire's annual budget process.

This committee provides important input when considering the value of local heritage.

7.5.5 **Community grants**

The Shire's community grants program aims to provide financial assistance to incorporated not-for-profit organisations and the community for delivery of projects and events that align with a set of principles including "*celebrate diversity and cultural heritage*".

Over the past four years, the Shire has issued for community grants to heritage projects.

7.5.6 **Jarrahdale Heritage Society**

Jarrahdale Heritage Society Inc is a not-for-profit organisation that works to the preserve the natural and historic heritage in and around Jarrahdale: this includes a public museum and conducting guided heritage walks. The Shire supports the Heritage Society by promoting their events.

7.5.7 **Serpentine Heritage Society**

The Serpentine Historical Society was formed in 1996. This society has focussed on updating the Walking with Our Ancestors publication (available at Serpentine Cemetery), documenting donated photographs and encouraging school visits to the Old School Building and associated walk trails (Royal Western Australian Historical Society, 2019).

7.6 Pressures

7.6.1 Societal change

Indigenous heritage in Australia remains under pressure from loss of knowledge and tradition, despite resurgence and reconnection in some areas and communities. Intangible Indigenous culture also continues to be threatened by disconnection between people and place, loss of language, and discontinuation of cultural practices, particularly where changing values and expectations of the growing proportion of young Indigenous people may not align with traditional values or systems. This is an Australia-wide pressure but may have relevance within the Shire.

7.6.2 Population growth and urbanisation

Changes to population create pressure for change and development in urban areas. Development pressures create tension between economic values and cultural values. Both inconsistent decision-making and differing perceptions of heritage value between communities and governments can lead to statutes, policies and outcomes that adversely affect heritage. Individual sites may also be subject to neglect and vandalism or, conversely, damage from increased visitation.

Historic heritage is particularly at risk from pressures for redevelopment on both large and small scales. The impacts range from complete destruction to inappropriate change and adverse effects on associated attributes such as visual setting. Other pressures include those that arise from population shift, including redundancy, neglect and decay. However, there is also greater recognition of the value of historic buildings and opportunities that can be provided by their adaptive re-use. The decline in professional and trade skills in the historic heritage sector, and the ageing specialist workforce and rise of non-specialist tradespeople present a looming threat.

Indigenous sites continue to be threatened by incremental destruction associated with urban and industrial development.

7.6.3 Climate change

The effects of climate change may directly affect natural heritage through altered fire regimes, increased prevalence of invasive species and altered hydrology as described in Theme 4: Biodiversity. This may also affect Indigenous cultural heritage practices and alter historical land-use patterns, affecting sense of place and changing cultural landscapes. It is important when planning new development areas to consider Aboriginal heritage and historic land-use patterns.

7.7 Responses

7.7.1 Celebration of local heritage

The first timber mill was built in Jarrahdale on the banks of Gooralong Creek in May 1872, in the area now rehabilitated as Langford Park. By the mid-1880s, Jarrahdale was a flourishing town with an increasing population. The active community organised log chops and dances with musical entertainment becoming well established.

In March 2019, more than 800 people enjoyed a spectacular evening of opera under the stars at Jarrahdale Heritage Mill. The town of Jarrahdale is no stranger to opera, with The Opera Bouffe Company paying two visits to Jarrahdale in 1885, playing two nights in

Crock's Hall. They returned in January 1886, with Mr Crock building a substantial theatre and music hall between visits.

Events such as "Opera at the Mill" are a great opportunity to celebrate local heritage values and promote the Shire.

Ongoing celebration of natural heritage is supported through the establishment of walking trails and promotion of guided and self-guided walks in the region. The Shire supports the Jarrahdale Heritage Society by promoting the guided walks they offer.

7.7.2 Statutory and strategic frameworks

The Shire of Serpentine Jarrahdale has unique heritage values and a strong sense of place and it is important to protect these values. However, it is desirable to ensure that the planning requirements (through provisions in the local planning scheme) are not too onerous or prescriptive as this may create apathy and unwillingness to participate in the approvals process. This could then lead to development and upgrades not going ahead, contributing to the lack of improvement, heritage degradation or residents proceeding with unauthorised work.

Development of a Heritage Strategy may also improve the overarching guidance and direction for heritage protection within the Shire. This strategy should consider the Shire's heritage assets – Aboriginal, Historic and natural and should include:

- Review and update of the Municipal Inventory and Heritage List – ensure sites requiring planning protection are listed on the Heritage List and continue to list other sites worthy of heritage recognition through the Municipal Heritage Inventory
- Identify ways heritage assets can be conserved, interpreted, celebrated and (where culturally appropriate) promoted
- Review of sites under assessment for inclusion on the State Heritage Register. Forward any supporting documentation relating to these sites to the Department of Planning, Lands and Heritage to encourage and aid consideration and assessment for State listing
- Preserve historical settlement patterns and street configurations within the Byford Old Quarter and Mundijong townsite through structure plan provisions or a heritage policy that informs future structure planning.
- Consider how the expression of cultural heritage, art and history can be to be incorporated into the design of public open space and facilities
- Consider mechanisms to actively improve heritage values e.g. targeted grants.

7.7.3 Summary of responses

Response	Potential actions
7.4.1 Celebrate local heritage	Continue to support events that celebrate local heritage
7.4.2 Statutory and strategic frameworks	Develop a Heritage Strategy Review and update the Municipal Inventory and Heritage List Forward any additional information regarding sites under assessment for inclusion on the State Heritage Register to DPLH Preserve historical settlement patterns Incorporate cultural heritage in POS and facility design Consider mechanisms to actively improve heritage values

References (Heritage)

Conservation Commission of Western Australia, 2013. Forest management plan 2014–2023.

National Trust, 2019. Heritage Policies, Definition. Accessed 11 July 2019 from:
<https://www.nationaltrust.org.au/heritage-policies-wa>

Royal Western Australian Historical Society, Serpentine Historical Society webpage. Accessed 25 September 2019 <https://www.histwest.org.au/affiliated-societies/serpentine-historical-society>

Shire of Serpentine Jarrahdale, 2000. Municipal Heritage Inventory (Review).

Shire of Serpentine Jarrahdale, 1989. Shire of Serpentine Jarrahdale Town Planning Scheme No. 2 (updated 2019).

Western Australian Planning Commission (WAPC), 2007. State Planning Policy 3.5 Historic Heritage Conservation, Government of Western Australia.

Appendices

Appendix A – Basic Summary of Records – Contaminated Sites



Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:29:36PM, 24/07/2019

Receipt No:

ID No: 6218

Search Results

This response relates to a search request received for:

640 South Western Hwy
Byford, WA, 6122

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	640 South Western Hwy Byford, WA, 6122
Lot on Plan Address	Lot 2 On Diagram 35013
Parcel Status	<p>Classification: 23/08/2017 - Remediated for restricted use</p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol) are present in soils at depth (greater than 4 metres below ground level) beneath the north-east corner of the site.</p> <p>Hydrocarbons (such as from petrol) are present in groundwater beneath the north-east corner of the site as a plume which extends off-site in a north westerly direction.</p> <p>Restrictions on Use:</p> <p>The land use of the site is restricted to commercial/industrial use, which excludes sensitive uses with accessible soil such as childcare centres, kindergartens, pre-schools and primary schools. The site should not be developed for a more sensitive use such as recreational open space, residential use or childcare centres without further contamination assessment and/or remediation.</p> <p>The installation of permanent below ground voids such as basements and utility pits to depths greater than two metres below ground level is restricted without further assessment, and if necessary, management.</p> <p>A site-specific health and safety plan is required to address the risks to the health of workers undertaking intrusive works to depths greater than two metres below ground level.</p> <p>Other than for analytical testing or remediation, disturbance of hydrocarbon-impacted soils present at depths greater than four metres below ground level is restricted.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site due to the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was reported to the Department of Water and Environmental Regulation (DWER) prior to the</p>

Disclaimer

This Summary of Records has been prepared by Department of Water and Environmental Regulation (DWER) as a requirement of the Contaminated Sites Act 2003. DWER makes every effort to ensure the accuracy, currency and reliability of this information at the time it was prepared, however advises that due to the ability of contamination to potentially change in nature and extent over time, circumstances may have changed since the information was originally provided. Users must exercise their own skill and care when interpreting the information contained within this Summary of Records and, where applicable, obtain independent professional advice appropriate to their circumstances. In no event will DWER, its agents or employees be held responsible for any loss or damage arising from any use of or reliance on this information. Additionally, the Summary of Records must not be reproduced or supplied to third parties except in full and unabridged form.



Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:29:36PM, 24/07/2019

commencement of the 'Contaminated Sites Act 2003' (the Act). The site was first classified under section 13 of the Act based on information submitted to DWER by November 2007, with the reasons for classification updated in February 2012. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.

This site was historically used as a service station for approximately 45 years, from 1955 to 2000. This is a land use that has the potential to cause contamination, as specified in Appendix B of 'Assessment and management of contaminated sites' (Department of Environment Regulation 2014).

The site was reported because a contamination assessment undertaken in 1999 found that former underground fuel infrastructure had leaked, and that hydrocarbons (such as from petrol or diesel) were present in soil and groundwater beneath the site.

Soil remedial work was carried out in 2000 and 2003 comprising the excavation of hydrocarbon-impacted soil for off-site disposal or on-site bioremediation and re-use.

Soil investigations carried out at the site between 2003 and 2010 found that soils had been successfully remediated to a depth of 4 metres below ground surface. Hydrocarbons (such as from petrol or diesel) remained in soils more than 4 metres below the ground surface near the former underground storage tanks (USTs).

Groundwater investigations carried out at the site between 1999 and 2010 found hydrocarbons (such as from petrol) were present in groundwater beneath the site as a plume which extended off-site from the north east corner of the site in a north westerly direction.

The substances in soil and groundwater beneath the site were deemed to pose a potentially unacceptable human health risk via vapour inhalation. Soil vapour investigations carried out in 2008 and 2010 found hydrocarbon vapours were present in soils beneath the site.

A detailed risk assessment completed in 2010 concluded that restrictions on use of the site were necessary to manage potential vapour intrusion risks and prevent exposure to contaminated groundwater.

Soil and groundwater investigations, soil remedial work and risk assessment carried out at the site up until October 2010 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's assessment was documented in a mandatory auditor's report dated 28 October 2011. The auditor concluded that this site was suitable for its current use as residential land and road reserves provided restrictions on groundwater abstraction and intrusive works were in place.

Further groundwater investigations and risk assessment carried out between 2013 and 2016 have demonstrated that the plume is decreasing in size and concentrations through natural attenuation. Concentrations of hydrocarbons (such as from petrol) in groundwater beneath the north eastern corner of the site appear to have reduced to below health-based guidelines set for non-potable uses of groundwater such as groundwater irrigation but continue to pose a potential vapour intrusion risk for subsurface voids such as basements or utility pits that are greater than 2 metres deep. A site management plan (SMP) has been developed which sets out the ongoing monitoring that is required to address groundwater contamination at related affected sites.

The further investigations, risk assessment and site management plan completed between 2013 and 2016 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's review is documented in a mandatory auditor's report (MAR) dated 2 August 2017. The

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:29:36PM, 24/07/2019

auditor recommended that the site is suitable for restricted commercial/industrial land use and can be classified as 'remediated for restricted use' provided the auditor endorsed site management plan dated July 2017 is implemented. DWER accepts the findings of the auditor.

The site is contaminated and has been remediated such that it is suitable for restricted commercial/industrial land use, but may not be suitable for more sensitive land uses. Therefore, the site is classified as 'remediated for restricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination described in the Reasons for Classification.

Based on the available information, contamination present beneath this site has also been identified beyond the site boundary beneath the adjacent land, consistent with the definition of a "source site" specified in Part 1, Section 3 of the Act. In accordance with Regulation 31(1)(b) of the 'Contaminated Sites Regulations 2006', reports or information submitted to DWER that are relevant to the investigation, assessment, monitoring or remediation of a source site are required to be accompanied by a mandatory auditor's report (MAR) prepared by an accredited contaminated sites auditor.

Where the land is part of a transaction - sale, mortgagee or lease agreement, the land owners **MUST PROVIDE WRITTEN DISCLOSURE** (on the prescribed Form 6) of the site's status to any potential owner, mortgagee (e.g. financial institutions) or lessee at least 14 days before the completion of the transaction. A copy of the disclosure must also be forwarded to DWER.

Action Required:

The auditor endorsed site management plan dated July 2017 'Former Oakland service station (Q036), 640 South Western Highway, Byford, Western Australia - site management plan' is to be implemented and will apply to the site until further notice.

Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.
Current Regulatory Notice Issued	Type of Regulatory Notice: <i>Nil</i> Date Issued: <i>Nil</i>
General	No other information relating to this parcel.

Disclaimer
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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:16:21PM, 24/07/2019

Receipt No:

ID No: 12570

Search Results

This response relates to a search request received for:

2 Jarrahdale Rd
Jarrahdale, WA, 6124

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	2 Jarrahdale Rd Jarrahdale, WA, 6124
Lot on Plan Address	Lot 269 On Plan 226157
Parcel Status	<p>Classification: 02/12/2015 - <i>Contaminated - restricted use</i></p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol/oil/diesel) are present in groundwater beneath the forecourt and extending to the west/northwest of the site. Light non-aqueous phase liquid (LNAPL) (e.g. pure petrol or diesel) is present in the vicinity of former tank infrastructure. Hydrocarbon-impacted soil is present in the smear zone of the seasonally fluctuating impacted groundwater.</p> <p>Restrictions on Use:</p> <p>The land use of the site is restricted to commercial/industrial use in the current site configuration; which excludes sensitive uses with accessible soil such as childcare centres, kindergartens, pre-schools and primary schools. The site should not be developed for a more sensitive use such as recreational open space; residential use or childcare centres without further contamination assessment and/or remediation.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was reported to the Department of Environment Regulation (DER) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003' (the Act), which commenced on 1 December 2006.</p> <p>The site was first classified under section 13 of the Act based on information submitted to DER by January 2007. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DER by December 2015.</p> <p>The site was reported because a contamination assessment, undertaken in 2007, found hydrocarbons in soil and groundwater.</p>

Disclaimer

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:16:21PM, 24/07/2019

This site was used as a service station, for approximately 50 years, from 1960 to 2006. This is a land use that has the potential to cause contamination, as specified in the guideline 'Assessment and Management of Contaminated Sites' (2014).

A contamination assessment and tank integrity tests were carried out in 2006 as part of the lease termination agreement for the site. Tank integrity tests indicated failures to all tanks and a diesel vacuum line.

The assessment found that hydrocarbons (such as from petrol) were present in soils at concentrations exceeding Ecological Investigation Levels and possibly Health-based Investigation Levels for commercial and industrial sites, as published in 'Assessment Levels for Soil, Sediment and Water' Department of Environment, (2003), which were the applicable guidelines at the time. The soil impact was present adjacent to the north-western diesel bowser and remote fill points.

Hydrocarbons such as from petrol were present in groundwater at elevated concentrations. Light non-aqueous phase liquid (LNAPL) were present on groundwater beneath the site (e.g. liquid petrol and/or diesel was observed floating on the surface of groundwater). The groundwater impact was present as a plume that extends beneath the north-western part of the site and off-site in a westerly direction.

The most recent assessments between 2012 and 2015 found that hydrocarbons (such as from petrol) were present in groundwater at concentrations exceeding assessment levels for non-potable use of groundwater, as published in the 'Assessment and management of contaminated sites' (DER 2014). These criteria are relevant because of the presence of groundwater abstraction bores within the vicinity of the site.

LNAPL has been identified since monitoring commenced in 2006, the apparent thickness has slowly reduced over time from its maximum recorded thickness of 1.6m (May 2012) to less than 0.2m in October 2014.

Hydrocarbon vapours (such as from petrol) were present in sub-surface soils (1-2m) at concentrations exceeding the relevant soil vapour Health Screening Levels for vapour intrusion on commercial/industrial land as published in the 'National Environment Protection (Assessment of Site Contamination) Measure 1999' (the NEPM). (No exceedances were detected in soil vapour bores in proximity to site infrastructure and no exceedances were identified in shallow soils.)

Groundwater was remediated by the use of monitored natural attenuation. Primary lines of evidence demonstrate an overall reducing plume and secondary lines of evidence indicate natural attenuation processes are active.

A risk assessment has indicated that the contamination present on the site does not currently pose an unacceptable risk to human health, the environment or environmental values under the current commercial/industrial land use. However, the contamination may present an unacceptable risk to human health under a more sensitive land use.

The investigations and risk assessment works were the subject of an independent review by an accredited contaminated sites auditor who provided a mandatory auditor's report (MAR) dated November 2015. The MAR recommended that the site is suitable for ongoing commercial/industrial land use in the current site configuration, however, further assessment of potential contamination should be undertaken before any change to a more sensitive land use (e.g. residential housing,

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:16:21PM, 24/07/2019

childcare centres) or before any changes to site configuration. DER accepts the findings of the MAR..

As the site, although contaminated, is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the site has been classified as 'contaminated - restricted use'.

A memorial stating the site's classification has been placed on the certificate of title, and will trigger the need for further investigations and risk assessment should the site be proposed for a more sensitive land use.

DER, in consultation with the Department of Health, has classified this site based on the information available to DER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Based on the available information, contamination present on this site has also been identified beyond the site boundary on adjacent land, and as such, DER considers this site meets the definition of a "source site" as specified in Part 1, Section 3 of the Act. I

Action Required:

If the site is proposed to be developed for a more sensitive land use, or changes to the site configuration are proposed, further assessment of contamination should be undertaken to ensure the site is suitable for the proposed land use.

Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this site has been classified as "contaminated - restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Environment Regulation.
Current Regulatory Notice Issued	Type of Regulatory Notice: <i>Nil</i> Date Issued: <i>Nil</i>
General	No other information relating to this parcel.

Disclaimer

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:17:12PM, 24/07/2019

Receipt No:

ID No: 13458

Search Results

This response relates to a search request received for:

2428 South Western Hwy
Serpentine, WA, 6125

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	2428 South Western Hwy Serpentine, WA, 6125
Lot on Plan Address	Lot 135 On Plan 156250
Parcel Status	<p>Classification: 05/09/2011 - <i>Remediated for restricted use</i></p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol or diesel) have been found in groundwater beneath the site.</p> <p>Restrictions on Use:</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater impacts.</p> <p>Reason for Classification:</p> <p>This site was reported to the Department of Environment and Conservation (DEC) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003', which commenced on 1 December 2006. The site classification is based on information submitted to DEC by August 2011.</p> <p>This site has been used as a service station for approximately 50 years, a land use that has the potential to cause contamination, as specified in the guideline 'Potentially Contaminating Activities, Industries and Landuses' (Department of Environment, 2004). The site lies within an area zoned 'rural' under the Metropolitan Region Scheme.</p> <p>Investigations were carried out in 2006 and 2010 to determine if the site had been contaminated by past or current activities. The 2006 investigation found that hydrocarbons and heavy metals were present in soils at concentrations exceeding ecological investigation levels and health-based investigation levels for residential land use with gardens/accessible soil, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment, 2003).</p> <p>Hydrocarbons were present in groundwater in 2006 at concentrations exceeding the intervention 'B' values as published in 'Circular on Target Values and Intervention Values for Soil Remediation (Netherlands Ministry of Housing, Spatial Planning and the Environment, 2000) and the guidelines for non-potable groundwater use as published in 'Contaminated Sites Reporting Guideline for Chemicals in Groundwater' (Department of Health, 2006). Further groundwater monitoring in 2010 did not detect</p>

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:17:12PM, 24/07/2019

	<p>hydrocarbons above laboratory limits of reporting. However, DEC notes that the construction of three of the groundwater monitoring wells is not suitable for the detection of hydrocarbon contamination.</p> <p>Metals were present in groundwater in 2006 and 2010 at concentrations exceeding hardness-modified trigger values for freshwater ecosystems, as published in 'Australian Water Quality Guidelines for Fresh and Marine Water Quality' (ANZECC & ARMCANZ, 2000).</p> <p>Underground storage tanks and related infrastructure were removed from the site in 2011 and soils around the tanks were remediated by excavation and off-site disposal. Validation of excavations indicated that all identified impacted soils were successfully remediated.</p> <p>Based on the information provided, soil has been remediated such that the site is suitable for all land uses, including residential land use. However, due to the groundwater impacts identified at the site, the abstraction of groundwater is not permitted, and the site has been classified as 'remediated for restricted use'.</p> <p>DEC, in consultation with Department of Health, has classified this site based on the information available to DEC at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DEC, and as such, the usefulness of this information may be limited.</p>
Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact the Contaminated Sites Branch of the Department of Environment & Conservation.
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: <i>Nil</i></p> <p>Date Issued: <i>Nil</i></p>
General	No other information relating to this parcel.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:15:54PM, 24/07/2019

Receipt No:

ID No: 20134

Search Results

This response relates to a search request received for:

South Western Hwy
Jarrahdale, WA, 6124

Approximate spatial representation of section of road reserve on South Western Highway, adjacent to 2 Jarrahdale Rd,
Jarrahdale WA 6124 (Landgate PIN 1160 9902)

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address

South Western Hwy
Jarrahdale, WA, 6124
Approximate spatial representation of section of road reserve on South Western Highway, adjacent to

Parcel Status

Classification: 02/12/2015 - *Remediated for restricted use*

Nature and Extent of Contamination:

Hydrocarbons (such as from petrol/oil/diesel) are present in groundwater beneath the South Western Highway road reserve.

Restrictions on Use:

The land use of the site is restricted to road reserve use; which excludes sensitive uses with accessible soil such as childcare centres, kindergartens, pre-schools and primary schools. The site should not be developed for a more sensitive use such as recreational open space; residential use or childcare centres without further contamination assessment and/or remediation.

Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.

Reason for Classification:

Information relating to the road reserve (the site) was submitted to the Department of Environment Regulation (DER) following a contamination assessment at an adjacent service station at 2 Jarrahdale Road, Jarrahdale. The site was first classified under section 13 of the Act based on information submitted to DER by January 2007. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DER by November 2015.

This site consists of 100m of road reserve on the South Western Highway at the junction of Jarrahdale Road and Shanley Road in Jarrahdale, This site was reported because a contamination assessment in 2006 found hydrocarbons (such as from petrol) present in soil and groundwater at the adjacent service station extended beyond the boundaries to this site. The service station to the east of the site is a land use that has the potential to cause contamination, as specified in the guideline 'Assessment and Management of Contaminated Sites' (2014).

A contamination assessment was carried out in 2006 as part of the lease termination agreement for

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:29:36PM, 24/07/2019

Receipt No:

ID No: 6218

Search Results

This response relates to a search request received for:

640 South Western Hwy
Byford, WA, 6122

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	640 South Western Hwy Byford, WA, 6122
Lot on Plan Address	Lot 2 On Diagram 35013
Parcel Status	<p>Classification: 23/08/2017 - <i>Remediated for restricted use</i></p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol) are present in soils at depth (greater than 4 metres below ground level) beneath the north-east corner of the site.</p> <p>Hydrocarbons (such as from petrol) are present in groundwater beneath the north-east corner of the site as a plume which extends off-site in a north westerly direction.</p> <p>Restrictions on Use:</p> <p>The land use of the site is restricted to commercial/industrial use, which excludes sensitive uses with accessible soil such as childcare centres, kindergartens, pre-schools and primary schools. The site should not be developed for a more sensitive use such as recreational open space, residential use or childcare centres without further contamination assessment and/or remediation.</p> <p>The installation of permanent below ground voids such as basements and utility pits to depths greater than two metres below ground level is restricted without further assessment, and if necessary, management.</p> <p>A site-specific health and safety plan is required to address the risks to the health of workers undertaking intrusive works to depths greater than two metres below ground level.</p> <p>Other than for analytical testing or remediation, disturbance of hydrocarbon-impacted soils present at depths greater than four metres below ground level is restricted.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site due to the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was reported to the Department of Water and Environmental Regulation (DWER) prior to the</p>

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:29:36PM, 24/07/2019

commencement of the 'Contaminated Sites Act 2003' (the Act). The site was first classified under section 13 of the Act based on information submitted to DWER by November 2007, with the reasons for classification updated in February 2012. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.

This site was historically used as a service station for approximately 45 years, from 1955 to 2000. This is a land use that has the potential to cause contamination, as specified in Appendix B of 'Assessment and management of contaminated sites' (Department of Environment Regulation 2014).

The site was reported because a contamination assessment undertaken in 1999 found that former underground fuel infrastructure had leaked, and that hydrocarbons (such as from petrol or diesel) were present in soil and groundwater beneath the site.

Soil remedial work was carried out in 2000 and 2003 comprising the excavation of hydrocarbon-impacted soil for off-site disposal or on-site bioremediation and re-use.

Soil investigations carried out at the site between 2003 and 2010 found that soils had been successfully remediated to a depth of 4 metres below ground surface. Hydrocarbons (such as from petrol or diesel) remained in soils more than 4 metres below the ground surface near the former underground storage tanks (USTs).

Groundwater investigations carried out at the site between 1999 and 2010 found hydrocarbons (such as from petrol) were present in groundwater beneath the site as a plume which extended off-site from the north east corner of the site in a north westerly direction.

The substances in soil and groundwater beneath the site were deemed to pose a potentially unacceptable human health risk via vapour inhalation. Soil vapour investigations carried out in 2008 and 2010 found hydrocarbon vapours were present in soils beneath the site.

A detailed risk assessment completed in 2010 concluded that restrictions on use of the site were necessary to manage potential vapour intrusion risks and prevent exposure to contaminated groundwater.

Soil and groundwater investigations, soil remedial work and risk assessment carried out at the site up until October 2010 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's assessment was documented in a mandatory auditor's report dated 28 October 2011. The auditor concluded that this site was suitable for its current use as residential land and road reserves provided restrictions on groundwater abstraction and intrusive works were in place.

Further groundwater investigations and risk assessment carried out between 2013 and 2016 have demonstrated that the plume is decreasing in size and concentrations through natural attenuation. Concentrations of hydrocarbons (such as from petrol) in groundwater beneath the north eastern corner of the site appear to have reduced to below health-based guidelines set for non-potable uses of groundwater such as groundwater irrigation but continue to pose a potential vapour intrusion risk for subsurface voids such as basements or utility pits that are greater than 2 metres deep. A site management plan (SMP) has been developed which sets out the ongoing monitoring that is required to address groundwater contamination at related affected sites.

The further investigations, risk assessment and site management plan completed between 2013 and 2016 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's review is documented in a mandatory auditor's report (MAR) dated 2 August 2017. The

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Contaminated Sites Act 2003 **Basic Summary of Records Search Response**

Report generated at 06:29:36PM, 24/07/2019

auditor recommended that the site is suitable for restricted commercial/industrial land use and can be classified as 'remediated for restricted use' provided the auditor endorsed site management plan dated July 2017 is implemented. DWER accepts the findings of the auditor.

The site is contaminated and has been remediated such that it is suitable for restricted commercial/industrial land use, but may not be suitable for more sensitive land uses. Therefore, the site is classified as 'remediated for restricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination described in the Reasons for Classification.

Based on the available information, contamination present beneath this site has also been identified beyond the site boundary beneath the adjacent land, consistent with the definition of a "source site" specified in Part 1, Section 3 of the Act. In accordance with Regulation 31(1)(b) of the 'Contaminated Sites Regulations 2006', reports or information submitted to DWER that are relevant to the investigation, assessment, monitoring or remediation of a source site are required to be accompanied by a mandatory auditor's report (MAR) prepared by an accredited contaminated sites auditor.

Where the land is part of a transaction - sale, mortgagee or lease agreement, the land owners **MUST PROVIDE WRITTEN DISCLOSURE** (on the prescribed Form 6) of the site's status to any potential owner, mortgagee (e.g. financial institutions) or lessee at least 14 days before the completion of the transaction. A copy of the disclosure must also be forwarded to DWER.

Action Required:

The auditor endorsed site management plan dated July 2017 'Former Oakland service station (Q036), 640 South Western Highway, Byford, Western Australia - site management plan' is to be implemented and will apply to the site until further notice.

Certificate of Title Memorial

Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.

Current Regulatory Notice Issued

Type of Regulatory Notice: *Nil*
Date Issued: *Nil*

General

No other information relating to this parcel.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:16:21PM, 24/07/2019

Receipt No:

ID No: 12570

Search Results

This response relates to a search request received for:

2 Jarrahdale Rd
Jarrahdale, WA, 6124

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	2 Jarrahdale Rd Jarrahdale, WA, 6124
Lot on Plan Address	Lot 269 On Plan 226157
Parcel Status	<p>Classification: 02/12/2015 - <i>Contaminated - restricted use</i></p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol/oil/diesel) are present in groundwater beneath the forecourt and extending to the west/northwest of the site. Light non-aqueous phase liquid (LNAPL) (e.g. pure petrol or diesel) is present in the vicinity of former tank infrastructure. Hydrocarbon-impacted soil is present in the smear zone of the seasonally fluctuating impacted groundwater.</p> <p>Restrictions on Use:</p> <p>The land use of the site is restricted to commercial/industrial use in the current site configuration; which excludes sensitive uses with accessible soil such as childcare centres, kindergartens, pre-schools and primary schools. The site should not be developed for a more sensitive use such as recreational open space; residential use or childcare centres without further contamination assessment and/or remediation.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was reported to the Department of Environment Regulation (DER) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003' (the Act), which commenced on 1 December 2006.</p> <p>The site was first classified under section 13 of the Act based on information submitted to DER by January 2007. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DER by December 2015.</p> <p>The site was reported because a contamination assessment, undertaken in 2007, found hydrocarbons in soil and groundwater.</p>

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:16:21PM, 24/07/2019

This site was used as a service station, for approximately 50 years, from 1960 to 2006. This is a land use that has the potential to cause contamination, as specified in the guideline 'Assessment and Management of Contaminated Sites' (2014).

A contamination assessment and tank integrity tests were carried out in 2006 as part of the lease termination agreement for the site. Tank integrity tests indicated failures to all tanks and a diesel vacuum line.

The assessment found that hydrocarbons (such as from petrol) were present in soils at concentrations exceeding Ecological Investigation Levels and possibly Health-based Investigation Levels for commercial and industrial sites, as published in 'Assessment Levels for Soil, Sediment and Water' Department of Environment, (2003), which were the applicable guidelines at the time. The soil impact was present adjacent to the north-western diesel bowser and remote fill points.

Hydrocarbons such as from petrol were present in groundwater at elevated concentrations. Light non-aqueous phase liquid (LNAPL) were present on groundwater beneath the site (e.g. liquid petrol and/or diesel was observed floating on the surface of groundwater). The groundwater impact was present as a plume that extends beneath the north-western part of the site and off-site in a westerly direction.

The most recent assessments between 2012 and 2015 found that hydrocarbons (such as from petrol) were present in groundwater at concentrations exceeding assessment levels for non-potable use of groundwater, as published in the 'Assessment and management of contaminated sites' (DER 2014). These criteria are relevant because of the presence of groundwater abstraction bores within the vicinity of the site.

LNAPL has been identified since monitoring commenced in 2006, the apparent thickness has slowly reduced over time from its maximum recorded thickness of 1.6m (May 2012) to less than 0.2m in October 2014.

Hydrocarbon vapours (such as from petrol) were present in sub-surface soils (1-2m) at concentrations exceeding the relevant soil vapour Health Screening Levels for vapour intrusion on commercial/industrial land as published in the 'National Environment Protection (Assessment of Site Contamination) Measure 1999' (the NEPM). (No exceedances were detected in soil vapour bores in proximity to site infrastructure and no exceedances were identified in shallow soils.)

Groundwater was remediated by the use of monitored natural attenuation. Primary lines of evidence demonstrate an overall reducing plume and secondary lines of evidence indicate natural attenuation processes are active.

A risk assessment has indicated that the contamination present on the site does not currently pose an unacceptable risk to human health, the environment or environmental values under the current commercial/industrial land use. However, the contamination may present an unacceptable risk to human health under a more sensitive land use.

The investigations and risk assessment works were the subject of an independent review by an accredited contaminated sites auditor who provided a mandatory auditor's report (MAR) dated November 2015. The MAR recommended that the site is suitable for ongoing commercial/industrial land use in the current site configuration, however, further assessment of potential contamination should be undertaken before any change to a more sensitive land use (e.g. residential housing,

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:16:21PM, 24/07/2019

childcare centres) or before any changes to site configuration. DER accepts the findings of the MAR..

As the site, although contaminated, is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the site has been classified as 'contaminated - restricted use'.

A memorial stating the site's classification has been placed on the certificate of title, and will trigger the need for further investigations and risk assessment should the site be proposed for a more sensitive land use.

DER, in consultation with the Department of Health, has classified this site based on the information available to DER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Based on the available information, contamination present on this site has also been identified beyond the site boundary on adjacent land, and as such, DER considers this site meets the definition of a "source site" as specified in Part 1, Section 3 of the Act. I

Action Required:

If the site is proposed to be developed for a more sensitive land use, or changes to the site configuration are proposed, further assessment of contamination should be undertaken to ensure the site is suitable for the proposed land use.

Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this site has been classified as "contaminated - restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Environment Regulation.
Current Regulatory Notice Issued	Type of Regulatory Notice: <i>Nil</i> Date Issued: <i>Nil</i>
General	No other information relating to this parcel.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:17:12PM, 24/07/2019

Receipt No:

ID No: 13458

Search Results

This response relates to a search request received for:

2428 South Western Hwy
Serpentine, WA, 6125

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	2428 South Western Hwy Serpentine, WA, 6125
Lot on Plan Address	Lot 135 On Plan 156250
Parcel Status	<p>Classification: 05/09/2011 - <i>Remediated for restricted use</i></p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol or diesel) have been found in groundwater beneath the site.</p> <p>Restrictions on Use:</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater impacts.</p> <p>Reason for Classification:</p> <p>This site was reported to the Department of Environment and Conservation (DEC) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003', which commenced on 1 December 2006. The site classification is based on information submitted to DEC by August 2011.</p> <p>This site has been used as a service station for approximately 50 years, a land use that has the potential to cause contamination, as specified in the guideline 'Potentially Contaminating Activities, Industries and Landuses' (Department of Environment, 2004). The site lies within an area zoned 'rural' under the Metropolitan Region Scheme.</p> <p>Investigations were carried out in 2006 and 2010 to determine if the site had been contaminated by past or current activities. The 2006 investigation found that hydrocarbons and heavy metals were present in soils at concentrations exceeding ecological investigation levels and health-based investigation levels for residential land use with gardens/accessible soil, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment, 2003).</p> <p>Hydrocarbons were present in groundwater in 2006 at concentrations exceeding the intervention 'B' values as published in 'Circular on Target Values and Intervention Values for Soil Remediation (Netherlands Ministry of Housing, Spatial Planning and the Environment, 2000) and the guidelines for non-potable groundwater use as published in 'Contaminated Sites Reporting Guideline for Chemicals in Groundwater' (Department of Health, 2006). Further groundwater monitoring in 2010 did not detect</p>

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:15:54PM, 24/07/2019

Receipt No:

ID No: 20134

Search Results

This response relates to a search request received for:

South Western Hwy
Jarrahdale, WA, 6124

Approximate spatial representation of section of road reserve on South Western Highway, adjacent to 2 Jarrahdale Rd,
Jarrahdale WA 6124 (Landgate PIN 1160 9902)

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address

South Western Hwy
Jarrahdale, WA, 6124
Approximate spatial representation of section of road reserve on South Western Highway, adjacent to

Parcel Status

Classification: 02/12/2015 - *Remediated for restricted use*

Nature and Extent of Contamination:

Hydrocarbons (such as from petrol/oil/diesel) are present in groundwater beneath the South Western Highway road reserve.

Restrictions on Use:

The land use of the site is restricted to road reserve use; which excludes sensitive uses with accessible soil such as childcare centres, kindergartens, pre-schools and primary schools. The site should not be developed for a more sensitive use such as recreational open space; residential use or childcare centres without further contamination assessment and/or remediation.

Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site because of the nature and extent of groundwater contamination.

Reason for Classification:

Information relating to the road reserve (the site) was submitted to the Department of Environment Regulation (DER) following a contamination assessment at an adjacent service station at 2 Jarrahdale Road, Jarrahdale. The site was first classified under section 13 of the Act based on information submitted to DER by January 2007. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DER by November 2015.

This site consists of 100m of road reserve on the South Western Highway at the junction of Jarrahdale Road and Shanley Road in Jarrahdale, This site was reported because a contamination assessment in 2006 found hydrocarbons (such as from petrol) present in soil and groundwater at the adjacent service station extended beyond the boundaries to this site. The service station to the east of the site is a land use that has the potential to cause contamination, as specified in the guideline 'Assessment and Management of Contaminated Sites' (2014).

A contamination assessment was carried out in 2006 as part of the lease termination agreement for

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:15:54PM, 24/07/2019

the up-gradient service station site. The assessment found that hydrocarbons (such as from petrol) were present in groundwater at elevated concentrations. The groundwater impact was present as a plume that extended beneath the north-western part of the service station lot and off-site in a westerly direction beneath the road reserve.

The most recent assessments between 2012 and 2015 found that hydrocarbons (such as from petrol/diesel/oil) were present in soils at concentrations exceeding Ecological Investigation Levels, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment and Conservation, 2010).

Hydrocarbons (such as from petrol) were present in groundwater at concentrations exceeding assessment levels for non-potable use of groundwater, as published in the 'Assessment and management of contaminated sites' (DER 2014). These criteria are relevant because of the presence of groundwater abstraction bores within the vicinity of the site.

Groundwater was remediated by the use of monitored natural attenuation. Primary lines of evidence demonstrate an overall reducing plume and secondary lines of evidence indicate natural attenuation processes are active.

A risk assessment in 2015 has indicated that the contamination present on the site does not currently pose an unacceptable risk to human health, the environment or environmental values under the current land use of road reserve. However, the contamination may present an unacceptable risk to human health under a more sensitive land use.

The investigations and risk assessment works were the subject of an independent review by an accredited contaminated sites auditor who provided a mandatory auditor's report (MAR) dated November 2015. The MAR recommended that the site is suitable for continued use as a road reserve, however, further assessment of potential contamination should be undertaken before any change to a more sensitive land use (e.g. residential housing, childcare centres). DER accepts the findings of the MAR.

Based on the information provided, the site appears suitable for continued road reserve use, but may not be suitable for more sensitive land uses (such as residential housing, child care centres).

As the site is contaminated and has been remediated such that it is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the site is classified as 'remediated for restricted use'.

DER, in consultation with the Department of Health, has classified this site based on the information available to DER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Based on the available information, contamination present on this site has originated from the adjacent land at Lot 269 on Plan 248364, which has been classified separately under the CS Act. As such, DER considers this site meets the definition of an "affected site" as specified in Part 1, Section 3 of the Act. Under the Act, the person responsible for the remediation of a source site is also responsible for remediation of any related affected sites.

Disclaimer

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	<p>Action Required:</p> <p>If the site is proposed to be developed for a more sensitive land use further assessment of contamination should be undertaken to ensure the site is suitable for the proposed land use.</p>
Certificate of Title Memorial	<p>Under the Contaminated Sites Act 2003, this Site has been classified as "Contaminated - remediation required". For further information on the contamination status of this Site, please contact the Contaminated Sites section of the Department of Environment & Conservation.</p>
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: <i>Nil</i></p> <p>Date Issued: <i>Nil</i></p>
General	<p>No other information relating to this parcel.</p>

Disclaimer

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:13:50PM, 24/07/2019

Receipt No:

ID No: 42429

Search Results

This response relates to a search request received for:

49 Aquanita Rise
Darling Downs, WA, 6122

This parcel belongs to a site that contains 5 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	49 Aquanita Rise Darling Downs, WA, 6122
Lot on Plan Address	Lot 215 On Plan 51299
Parcel Status	<p>Classification: 23/08/2017 - Remediated for restricted use</p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol) are present in groundwater beneath the adjacent former service station as a plume which extends to beneath this site.</p> <p>Restrictions on Use:</p> <p>The installation of permanent below ground voids such as basements and utility pits to depths greater than two metres below ground level is restricted without further assessment, and if necessary, management.</p> <p>A site-specific health and safety plan is required to address the risks to the health of workers undertaking intrusive works to depths greater than two metres below ground level.</p> <p>Other than for analytical testing or remediation, disturbance of hydrocarbon-impacted soils present at depths greater than four metres below ground level is restricted.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site due to the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was originally reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act), and was reported again as per reporting obligations under section 11 of the Act, which commenced on 1 December 2006.</p> <p>The site was first classified under section 13 of the Act based on information submitted to DWER by April 2007, with the reasons for classification updated in August 2012. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.</p>

Disclaimer

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:13:50PM, 24/07/2019

This site is located north of 640 South Western Highway Byford which was historically used as a service station for approximately 45 years, from 1955 to 2000. A service station is a land use that has the potential to cause contamination, as specified in Appendix B of 'Assessment and management of contaminated sites' (Department of Environment Regulation 2014).

The site was reported because contamination assessments undertaken between 2003 and 2008 established that hydrocarbons (such as from petrol) present in groundwater beneath the service station were present as a plume which extended approximately 250 metres north west from the service station to beneath this site.

The substances in groundwater beneath the site were deemed to pose a potentially unacceptable human health risk via vapour inhalation and direct contact. Soil vapour investigations carried out in 2008 and 2010 found hydrocarbon vapours were present in soils beneath the site.

A detailed risk assessment completed in 2010 concluded that restrictions on use of the site were necessary to manage potential vapour intrusion risks and prevent exposure to contaminated groundwater.

Soil vapour and groundwater investigations and risk assessment carried out at the site up until October 2010 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's assessment was documented in a mandatory auditor's report dated 28 October 2011. The auditor concluded that this site was suitable for its current use as residential land and road reserves provided restrictions on groundwater abstraction and intrusive works were in place.

Further groundwater investigations and risk assessment carried out between 2013 and 2016 have demonstrated that natural attenuation of hydrocarbons in groundwater is occurring and the plume is decreasing in size and concentrations. Hydrocarbons remain in groundwater at concentrations exceeding non-potable use guidelines as specified in 'Assessment and management of contaminated sites' (DER 2014) and have the potential to pose a vapour intrusion risk for subsurface voids such as basements or utility pits that are greater than 2 metres deep.

The further groundwater investigations and risk assessment carried out between 2013 and 2016 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's review is documented in a mandatory auditor's report (MAR) dated 2 August 2017. The auditor recommended that the site is suitable for restricted residential land use and can be classified as 'remediated for restricted use' provided the auditor endorsed site management plan dated July 2017 is implemented. DWER accepts the findings of the auditor.

The site is contaminated and has been remediated such that it is suitable for the current land use provided restrictions on use are in place. Therefore, the site is classified as 'remediated for restricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination

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Contaminated Sites Act 2003 **Basic Summary of Records Search Response**

Report generated at 06:13:51PM, 24/07/2019

	<p>described in the Reasons for Classification.</p> <p>Based on the available information, contamination present on this site has originated from the adjacent land at 640 South Western Highway, which has been classified separately under the CS Act. Therefore this site is consistent with the definition of an "affected site" as specified in Part 1, Section 3 of the Act. Under the Act, the person responsible for the remediation of a source site is also responsible for remediation of any related affected sites.</p> <p>Where the land is part of a transaction - sale, mortgagee or lease agreement, the land owners MUST PROVIDE WRITTEN DISCLOSURE (on the prescribed Form 6) of the site's status to any potential owner, mortgagee (e.g. financial institutions) or lessee at least 14 days before the completion of the transaction. A copy of the disclosure must also be forwarded to DWER.</p> <p>Action Required:</p> <p>The auditor endorsed site management plan dated July 2017 'Former Oakland service station (Q036), 640 South Western Highway, Byford, Western Australia - site management plan' is to be implemented and will apply to the site until further notice.</p>
Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: <i>Nil</i></p> <p>Date Issued: <i>Nil</i></p>
General	No other information relating to this parcel.

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:15:54PM, 24/07/2019

the up-gradient service station site. The assessment found that hydrocarbons (such as from petrol) were present in groundwater at elevated concentrations. The groundwater impact was present as a plume that extended beneath the north-western part of the service station lot and off-site in a westerly direction beneath the road reserve.

The most recent assessments between 2012 and 2015 found that hydrocarbons (such as from petrol/diesel/oil) were present in soils at concentrations exceeding Ecological Investigation Levels, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment and Conservation, 2010).

Hydrocarbons (such as from petrol) were present in groundwater at concentrations exceeding assessment levels for non-potable use of groundwater, as published in the 'Assessment and management of contaminated sites' (DER 2014). These criteria are relevant because of the presence of groundwater abstraction bores within the vicinity of the site.

Groundwater was remediated by the use of monitored natural attenuation. Primary lines of evidence demonstrate an overall reducing plume and secondary lines of evidence indicate natural attenuation processes are active.

A risk assessment in 2015 has indicated that the contamination present on the site does not currently pose an unacceptable risk to human health, the environment or environmental values under the current land use of road reserve. However, the contamination may present an unacceptable risk to human health under a more sensitive land use.

The investigations and risk assessment works were the subject of an independent review by an accredited contaminated sites auditor who provided a mandatory auditor's report (MAR) dated November 2015. The MAR recommended that the site is suitable for continued use as a road reserve, however, further assessment of potential contamination should be undertaken before any change to a more sensitive land use (e.g. residential housing, childcare centres). DER accepts the findings of the MAR.

Based on the information provided, the site appears suitable for continued road reserve use, but may not be suitable for more sensitive land uses (such as residential housing, child care centres).

As the site is contaminated and has been remediated such that it is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the site is classified as 'remediated for restricted use'.

DER, in consultation with the Department of Health, has classified this site based on the information available to DER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Based on the available information, contamination present on this site has originated from the adjacent land at Lot 269 on Plan 248364, which has been classified separately under the CS Act. As such, DER considers this site meets the definition of an "affected site" as specified in Part 1, Section 3 of the Act. Under the Act, the person responsible for the remediation of a source site is also responsible for remediation of any related affected sites.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:15:54PM, 24/07/2019

	Action Required: If the site is proposed to be developed for a more sensitive land use further assessment of contamination should be undertaken to ensure the site is suitable for the proposed land use.
Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this Site has been classified as "Contaminated - remediation required". For further information on the contamination status of this Site, please contact the Contaminated Sites section of the Department of Environment & Conservation.
Current Regulatory Notice Issued	Type of Regulatory Notice: <i>Nil</i> Date Issued: <i>Nil</i>
General	No other information relating to this parcel.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:13:50PM, 24/07/2019

<i>Receipt No:</i>

<i>ID No:</i> 42429

Search Results

This response relates to a search request received for:

49 Aquanita Rise
Darling Downs, WA, 6122

This parcel belongs to a site that contains 5 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	49 Aquanita Rise Darling Downs, WA, 6122
Lot on Plan Address	Lot 215 On Plan 51299
Parcel Status	<p>Classification: 23/08/2017 - <i>Remediated for restricted use</i></p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol) are present in groundwater beneath the adjacent former service station as a plume which extends to beneath this site.</p> <p>Restrictions on Use:</p> <p>The installation of permanent below ground voids such as basements and utility pits to depths greater than two metres below ground level is restricted without further assessment, and if necessary, management.</p> <p>A site-specific health and safety plan is required to address the risks to the health of workers undertaking intrusive works to depths greater than two metres below ground level.</p> <p>Other than for analytical testing or remediation, disturbance of hydrocarbon-impacted soils present at depths greater than four metres below ground level is restricted.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site due to the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was originally reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act), and was reported again as per reporting obligations under section 11 of the Act, which commenced on 1 December 2006.</p> <p>The site was first classified under section 13 of the Act based on information submitted to DWER by April 2007, with the reasons for classification updated in August 2012. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.</p>

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:13:50PM, 24/07/2019

This site is located north of 640 South Western Highway Byford which was historically used as a service station for approximately 45 years, from 1955 to 2000. A service station is a land use that has the potential to cause contamination, as specified in Appendix B of 'Assessment and management of contaminated sites' (Department of Environment Regulation 2014).

The site was reported because contamination assessments undertaken between 2003 and 2008 established that hydrocarbons (such as from petrol) present in groundwater beneath the service station were present as a plume which extended approximately 250 metres north west from the service station to beneath this site.

The substances in groundwater beneath the site were deemed to pose a potentially unacceptable human health risk via vapour inhalation and direct contact. Soil vapour investigations carried out in 2008 and 2010 found hydrocarbon vapours were present in soils beneath the site.

A detailed risk assessment completed in 2010 concluded that restrictions on use of the site were necessary to manage potential vapour intrusion risks and prevent exposure to contaminated groundwater.

Soil vapour and groundwater investigations and risk assessment carried out at the site up until October 2010 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's assessment was documented in a mandatory auditor's report dated 28 October 2011. The auditor concluded that this site was suitable for its current use as residential land and road reserves provided restrictions on groundwater abstraction and intrusive works were in place.

Further groundwater investigations and risk assessment carried out between 2013 and 2016 have demonstrated that natural attenuation of hydrocarbons in groundwater is occurring and the plume is decreasing in size and concentrations. Hydrocarbons remain in groundwater at concentrations exceeding non-potable use guidelines as specified in 'Assessment and management of contaminated sites' (DER 2014) and have the potential to pose a vapour intrusion risk for subsurface voids such as basements or utility pits that are greater than 2 metres deep.

The further groundwater investigations and risk assessment carried out between 2013 and 2016 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's review is documented in a mandatory auditor's report (MAR) dated 2 August 2017. The auditor recommended that the site is suitable for restricted residential land use and can be classified as 'remediated for restricted use' provided the auditor endorsed site management plan dated July 2017 is implemented. DWER accepts the findings of the auditor.

The site is contaminated and has been remediated such that it is suitable for the current land use provided restrictions on use are in place. Therefore, the site is classified as 'remediated for restricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination

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Contaminated Sites Act 2003 **Basic Summary of Records Search Response**

Report generated at 06:13:51PM, 24/07/2019

	<p>described in the Reasons for Classification.</p> <p>Based on the available information, contamination present on this site has originated from the adjacent land at 640 South Western Highway, which has been classified separately under the CS Act. Therefore this site is consistent with the definition of an "affected site" as specified in Part 1, Section 3 of the Act. Under the Act, the person responsible for the remediation of a source site is also responsible for remediation of any related affected sites.</p> <p>Where the land is part of a transaction - sale, mortgagee or lease agreement, the land owners MUST PROVIDE WRITTEN DISCLOSURE (on the prescribed Form 6) of the site's status to any potential owner, mortgagee (e.g. financial institutions) or lessee at least 14 days before the completion of the transaction. A copy of the disclosure must also be forwarded to DWER.</p> <p>Action Required:</p> <p>The auditor endorsed site management plan dated July 2017 'Former Oakland service station (Q036), 640 South Western Highway, Byford, Western Australia - site management plan' is to be implemented and will apply to the site until further notice.</p>
Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: <i>Nil</i></p> <p>Date Issued: <i>Nil</i></p>
General	No other information relating to this parcel.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:11:50PM, 24/07/2019

Receipt No:

ID No: 42430

Search Results

This response relates to a search request received for:

34 Aquanita Rise
Darling Downs, WA, 6122

This parcel belongs to a site that contains 5 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	34 Aquanita Rise Darling Downs, WA, 6122
Lot on Plan Address	Lot 216 On Plan 51299
Parcel Status	<p>Classification: 23/08/2017 - Remediated for restricted use</p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol) are present in groundwater beneath the adjacent former service station as a plume which extends to beneath this site.</p> <p>Restrictions on Use:</p> <p>The installation of permanent below ground voids such as basements and utility pits to depths greater than two metres below ground level is restricted without further assessment, and if necessary, management.</p> <p>A site-specific health and safety plan is required to address the risks to the health of workers undertaking intrusive works to depths greater than two metres below ground level.</p> <p>Other than for analytical testing or remediation, disturbance of hydrocarbon-impacted soils present at depths greater than four metres below ground level is restricted.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site due to the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was originally reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act), and was reported again as per reporting obligations under section 11 of the Act, which commenced on 1 December 2006.</p> <p>The site was first classified under section 13 of the Act based on information submitted to DWER by April 2007, with the reasons for classification updated in August 2012. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.</p>

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:11:51PM, 24/07/2019

This site is located north of 640 South Western Highway Byford which was historically used as a service station for approximately 45 years, from 1955 to 2000. A service station is a land use that has the potential to cause contamination, as specified in Appendix B of 'Assessment and management of contaminated sites' (Department of Environment Regulation 2014).

The site was reported because contamination assessments undertaken between 2003 and 2008 established that hydrocarbons (such as from petrol) present in groundwater beneath the service station were present as a plume which extended approximately 250 metres north west from the service station to beneath this site.

The substances in groundwater beneath the site were deemed to pose a potentially unacceptable human health risk via vapour inhalation and direct contact. Soil vapour investigations carried out in 2008 and 2010 found hydrocarbon vapours were present in soils beneath the site.

A detailed risk assessment completed in 2010 concluded that restrictions on use of the site were necessary to manage potential vapour intrusion risks and prevent exposure to contaminated groundwater.

Soil vapour and groundwater investigations and risk assessment carried out at the site up until October 2010 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's assessment was documented in a mandatory auditor's report dated 28 October 2011. The auditor concluded that this site was suitable for its current use as residential land and road reserves provided restrictions on groundwater abstraction and intrusive works were in place.

Further groundwater investigations and risk assessment carried out between 2013 and 2016 have demonstrated that natural attenuation of hydrocarbons in groundwater is occurring and the plume is decreasing in size and concentrations. Hydrocarbons remain in groundwater at concentrations exceeding non-potable use guidelines as specified in 'Assessment and management of contaminated sites' (DER 2014) and have the potential to pose a vapour intrusion risk for subsurface voids such as basements or utility pits that are greater than 2 metres deep.

The further groundwater investigations and risk assessment carried out between 2013 and 2016 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's review is documented in a mandatory auditor's report (MAR) dated 2 August 2017. The auditor recommended that the site is suitable for restricted residential land use and can be classified as 'remediated for restricted use' provided the auditor endorsed site management plan dated July 2017 is implemented. DWER accepts the findings of the auditor.

The site is contaminated and has been remediated such that it is suitable for the current land use provided restrictions on use are in place. Therefore, the site is classified as 'remediated for restricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination

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Contaminated Sites Act 2003 **Basic Summary of Records Search Response**

Report generated at 06:11:51PM, 24/07/2019

described in the Reasons for Classification.

Based on the available information, contamination present on this site has originated from the adjacent land at 640 South Western Highway, which has been classified separately under the CS Act. Therefore this site is consistent with the definition of an "affected site" as specified in Part 1, Section 3 of the Act. Under the Act, the person responsible for the remediation of a source site is also responsible for remediation of any related affected sites.

Where the land is part of a transaction - sale, mortgagee or lease agreement, the land owners MUST PROVIDE WRITTEN DISCLOSURE (on the prescribed Form 6) of the site's status to any potential owner, mortgagee (e.g. financial institutions) or lessee at least 14 days before the completion of the transaction. A copy of the disclosure must also be forwarded to DWER.

Action Required:

The auditor endorsed site management plan dated July 2017 'Former Oakland service station (Q036), 640 South Western Highway, Byford, Western Australia - site management plan' is to be implemented and will apply to the site until further notice.

Certificate of Title Memorial
Current Regulatory Notice Issued
General

Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.

Type of Regulatory Notice: *Nil*

Date Issued: *Nil*

No other information relating to this parcel.

Disclaimer

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:13:08PM, 24/07/2019

Receipt No:

ID No: 42434

Search Results

This response relates to a search request received for:

Lot 300 On Plan 51299
Darling Downs, WA, 6122

This parcel belongs to a site that contains 5 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	Lot 300 On Plan 51299 Darling Downs, WA, 6122
Lot on Plan Address	Lot 300 On Plan 51299
Parcel Status	<p>Classification: 23/08/2017 - <i>Remediated for restricted use</i></p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol) are present in groundwater beneath the adjacent former service station as a plume which extends to beneath this site.</p> <p>Restrictions on Use:</p> <p>The installation of permanent below ground voids such as basements and utility pits to depths greater than two metres below ground level is restricted without further assessment, and if necessary, management.</p> <p>A site-specific health and safety plan is required to address the risks to the health of workers undertaking intrusive works to depths greater than two metres below ground level.</p> <p>Other than for analytical testing or remediation, disturbance of hydrocarbon-impacted soils present at depths greater than four metres below ground level is restricted.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site due to the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was originally reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act), and was reported again as per reporting obligations under section 11 of the Act, which commenced on 1 December 2006.</p> <p>The site was first classified under section 13 of the Act based on information submitted to DWER by April 2007, with the reasons for classification updated in August 2012. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.</p>

Disclaimer

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:13:08PM, 24/07/2019

This site is located north of 640 South Western Highway Byford which was historically used as a service station for approximately 45 years, from 1955 to 2000. A service station is a land use that has the potential to cause contamination, as specified in Appendix B of 'Assessment and management of contaminated sites' (Department of Environment Regulation 2014).

The site was reported because contamination assessments undertaken between 2003 and 2008 established that hydrocarbons (such as from petrol) present in groundwater beneath the service station were present as a plume which extended approximately 250 metres north west from the service station to beneath this site.

The substances in groundwater beneath the site were deemed to pose a potentially unacceptable human health risk via vapour inhalation and direct contact. Soil vapour investigations carried out in 2008 and 2010 found hydrocarbon vapours were present in soils beneath the site.

A detailed risk assessment completed in 2010 concluded that restrictions on use of the site were necessary to manage potential vapour intrusion risks and prevent exposure to contaminated groundwater.

Soil vapour and groundwater investigations and risk assessment carried out at the site up until October 2010 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's assessment was documented in a mandatory auditor's report dated 28 October 2011. The auditor concluded that this site was suitable for its current use as residential land and road reserves provided restrictions on groundwater abstraction and intrusive works were in place.

Further groundwater investigations and risk assessment carried out between 2013 and 2016 have demonstrated that natural attenuation of hydrocarbons in groundwater is occurring and the plume is decreasing in size and concentrations. Hydrocarbons remain in groundwater at concentrations exceeding non-potable use guidelines as specified in 'Assessment and management of contaminated sites' (DER 2014) and have the potential to pose a vapour intrusion risk for subsurface voids such as basements or utility pits that are greater than 2 metres deep.

The further groundwater investigations and risk assessment carried out between 2013 and 2016 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's review is documented in a mandatory auditor's report (MAR) dated 2 August 2017. The auditor recommended that the site is suitable for restricted residential land use and can be classified as 'remediated for restricted use' provided the auditor endorsed site management plan dated July 2017 is implemented. DWER accepts the findings of the auditor.

The site is contaminated and has been remediated such that it is suitable for the current land use provided restrictions on use are in place. Therefore, the site is classified as 'remediated for restricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination

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Contaminated Sites Act 2003 **Basic Summary of Records Search Response**

Report generated at 06:13:08PM, 24/07/2019

	<p>described in the Reasons for Classification.</p> <p>Based on the available information, contamination present on this site has originated from the adjacent land at 640 South Western Highway, which has been classified separately under the CS Act. Therefore this site is consistent with the definition of an "affected site" as specified in Part 1, Section 3 of the Act. Under the Act, the person responsible for the remediation of a source site is also responsible for remediation of any related affected sites.</p> <p>Where the land is part of a transaction - sale, mortgagee or lease agreement, the land owners MUST PROVIDE WRITTEN DISCLOSURE (on the prescribed Form 6) of the site's status to any potential owner, mortgagee (e.g. financial institutions) or lessee at least 14 days before the completion of the transaction. A copy of the disclosure must also be forwarded to DWER.</p> <p>Action Required:</p> <p>The auditor endorsed site management plan dated July 2017 'Former Oakland service station (Q036), 640 South Western Highway, Byford, Western Australia - site management plan' is to be implemented and will apply to the site until further notice.</p>
Certificate of Title Memorial	Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: <i>Nil</i></p> <p>Date Issued: <i>Nil</i></p>
General	No other information relating to this parcel.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:15:03PM, 24/07/2019

Receipt No:

ID No: 42435

Search Results

This response relates to a search request received for:

Road Reserve
Byford, WA, 6122
Road Reserve - Thomas Road (Landgate PIN 11470143)

This parcel belongs to a site that contains 5 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address	Road Reserve Byford, WA, 6122 Road Reserve - Thomas Road (Landgate PIN 11470143)
Lot on Plan Address	Road Reserve
Parcel Status	<p>Classification: 23/08/2017 - Remediated for restricted use</p> <p>Nature and Extent of Contamination:</p> <p>Hydrocarbons (such as from petrol) are present in groundwater beneath the adjacent former service station as a plume which extends to beneath this site.</p> <p>Restrictions on Use:</p> <p>The installation of permanent below ground voids such as basements and utility pits to depths greater than two metres below ground level is restricted without further assessment, and if necessary, management.</p> <p>A site-specific health and safety plan is required to address the risks to the health of workers undertaking intrusive works to depths greater than two metres below ground level.</p> <p>Other than for analytical testing or remediation, disturbance of hydrocarbon-impacted soils present at depths greater than four metres below ground level is restricted.</p> <p>Other than for analytical testing or remediation, groundwater abstraction is not permitted at this site due to the nature and extent of groundwater contamination.</p> <p>Reason for Classification:</p> <p>This site was originally reported to the Department of Water and Environmental Regulation (DWER) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act), and was reported again as per reporting obligations under section 11 of the Act, which commenced on 1 December 2006.</p> <p>The site was first classified under section 13 of the Act based on information submitted to DWER by April 2007, with the reasons for classification updated in August 2012. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DWER by August 2017.</p>

Disclaimer

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:15:03PM, 24/07/2019

This site is located north of 640 South Western Highway Byford which was historically used as a service station for approximately 45 years, from 1955 to 2000. A service station is a land use that has the potential to cause contamination, as specified in Appendix B of 'Assessment and management of contaminated sites' (Department of Environment Regulation 2014).

The site was reported because contamination assessments undertaken between 2003 and 2008 established that hydrocarbons (such as from petrol) present in groundwater beneath the service station were present as a plume which extended approximately 250 metres north west from the service station to beneath this site.

The substances in groundwater beneath the site were deemed to pose a potentially unacceptable human health risk via vapour inhalation and direct contact. Soil vapour investigations carried out in 2008 and 2010 found hydrocarbon vapours were present in soils beneath the site.

A detailed risk assessment completed in 2010 concluded that restrictions on use of the site were necessary to manage potential vapour intrusion risks and prevent exposure to contaminated groundwater.

Soil vapour and groundwater investigations and risk assessment carried out at the site up until October 2010 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's assessment was documented in a mandatory auditor's report dated 28 October 2011. The auditor concluded that this site was suitable for its current use as residential land and road reserves provided restrictions on groundwater abstraction and intrusive works were in place.

Further groundwater investigations and risk assessment carried out between 2013 and 2016 have demonstrated that natural attenuation of hydrocarbons in groundwater is occurring and the plume is decreasing in size and concentrations. Hydrocarbons remain in groundwater at concentrations exceeding non-potable use guidelines as specified in 'Assessment and management of contaminated sites' (DER 2014) and have the potential to pose a vapour intrusion risk for subsurface voids such as basements or utility pits that are greater than 2 metres deep.

The further groundwater investigations and risk assessment carried out between 2013 and 2016 were the subject of an independent review by an accredited contaminated sites auditor. The auditor's review is documented in a mandatory auditor's report (MAR) dated 2 August 2017. The auditor recommended that the site is suitable for restricted residential land use and can be classified as 'remediated for restricted use' provided the auditor endorsed site management plan dated July 2017 is implemented. DWER accepts the findings of the auditor.

The site is contaminated and has been remediated such that it is suitable for the current land use provided restrictions on use are in place. Therefore, the site is classified as 'remediated for restricted use'.

DWER, in consultation with the Department of Health, has classified this site based on the information available to DWER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DWER, and as such, the usefulness of this information may be limited.

Other Relevant Information:

Additional information included herein is relevant to the contamination status of the site and includes DWER's expectations for action that should be taken to address potential or actual contamination

Disclaimer

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Contaminated Sites Act 2003 **Basic Summary of Records Search Response**

Report generated at 06:15:03PM, 24/07/2019

described in the Reasons for Classification.

Based on the available information, contamination present on this site has originated from the adjacent land at 640 South Western Highway, which has been classified separately under the CS Act. Therefore this site is consistent with the definition of an "affected site" as specified in Part 1, Section 3 of the Act. Under the Act, the person responsible for the remediation of a source site is also responsible for remediation of any related affected sites.

Where the land is part of a transaction - sale, mortgagee or lease agreement, the land owners MUST PROVIDE WRITTEN DISCLOSURE (on the prescribed Form 6) of the site's status to any potential owner, mortgagee (e.g. financial institutions) or lessee at least 14 days before the completion of the transaction. A copy of the disclosure must also be forwarded to DWER.

Action Required:

The auditor endorsed site management plan dated July 2017 'Former Oakland service station (Q036), 640 South Western Highway, Byford, Western Australia - site management plan' is to be implemented and will apply to the site until further notice.

Certificate of Title Memorial
Current Regulatory Notice Issued
General

Under the Contaminated Sites Act 2003, this site has been classified as "remediated for restricted use". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Water and Environmental Regulation.

Type of Regulatory Notice: *Nil*

Date Issued: *Nil*

No other information relating to this parcel.

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report generated at 06:18:09PM, 24/07/2019

Receipt No:

ID No: 55155

Search Results

This response relates to a search request received for:

Keysbrook, WA, 6125

Rubbish dump area within State Forrest 22, Landgate PIN 374775, adjacent to Karnet Prison Farm, Kingsbury Drive,

Keysbrook WA 6126 (central co-ordinate: MGA Zone 50, 413140E, 6409455N)

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Water and Environmental Regulation records, this land has been reported as a known or suspected contaminated site.

Address

Keysbrook, WA, 6125

Rubbish dump area within State Forrest 22, Landgate PIN 374775, adjacent to Karnet Prison Farm, Kingsbury Drive, Keysbrook WA 6126 (central co-ordinate: MGA Zone 50, 413140E, 6409455N)

Parcel Status

Classification: 23/06/2015 - Contaminated - remediation required

Nature and Extent of Contamination:

Fragments of asbestos-containing material (ACM) are present within soils at the site.

Restrictions on Use:

The land use of the site is restricted to parks and recreation/recreational open space; which excludes sensitive uses with accessible soil such as childcare centres, kindergartens, pre-schools and primary schools. The site should not be developed for a more sensitive use such as residential use or childcare centres without further contamination assessment and/or remediation.

Due to the possible presence of asbestos in soils at the site a site-specific health and safety plan is required to address the risks to the health of any workers undertaking maintenance and/or intrusive works.

Reason for Classification:

This site was reported to the Department of Environment Regulation (DER) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003' (the Act), which commenced on 1 December 2006.

The site was first classified under section 13 of the Act based on information submitted to DER by April 2013. The site has been classified again under section 13 of the Act to reflect additional technical information submitted to DER by May 2015.

This site was historically used as a landfill, receiving waste from the adjacent prison farm for approximately 40 years, from 1963 to 2003. This is a land use that has the potential to cause contamination, as specified in the guideline 'Assessment and Management of Contaminated Sites' (Department of Environment Regulation, 2014).

A preliminary site investigation (PSI) dated February 2015 identified the presence of two distinct

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report generated at 06:18:09PM, 24/07/2019

landfill areas and 17 stockpiles across the site. Observations made during 2014 identified fragments of asbestos-containing materials (ACM) within soils around five of the stockpiles and in Landfill (2). No other visual evidence of significant contamination was identified at this time.

The results of soil investigations conducted in January 2006, but not documented in an earlier report, were incorporated into the PSI. Asbestos (chrysotile) was identified in one surface sample. Metals (copper, cadmium, nickel and zinc) and pesticides (DDT+DDD+DDE, and methoxychlor) were present in soils at concentrations exceeding the Ecological Investigation Levels, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment and Conservation, 2010), which were the relevant assessment levels at that time.

The presence of metals (cadmium, copper, nickel and zinc) and pesticides (DDT+DDD+DDE, and methoxychlor) at the site does not currently pose an unacceptable risk to human health, the environment or any environmental value under the current land use.

A tier 1 screening risk assessment has indicated that the presence of fragments of ACM within soils across the site poses an unacceptable risk to human health under the current 'State Forest' land use and remediation and management is required.

Groundwater investigations identified metals (copper and zinc) in groundwater at concentrations exceeding the assessment levels for fresh waters, as published in the 'Assessment and management of contaminated sites' (DER 2014). However, these were considered to be representative of background groundwater quality in the region.

The condition of groundwater at the site does not currently pose an unacceptable risk to human health, the environment or any environmental value under the current or proposed land use.

The investigations and risk assessment works were the subject of an independent review by an accredited contaminated sites auditor who provided a Voluntary Auditor's Report (VAR) dated April 2015. The MAR recommended that appropriate management measures be implemented to manage the risk to human health. DER accepts the findings of the VAR.

A 'Site Management Plan' (SMP) is required to mitigate the risks posed to site users by the potential presence of ACM in soils.

As the site has been shown to be contaminated, and remediation is required to reduce unacceptable risks to human health, the environment or any environmental value to acceptable levels, the site is classified as 'contaminated - remediation required'.

DER, in consultation with the Department of Health, has classified this site based on the information available to DER at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DER, and as such, the usefulness of this information may be limited.

In accordance with Department of Health advice, if groundwater is being, or is proposed to be abstracted, DER recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use.

Action Required:

As remediation of the site is required a SMP should be prepared to mitigate the risks posed to site

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Contaminated Sites Act 2003 **Basic Summary of Records Search Response**

Report generated at 06:18:09PM, 24/07/2019

	users by the presence of ACM in soils. The SMP should address short-term remedial/management measures such as removal of larger sheets of potential ACM from the site's surface, periodic hand-picking of ACM in surface soils and long-term management measures such as restricting access via suitable fencing and appropriate signage. The SMP should also include a site-specific health and safety plan to address potential risks to workers undertaking any maintenance and/or intrusive work at the site. Any remedial/management measures should be consistent with the 'Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia' (Department of Health, May 2009).
Certificate of Title Memorial	<p>Under the Contaminated Sites Act 2003, this site has been classified as "possibly contaminated - investigation required". For further information on the contamination status of this site, please contact the Contaminated Sites section of the Department of Environment Regulation.</p> <p>Under the Contaminated Sites Act 2003, this site has been classified as "contaminated - remediation required". For further information on the contamination status of this site, please contact Contaminated Sites at the Department of Environment Regulation.</p>
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: <i>Nil</i></p> <p>Date Issued: <i>Nil</i></p>
General	No other information relating to this parcel.

Disclaimer

This Summary of Records has been prepared by Department of Water and Environmental Regulation (DWER) as a requirement of the Contaminated Sites Act 2003. DWER makes every effort to ensure the accuracy, currency and reliability of this information at the time it was prepared, however advises that due to the ability of contamination to potentially change in nature and extent over time, circumstances may have changed since the information was originally provided. Users must exercise their own skill and care when interpreting the information contained within this Summary of Records and, where applicable, obtain independent professional advice appropriate to their circumstances. In no event will DWER, its agents or employees be held responsible for any loss or damage arising from any use of or reliance on this information. Additionally, the Summary of Records must not be reproduced or supplied to third parties except in full and unabridged form.

Appendix B – Water Efficiency Action Plan

Water Saving Area	Ref	Action / Initiative	Status	Proposed Completion Date	Department Responsible	Commentary
Irrigation, POS and reserves	1	Extensive use of local native species in public open spaces and gardens, creating dry park areas with temporary irrigation set up for establishment only.	Ongoing	Ongoing	Operations Environment Subdivisions	Standard practice in landscape approvals and ongoing maintenance
	2	Nominate areas of Public Open Space suited to either revegetation or "browning off".	Complete	NA	Operations Environment	Assessment of existing POS complete, ongoing for new POS at handover
	3	Control and monitor fertiliser use on Shire reserves, with a focus on ovals, to ensure best management practice fertilising.	Ongoing	Ongoing	Operations	Standard practice
	4	Upgrade irrigation with more efficient systems.	Ongoing	Ongoing	Operations	Subject to funding More efficient systems are fitted as budget allows and/or when replacement is required
	5	Apply soil improvers on sports fields and in nutrient stripping rain gardens.	Ongoing	Ongoing	Operations	Standard practice
	6	Install flow meters on all Shire bores servicing public open space.	Ongoing	Ongoing	Operations	Standard practice
	7	Develop an Irrigation and Nutrient Management Guideline and implement on all Shire sports grounds, reserves and POS.	Complete	NA	Environment Operations	Standard practice

Council facilities	8	Retrofit Council buildings with water efficient appliances.	Ongoing	Ongoing	Operations Assets	Subject to funding Water efficient appliances are fitted as budget allows and/or when replacement is required
	9	Detailed water audit of Council buildings as done by Planet Footprint each year.	Complete	NA	Environment Assets	Subject to funding Planet Footprint data used to assess water usage of buildings
	10	Incorporate water wise design in new facilities.	Ongoing	Ongoing	Assets Project Management	Waterwise design incorporated into all new facilities
	11	Install rainwater tanks at Shire buildings for non-potable use.	Ongoing	Ongoing	Operations	Subject to funding Installation occurs as budget allows
Planning and development	12	Work in partnership with developers to achieve water efficient and water sensitive design.	Ongoing	Ongoing	Subdivisions Environment Statutory Planning	Negotiation on structure plans, subdivisions and development applications
	13	Adopt WSUD for all new subdivisions with consideration for management and maintenance methodology passed on to operations.	Complete	NA	Subdivisions Environment Operations	In place for existing subdivisions and ongoing for new ones
	14	Support wider road reserves within Liveable Neighbourhoods to allow for adequate street tree space.	Complete	NA	Environment Subdivisions Statutory Planning	Discussions with State agencies to encourage consideration of wider road reserves in policies and statutory documents
	15	Enforce better urban water management guidelines and ensure appropriate water management plans are prepared through the planning and development processes.	Ongoing	Ongoing	Environment Subdivisions Statutory Planning	In place for existing planning and development and ongoing for new ones

External liaison	16	Liaise with local industries who use large amounts of water on landscaping to promote retrofitting to waterless or waterwise landscaping techniques.	Ongoing	Ongoing	Environment Subdivisions Statutory Planning	Standard practice in the assessment of landscape plans, but yet to occur for existing landscaping
	17	Increase communications with the Department of Water and Environmental Regulation for bore approval information exchange and requirements for sustainable yield and capacity information at the district structure plan stage.	To be completed	To be completed	Environment Subdivisions Statutory Planning	Consider bore water use and allocations in an early stage of structure planning
Public engagement	18	Encourage the public to harvest and use their rainwater effectively.	Ongoing	Ongoing	Environment Community Development	Education campaigns, development approvals and promotion of Switch your Thinking's Rebates for Residents
	19	Install and approve Biomax wastewater treatment and recycling systems.	Ongoing	Ongoing	Health Statutory Planning	Standard practice in the assessment of development applications
	20	Encourage the public to help protect our waterways.	Ongoing	Ongoing	Environment Communications	Education campaigns and promotion of relevant events
	21	Target catchment nutrient load reductions in the Serpentine (Lower) Sub-Catchment area.	Ongoing	Ongoing	Environment Subdivisions Statutory Planning	Education campaigns and standard practice in assessment of development applications

Appendix C – Desktop Searches

EPBC Act Protected Matters Database

NatureMap Flora Report and Statistics

NatureMap Fauna Report and Statistics

EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 29/04/19 17:24:04

[Summary](#)

[Details](#)

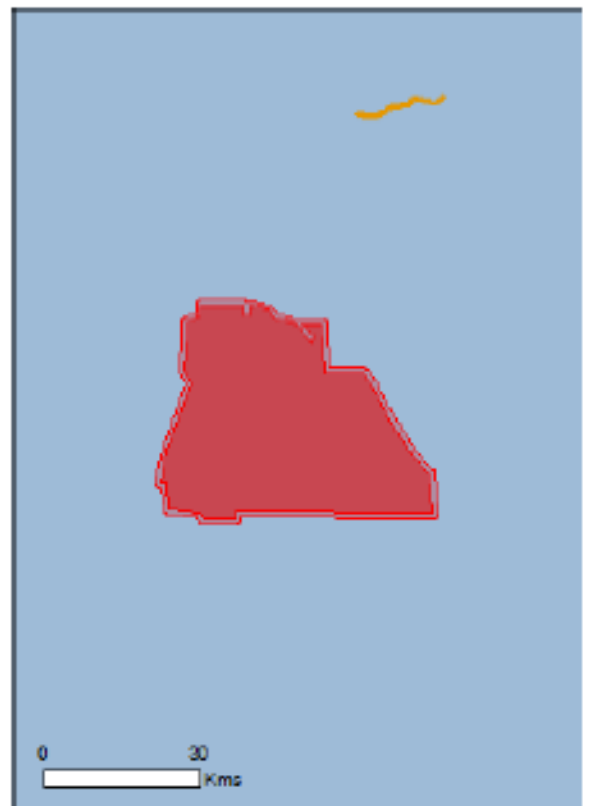
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

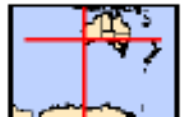
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 1.0Km](#)



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	37
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	21
Regional Forest Agreements:	1
Invasive Species:	41
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Forrestdale and thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	10 - 20km upstream

Listed Threatened Ecological Communities

 [[Resource Information](#)]

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

Name	Status	Type of Presence
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	Endangered	Community known to occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species

 [[Resource Information](#)]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Roosting known to occur within area
Calyptorhynchus latirostris Camaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Insects		
Leucopoctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat likely to occur within area
Neopasiphae simplicior A native bee [66821]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Beltongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area
Dasyurus geoffroi Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
Westralunio carter Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Anthocercis gracilis Slender Tallflower [11103]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegell King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [66755]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis kelgheryi Kelghery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Grevillea flexuosa Zig Zag Grevillea [2957]	Vulnerable	Species or species habitat likely to occur within area
Laslopetalum pterocarpum Wing-fruited Laslopetalum [64922]	Endangered	Species or species habitat known to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat known to occur within area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat likely to occur within area
Tetraria australiensis Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra dedmanianum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area
Verticordia fimbriata subsp. fimbriata Shy Featherflower [24631]	Endangered	Species or species habitat may occur within area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat may occur within area

Listed Migratory Species

[[Resource Information](#)]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Callidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Callidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Callidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Callidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

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

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Callidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Callidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Callidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur

Name	Threatened	Type of Presence
Callidris melanotos Pectoral Sandpiper [858]		within area Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinomys rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Banksia	WA
Cardup	WA
Gooralong	WA
Kamet	WA
Lambkin	WA
Modong	WA
Monadnocks	WA
NTWA Bushland covenant (0011)	WA
NTWA Bushland covenant (0076)	WA
NTWA Bushland covenant (0077)	WA
NTWA Bushland covenant (0086)	WA
NTWA Bushland covenant (0089)	WA
North Dandalup	WA
Serpentine	WA
Unnamed WA42044	WA
Unnamed WA46587	WA
Unnamed WA46818	WA
Unnamed WA50643	WA
Unnamed WA51784	WA
Wandi	WA
Watkins Road	WA

Regional Forest Agreements

[[Resource Information](#)]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species

[\[Resource Information \]](#)

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

Name	Status	Type of Presence
Birds		
<i>Acridotheres tristis</i> Common Myna, Indian Myna [367]		Species or species habitat likely to occur within area
<i>Anas platyrhynchos</i> Mallard [974]		Species or species habitat likely to occur within area
<i>Carduelis carduelis</i> European Goldfinch [403]		Species or species habitat likely to occur within area
<i>Columba livia</i> Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
<i>Passer domesticus</i> House Sparrow [405]		Species or species habitat likely to occur within area
<i>Passer montanus</i> Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
<i>Streptopelia chinensis</i> Spotted Turtle-Dove [760]		Species or species habitat likely to occur within area
<i>Streptopelia senegalensis</i> Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
<i>Sturnus vulgaris</i> Common Starling [389]		Species or species habitat likely to occur within area
<i>Turdus merula</i> Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
<i>Bos taurus</i> Domestic Cattle [16]		Species or species habitat likely to occur within area
<i>Canis lupus familiaris</i> Domestic Dog [82654]		Species or species habitat likely to occur within area
<i>Capra hircus</i> Goat [2]		Species or species habitat likely to occur within area
<i>Felis catus</i> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
<i>Funambulus pennanti</i> Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
<i>Mus musculus</i> House Mouse [120]		Species or species habitat likely to occur within area
<i>Oryctolagus cuniculus</i> Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
<i>Rattus norvegicus</i> Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
<i>Rattus rattus</i> Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
<i>Sus scrofa</i> Pig [6]		Species or species habitat likely to occur within area
<i>Vulpes vulpes</i> Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
<i>Asparagus asparagoides</i> Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
<i>Brachiaria mutica</i> Para Grass [5879]		Species or species habitat may occur within area
<i>Cenchrus ciliaris</i> Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
<i>Chrysanthemoides monillifera</i> Blitou Bush, Boneseed [18983]		Species or species habitat may occur within area
<i>Chrysanthemoides monillifera</i> subsp. <i>monillifera</i> Boneseed [16905]		Species or species habitat likely to occur within area
<i>Genista linifolia</i> Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
<i>Genista monspessulana</i> Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
<i>Genista</i> sp. X <i>Genista monspessulana</i> Broom [67538]		Species or species habitat may occur within area
<i>Lantana camara</i> Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
<i>Lycium ferocissimum</i> African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
<i>Olea europaea</i> Olive, Common Olive [9160]		Species or species habitat may occur within area
<i>Opuntia</i> spp. Prickly Pears [82753]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
<i>Pinus radiata</i> Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
<i>Rubus fruticosus</i> aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
<i>Salix</i> spp. except <i>S.babylonica</i> , <i>S.x calodendron</i> & <i>S.x reichardtii</i> Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
<i>Salvinia molesta</i> Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
<i>Solanum elaeagnifolium</i> Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
<i>Tamarix aphylla</i> Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
<i>Hemidactylus frenatus</i> Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Gibbs Road Swamp System		WA

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.22228 115.874072,-32.205381 115.875507,-32.195849 115.899939,-32.180531 115.899939,-32.18108 115.872352,-32.180374 115.872352,-32.194762 115.983588,-32.182118 115.983588,-32.187929 116.016044,-32.20168 116.030401,-32.20747 116.063484,-32.234929 116.091575,-32.224898 116.094074,-32.20747 116.075349,-32.207998 116.107807,-32.27769 116.112174,-32.278218 116.180214,-32.29352 116.195198,-32.308881 116.203937,-32.345218 116.225181,-32.398485 116.266985,-32.422181 116.298828,-32.482231 116.300068,-32.479598 115.950344,-32.490128 115.950344,-32.490128 115.903888,-32.48085 115.899939,-32.475912 115.844382,-32.437985 115.840015,-32.438938 115.829406,-32.389508 115.84084,-32.291413 115.881839,-32.273997 115.870605,-32.220675 115.874872,-32.220675 115.874872,-32.22228 115.874872

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

NatureMap Species Report

Created By Guest user on 25/09/2019

Current Names Only Yes
Core Datasets Only Yes
Method 'Predefined Area Intersect'
Area Type Shire Boundary
Intersect SERPENTINE-JARRAHDALÉ
Group By Kingdom

Kingdom	Species	Records
Animalia	622	17368
Fungi	150	592
Plantae	1403	9216
Protozoa	8	9
TOTAL	2183	27185

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Animalia				
1.	??			
2.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill, Inland Thornbill)			
3.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
4.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
5.	24265 <i>Acanthiza uropygialis</i> (Chestnut-rumped Thornbill)			
6.	25242 <i>Acanthophis antarcticus</i> (Southern Death Adder)		P3	
7.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
8.	<i>Acariformes</i> sp.			
9.	25535 <i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)			
10.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
11.	<i>Acritoptila margaretae</i>			
12.	<i>Acritoptila</i> sp.			
13.	42368 <i>Acritoscincus trilineatus</i> (Western Three-lined Skink)			
14.	25755 <i>Acrocephalus australis</i> (Australian Reed Warbler)			
15.	<i>Adoxotoma chionopogon</i>			
16.	<i>Adoxotoma embolica</i>			Y
17.	<i>Adoxotoma nitida</i>			Y
18.	<i>Adversaeschna brevistyla</i>			
19.	25544 <i>Aegotheles cristatus</i> (Australian Owllet-nightjar)			
20.	<i>Aeshnidae</i> sp.			
21.	<i>Agraptocorixa</i> sp.			
22.	<i>Ainudrilus nharna</i>			
23.	<i>Allodessus bistrigatus</i>			
24.	<i>Allotheruea maculata</i>			
25.	<i>Alotanypus dalyupensis</i>			
26.	<i>Ambicodamus marae</i>			
27.	<i>Amblyomma triguttatum</i>			
28.	<i>Aname mainae</i>			
29.	<i>Aname tepperi</i>			
30.	24312 <i>Anas gracilis</i> (Grey Teal)			
31.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
32.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
33.	<i>Ancylidae</i> sp.			
34.	47414 <i>Anhinga novaehollandiae</i> (Australasian Darter)			
35.	25449 <i>Antechinus flavipes</i> (Yellow-footed Antechinus)			
36.	24088 <i>Antechinus flavipes</i> subsp. <i>leucogaster</i> (Yellow-footed Antechinus, Mardo)			
37.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
38.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
39.	25670 <i>Anthus australis</i> (Australian Pipit)			
40.	24599 <i>Anthus australis</i> subsp. <i>australis</i> (Australian Pipit)			
41.	<i>Antiporus gilberti</i>			
42.	<i>Antiporus</i> sp.			
43.	24990 <i>Aprasia pulchella</i> (Granite Worm-lizard)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
44.	24991 <i>Aprasia repens</i> (Sand-plain Worm-lizard)			
45.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
46.	<i>Arachnura higginsii</i>			
47.	<i>Araneus amblycyphus</i>			Y
48.	<i>Araneus cyphoxis</i>			
49.	<i>Araneus eburneiventris</i>			
50.	<i>Araneus senicaudatus</i>			
51.	<i>Araneus stolidus</i>			
52.	<i>Archiargiolestes pusillus</i>			
53.	24337 <i>Ardea garzetta</i> subsp. <i>nigripes</i> (Little Egret)			
54.	24340 <i>Ardea novaehollandiae</i> (White-faced Heron)			
55.	24341 <i>Ardea pacifica</i> (White-necked Heron)			
56.	24610 <i>Ardeotis australis</i> (Australian Bustard)			
57.	<i>Argiope trifasciata</i>			
58.	<i>Arkys alticephala</i>			
59.	<i>Arkys walckenaeri</i>			
60.	<i>Arrenuridae</i> sp.			
61.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
62.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
63.	<i>Artoria flavimana</i>			
64.	<i>Artoria flavimanus</i>			
65.	<i>Artoria schizocoides</i>			
66.	<i>Asadipus kunderang</i>			
67.	<i>Athericidae</i> sp.			
68.	<i>Aturidae</i> sp.			
69.	<i>Austracantha minax</i>			
70.	<i>Australomimetus aurioculatus</i>			
71.	<i>Australomimetus dunlopi</i>			
72.	<i>Australopelopia prionopectera</i>			
73.	<i>Australotiphys barmutai</i>			
74.	<i>Austrogrion coeruleum</i>			
75.	<i>Austrogomphus collaris</i>			
76.	<i>Austrolestes analis</i>			
77.	47713 <i>Austronomus australis</i> (White-striped Free-tailed Bat)			
78.	24318 <i>Aythya australis</i> (Hardhead)			
79.	<i>Backbourkia brounii</i>			
80.	<i>Backbourkia heroine</i>			
81.	<i>Baetidae</i> sp.			
82.	<i>Baiami volucripes</i>			
83.	<i>Ballarra longipalpus</i>			
84.	<i>Barnardius zonarius</i>			
85.	<i>Berosus approximans</i>			
86.	<i>Berosus discolor</i>			
87.	24162 <i>Bettongia penicillata</i> subsp. <i>ogilbyi</i> (Woylie, Brush-tailed Bettong)		T	
88.	<i>Bibulmena kadjina</i>			
89.	24319 <i>Biziura lobata</i> (Musk Duck)			
90.	<i>Bostockia porosa</i>			
91.	<i>Botryocladus freemani</i>			
92.	<i>Botryocladus petrophilus</i>			
93.	25714 <i>Cacatua pastinator</i> (Western Long-billed Corella)			
94.	24724 <i>Cacatua pastinator</i> subsp. <i>pastinator</i> (Muir's Corella, Muir's Corella (Western Corella SW WA))		S	
95.	25715 <i>Cacatua roseicapilla</i> (Galah)			
96.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
97.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
98.	42307 <i>Cacomantis pallidus</i> (Pallid Cuckoo)			
99.	<i>Caenidae</i> sp.			
100.	<i>Calanoida</i> sp.			
101.	24784 <i>Calidris ferruginea</i> (Curlew Sandpiper)		T	
102.	24788 <i>Calidris ruficollis</i> (Red-necked Stint)		IA	
103.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
104.	24731 <i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black Cockatoo)		T	
105.	24733 <i>Calyptorhynchus baudinii</i> (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)		T	
106.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)		T	
107.	48400 <i>Calyptorhynchus</i> sp. (white-tailed black cockatoo)		T	
108.	<i>Carabidae</i> sp.			
109.	<i>Ceinidae</i> sp.			
110.	<i>Ceratopogonidae</i> sp.			

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111.	24086 <i>Cercartetus concinnus</i> (Western Pygmy-possum, <i>Mundarda</i>)			
112.	<i>Cercophonius sulcatus</i>			
113.	<i>Cethegus fugax</i>			
114.	24186 <i>Chalinolobus gouldii</i> (Gould's Wattled Bat)			
115.	24187 <i>Chalinolobus morio</i> (Chocolate Wattled Bat)			
116.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
117.	43380 <i>Chelodina colliei</i> (South-western Snake-necked Turtle)			
118.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
119.	33939 <i>Cherax cainii</i> (Marron)			
120.	<i>Cherax destructor</i>			
121.	<i>Cherax quinquecarinatus</i>			
122.	<i>Cheumatopsyche</i> sp. AV2 (SAP)			
123.	<i>Chironominae</i> sp.			
124.	<i>Chironomus</i> aff. <i>alternans</i> (V24) (CB)			
125.	<i>Chironomus tepperi</i>			
126.	24980 <i>Christinus marmoratus</i> (Marbled Gecko)			
127.	<i>Chroicocephalus novaehollandiae</i>			
128.	24431 <i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)			
129.	25601 <i>Chrysococcyx lucidus</i> (Shining Bronze Cuckoo)			
130.	<i>Chrysomelidae</i> sp.			
131.	24288 <i>Circus approximans</i> (Swamp Harrier)			
132.	<i>Cladocera</i> (unident.)			
133.	<i>Cladopelma curtivalva</i>			
134.	<i>Cladotanytarsus</i> sp. A (SAP)			
135.	<i>Cloeon</i> sp.			
136.	<i>Cloeon</i> sp. 2 (SFM)			
137.	<i>Clynotis severus</i>			
138.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
139.	24613 <i>Colluricincla harmonica</i> subsp. <i>rufiventris</i> (Grey Shrike-thrush)			
140.	24399 <i>Columba livia</i> (Domestic Pigeon)	Y		
141.	<i>Condocerus aptus</i>			
142.	<i>Copepoda</i> sp.			
143.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
144.	24362 <i>Coracina novaehollandiae</i> subsp. <i>novaehollandiae</i> (Black-faced Cuckoo-shrike)			
145.	<i>Corduliidae</i> sp.			
146.	<i>Corixidae</i> sp.			
147.	<i>Cormocephalus aurantiipes</i>			
148.	<i>Cormocephalus hartmeyer</i>			
149.	<i>Cormocephalus turneri</i>			
150.	25592 <i>Corvus coronoides</i> (Australian Raven)			
151.	24417 <i>Corvus coronoides</i> subsp. <i>perplexus</i> (Australian Raven)			
152.	25593 <i>Corvus orru</i> (Torresian Crow)			
153.	24419 <i>Corvus splendens</i> (House Crow)			
154.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
155.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
156.	24422 <i>Cracticus tibicen</i> subsp. <i>dorsalis</i> (White-backed Magpie)			
157.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
158.	<i>Cricotopus 'brevicornis'</i>			
159.	<i>Cricotopus 'parbicinctus'</i>			
160.	25398 <i>Crinia georgiana</i> (Quacking Frog)			
161.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
162.	25400 <i>Crinia insignifera</i> (Squelching Froglet)			
163.	25401 <i>Crinia pseudinsignifera</i> (Bleating Froglet)			
164.	<i>Crustulina bicrucata</i>			
165.	30893 <i>Cryptoblepharus buchananii</i>			
166.	25020 <i>Cryptoblepharus plagioccephalus</i>			
167.	<i>Cryptochironomus</i> aff. <i>griseidorsum</i>			
168.	<i>Cryptochironomus griseidorsum</i>			
169.	<i>Cryptoerithus melindae</i>			
170.	24883 <i>Ctenophorus ornatus</i> (Ornate Crevice-Dragon)			
171.	25035 <i>Ctenotus delli</i> (Dell's skink, Darling Range southwest Ctenotus)		P4	
172.	25039 <i>Ctenotus fallens</i>			
173.	25047 <i>Ctenotus impar</i>			
174.	25049 <i>Ctenotus labillardieri</i>			
175.	<i>Culicidae</i> sp.			
176.	<i>Curculionidae</i> sp.			
177.	<i>Cyclosa bacilliformis</i>			Y
178.	<i>Cyclosa trilobata</i>			
179.	24322 <i>Cygnus atratus</i> (Black Swan)			
180.	<i>Cyrtophora parnasia</i>			

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181.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)	Y		
182.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
183.	24092 <i>Dasyurus geoffroi</i> (Chuditch, Western Quoll)		T	
184.	25766 <i>Delma fraseri</i> (Fraser's Legless Lizard)			
185.	<i>Demadiana cerula</i>			
186.	<i>Diaprograpta striola</i>			
187.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
188.	<i>Dicrotendipes conjunctus</i>			
189.	<i>Dicrotendipes jobetus</i>			
190.	<i>Dicrotendipes pseudoconjunctus</i>			
191.	<i>Dicrotendipes</i> sp.			
192.	<i>Dicrotendipes</i> sp. A (V47) (SAP)			
193.	<i>Dingosa serrata</i>			
194.	<i>Dinocambala ingens</i>			
195.	<i>Diplacodes bipunctata</i>			
196.	24939 <i>Diplodactylus polyophthalmus</i>			
197.	<i>Dolichopodidae</i> sp.			
198.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
199.	<i>Dytiscidae</i> sp.			
200.	<i>Ecnomidae</i> sp.			
201.	25096 <i>Egernia kingii</i> (King's Skink)			
202.	25100 <i>Egernia napoleonis</i>			
203.	<i>Egretta novaehollandiae</i>			
204.	<i>Elanus axillaris</i>			
205.	25250 <i>Elapognathus coronatus</i> (Crowned Snake)			
206.	47937 <i>Euseiornis melanops</i> (Black-fronted Dotterel)			
207.	<i>Empididae</i> sp.			
208.	<i>Enchytraeidae</i> sp.			
209.	<i>Eolophus roseicapillus</i>			
210.	25692 <i>Eopsaltria australis</i> (Yellow Robin)			
211.	24651 <i>Eopsaltria australis</i> subsp. <i>griseogularis</i> (Western Yellow Robin)			
212.	24652 <i>Eopsaltria georgiana</i> (White-breasted Robin)			
213.	<i>Ephydriidae</i> sp.			
214.	24567 <i>Ephianura albifrons</i> (White-fronted Chat)			
215.	<i>Erigone prominens</i>			
216.	<i>Eriophora biapicata</i>			
217.	<i>Ero aphana</i>			
218.	<i>Eucyrtops latior</i>			
219.	48579 <i>Euoplos inornatus</i> (inornate trapdoor spider (northern Jarrah Forest))		P3	
220.	<i>Exocelina ater</i>			
221.	25621 <i>Falco berigora</i> (Brown Falcon)			
222.	25622 <i>Falco cenchroides</i> (Australian Kestrel, Nankeen Kestrel)			
223.	25623 <i>Falco longipennis</i> (Australian Hobby)			
224.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
225.	24476 <i>Falco subniger</i> (Black Falcon)			
226.	24189 <i>Falsistrellus mackenziei</i> (Western False Pipistrelle, Western Falsistrelle)		P4	
227.	24041 <i>Felis catus</i> (Cat)	Y		
228.	25727 <i>Fulica atra</i> (Eurasian Coot)			
229.	24761 <i>Fulica atra</i> subsp. <i>australis</i> (Eurasian Coot)			
230.	34028 <i>Galaxias occidentalis</i> (Western Minnow)			
231.	24763 <i>Gallinula tenebrosa</i> subsp. <i>tenebrosa</i> (Dusky Moorhen)			
232.	25730 <i>Gallirallus philippensis</i> (Buff-banded Rail)			
233.	24765 <i>Gallirallus philippensis</i> subsp. <i>mellori</i> (Buff-banded Rail)			
234.	42314 <i>Gavicalis virescens</i> (Singing Honeyeater)			
235.	25404 <i>Geocrinia leai</i> (Ticking Frog)			
236.	34030 <i>Geotria australis</i> (Pouched Lamprey)		P3	
237.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
238.	34114 <i>Glacidorbis occidentalis</i> (Jarrah forest freshwater snail, freshwater snail)		P3	
239.	47962 <i>Glyciphila melanops</i> (Tawny-crowned Honeyeater)			
240.	<i>Gomphidae</i> sp.			
241.	24443 <i>Gallina cyanoleuca</i> (Magpie-lark)			
242.	<i>Griopterygidae</i> sp.			
243.	<i>Gyrinidae</i> sp.			
244.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
245.	<i>Haliplidae</i> sp.			
246.	<i>Haliplus fuscatus</i>			
247.	<i>Haliplus</i> sp.			
248.	<i>Harrisius</i> sp. A (SAP)			
249.	<i>Harrisius</i> sp. B (SFM)			
250.	25409 <i>Heleioporus barycragus</i> (Hooting Frog)			

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251.	25410 <i>Heleioporus eyrei</i> (Moaning Frog)			
252.	25411 <i>Heleioporus inornatus</i> (Whooping Frog)			
253.	25412 <i>Heleioporus psammophilus</i> (Sand Frog)			
254.	<i>Helyethira litua</i>			
255.	<i>Helochares tenuistriatus</i>			
256.	<i>Hemicordulia australiae</i>			
257.	<i>Hemicordulia tau</i>			
258.	<i>Hemicorduliidae</i> sp.			
259.	25474 <i>Hemiergis initialis</i>			
260.	25115 <i>Hemiergis initialis</i> subsp. <i>initialis</i>			
261.	25119 <i>Hemiergis quadrilineata</i>			
262.	<i>Henicops dentatus</i>			
263.	47965 <i>Hieraaetus morphnoides</i> (Little Eagle)			
264.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
265.	<i>Hirudinea</i> sp.			
266.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
267.	<i>Hogna crispipes</i>			
268.	<i>Holconia westralia</i>			
269.	<i>Holoplatsy dejongi</i>			
270.	<i>Hydrobiosella michaelsoni</i>			
271.	<i>Hydrobiosidae</i> sp.			
272.	<i>Hydrodromidae</i> sp.			
273.	24215 <i>Hydromys chrysogaster</i> (Water-rat, Rakali)		P4	
274.	<i>Hydrophilidae</i> sp.			
275.	48587 <i>Hydroprogne caspia</i> (Caspian Tern)		IA	
276.	<i>Hydropsychidae</i> sp.			
277.	<i>Hydroptila losida</i>			
278.	<i>Hydroptilidae</i> sp.			
279.	<i>Hydryphantidae</i> sp.			
280.	<i>Hygrobatidae</i> sp.			
281.	<i>Hyphydrus elegans</i>			
282.	<i>Hyriidae</i> sp.			
283.	<i>Idiommata blackwalli</i>			
284.	48935 <i>Idiosoma sigillatum</i> (Swan Coastal Plain shield-backed trapdoor spider)		P3	
285.	<i>Isometroides vescus</i>			
286.	48588 <i>Isodon fusciventer</i> (Quenda, southwestern brown bandicoot)		P4	
287.	<i>Isopoda leishmanni</i>			
288.	<i>Karaops ellenae</i>			
289.	<i>Kiefferulus intertinctus</i>			
290.	<i>Kiefferulus martini</i>			
291.	24367 <i>Lalage tricolor</i> (White-winged Triller)			
292.	<i>Lampona brevipis</i>			
293.	<i>Lampona yanchep</i>			
294.	<i>Lamponella ainslie</i>			
295.	<i>Lamponusa gleneagle</i>			
296.	<i>Lancetes lanceolatus</i>			
297.	<i>Laperousea blattifera</i>			
298.	<i>Larsia albiceps</i>			
299.	24511 <i>Larus novaehollandiae</i> subsp. <i>novaehollandiae</i> (Silver Gull)			
300.	<i>Latrodectus hasseltii</i>			
301.	<i>Lectrides parilis</i>			
302.	24557 <i>Leipoa ocellata</i> (Malleefowl)		T	
303.	<i>Lepidoptera</i> (non-pyralid)			
304.	<i>Leptoceridae</i> sp.			
305.	<i>Leptoperla australica</i>			
306.	<i>Leptophlebiidae</i> sp.			
307.	25131 <i>Lerista distinguenda</i>			
308.	25133 <i>Lerista elegans</i>			
309.	25147 <i>Lerista lineata</i> (Perth Slider, Lined Skink)		P3	
310.	25148 <i>Lerista lineopunctulata</i>			
311.	25005 <i>Lialis burtonis</i>			
312.	<i>Libellulidae</i> sp.			
313.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
314.	<i>Limbodessus inornatus</i>			
315.	<i>Limbodessus shuckhardi</i>			
316.	<i>Limnesiidae</i> sp.			
317.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
318.	<i>Limnophyes vestitus</i> (V41)			
319.	<i>Limnoxenus zelandicus</i>			
320.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			

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321.	25388 <i>Litoria moorei</i> (Motorbike Frog)			
322.	<i>Longepi woodman</i>			
323.	<i>Longrita insidiosa</i>			
324.	<i>Lophoictinia isura</i>			
325.	<i>Lycosa ariadnae</i>			
326.	<i>Macrogyrus angustatus</i>			
327.	<i>Macrogyrus</i> sp.			
328.	24132 <i>Macropus fuliginosus</i> (Western Grey Kangaroo)			
329.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
330.	25650 <i>Malurus elegans</i> (Red-winged Fairy-wren)			
331.	25651 <i>Malurus lamberti</i> (Variegated Fairy-wren)			
332.	24551 <i>Malurus pulcherrimus</i> (Blue-breasted Fairy-wren)			
333.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
334.	24552 <i>Malurus splendens</i> subsp. <i>splendens</i> (Splendid Fairy-wren)			
335.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
336.	<i>Maratus pavonis</i>			
337.	<i>Maydenoptila baynesi</i>			
338.	<i>Maydenoptila</i> sp.			
339.	25758 <i>Megalurus gramineus</i> (Little Grassbird)			
340.	<i>Megapodagrionidae</i> sp.			
341.	<i>Megaporus</i> sp.			
342.	47997 <i>Melanodryas cucullata</i> (Hooded Robin)			
343.	25663 <i>Melithreptus brevirostris</i> (Brown-headed Honeyeater)			
344.	24587 <i>Melithreptus chloropsis</i> (Western White-naped Honeyeater)			
345.	25184 <i>Menetia greyii</i>			
346.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)			
347.	<i>Microcarbo melanoleucos</i>			
348.	<i>Microctenonyx subitaneus</i>			
349.	25693 <i>Microeca fascinans</i> (Jacky Winter)			
350.	<i>Micronecta gracilis</i>			
351.	<i>Micronecta robusta</i>			
352.	<i>Micronecta</i> sp.			
353.	<i>Missulena granulosa</i>			
354.	<i>Missulena hoggi</i>			
355.	<i>Missulena occatoria</i>			
356.	<i>Mituliodon tarantulinus</i>			
357.	<i>Miturga agelenina</i>			Y
358.	<i>Miturga catograpt</i>			
359.	<i>Molycris quadricauda</i>			
360.	25240 <i>Morelia spilota</i> subsp. <i>imbricata</i> (Carpet Python)			
361.	25191 <i>Morethia lineocellata</i>			
362.	25192 <i>Morethia obscura</i>			
363.	24223 <i>Mus musculus</i> (House Mouse)	Y		
364.	24042 <i>Mustela putorius</i> (European Polecat, Ferret)	Y		
365.	<i>Muziris carinatus</i>			
366.	<i>Myandra bicincta</i>			
367.	25610 <i>Myiagra inquieta</i> (Restless Flycatcher)			
368.	24146 <i>Myrmecobius fasciatus</i> (Numbat, Walpurti)		T	
369.	<i>Naididae</i> sp.			
370.	<i>Nannoperca vittata</i>			
371.	<i>Necterosoma darwini</i>			
372.	<i>Necterosoma penicillatus</i>			
373.	<i>Necterosoma</i> sp.			
374.	<i>Nematoda</i> sp.			
375.	<i>Nemertini</i> sp.			
376.	25426 <i>Neobatrachus pelobatoides</i> (Humming Frog)			
377.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
378.	24739 <i>Neophema petrophila</i> (Rock Parrot)			
379.	<i>Neosilurus hyrtlii</i>			
380.	<i>Neostorena vituperata</i>			Y
381.	<i>Nephila edulis</i>			
382.	<i>Newmanoperla exigua</i>			
383.	<i>Notalina</i> nr. sp. AV14			
384.	<i>Notalina</i> sp. AV15 (PSW)			
385.	<i>Notalina</i> sp. AV17 (RCM)			Y
386.	<i>Notalina spira</i>			
387.	48024 <i>Notamacropus eugenii</i> subsp. <i>derbianus</i> (Tammar Wallaby, Tammar)		P4	
388.	48022 <i>Notamacropus irma</i> (Western Brush Wallaby)		P4	
389.	25252 <i>Notechis scutatus</i> (Tiger Snake)			
390.	<i>Notonectidae</i> sp.			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
391.	<i>Notoperata tenax</i>			
392.	<i>Nousia</i> sp. AV16			
393.	<i>Novakiella trituberculosa</i>			
394.	<i>Nunciella aspera</i>			
395.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
396.	24194 <i>Nyctophilus geoffroyi</i> (Lesser Long-eared Bat)			
397.	24195 <i>Nyctophilus gouldi</i> (Gould's Long-eared Bat)			
398.	<i>Nyungara bunni</i>			
399.	<i>Occiperipatooides gilesii</i>			
400.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
401.	<i>Oecetis</i> sp.			
402.	<i>Oecobius putus</i>			
403.	<i>Offadens soror</i> (ex genus 1 WA sp. 1)			
404.	<i>Oligochaeta</i> sp.			
405.	<i>Oniscidae</i> sp.			
406.	<i>Opisthopora</i> sp.			
407.	<i>Oribatida</i> sp.			
408.	<i>Orthetrum caledonicum</i>			
409.	<i>Orthoclaadiinae</i> 'woodminer' (SAP)			
410.	<i>Orthoclaadiinae</i> SO3 sp. A (SAP)			
411.	<i>Orthoclaadiinae</i> sp.			
412.	24085 <i>Oryctolagus cuniculus</i> (Rabbit)	Y		
413.	<i>Ostearius melanopygius</i>			
414.	<i>Ostracoda</i> (unident.)			
415.	<i>Oxidae</i> sp.			
416.	<i>Oxyethira</i> sp.			
417.	<i>Oxyopes gracilipes</i>			
418.	<i>Oxyopes rubicundus</i>			
419.	24328 <i>Oxyura australis</i> (Blue-billed Duck)		P4	
420.	<i>Ozarchaea westraliensis</i>			
421.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
422.	24693 <i>Pachyptila desolata</i> (Antarctic Prion)			
423.	<i>Palaemonidae</i> sp.			
424.	<i>Parachironomus</i> sp. 1 (VSCL35) (SAP)			
425.	<i>Paracladopelma</i> M1 (SFM)			
426.	<i>Paracymus pygmaeus</i>			
427.	<i>Parakiefferiella</i> sp. S1			
428.	<i>Parakiefferiella variegatus</i>			
429.	<i>Paralampona marangaroo</i>			
430.	<i>Paralimnophyes pullulus</i> (V42)			
431.	<i>Paramelitidae</i> sp.			
432.	<i>Paramerina levidensis</i>			
433.	<i>Paraplatooides nigrum</i>			
434.	<i>Parastacidae</i> sp.			
435.	25253 <i>Parasuta gouldii</i>			
436.	25255 <i>Parasuta nigriceps</i>			
437.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
438.	24625 <i>Pardalotus punctatus</i> subsp. <i>punctatus</i> (Spotted Pardalote)			
439.	24626 <i>Pardalotus punctatus</i> subsp. <i>xanthopyge</i> (Yellow-rumped Pardalote)			
440.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
441.	24630 <i>Pardalotus striatus</i> subsp. <i>westraliensis</i> (Striated Pardalote)			
442.	<i>Pediana occidentalis</i>			
443.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
444.	<i>Penemideopsis pusilla</i>			Y
445.	<i>Pentaneurini</i> genus V20			
446.	<i>Pentastemon securifer</i>			
447.	24155 <i>Perameles eremiana</i> (Desert Bandicoot, walilya)		X	
448.	<i>Perthiidae</i> sp.			
449.	48060 <i>Petrochelidon ariel</i> (Fairy Martin)			
450.	48061 <i>Petrochelidon nigricans</i> (Tree Martin)			
451.	48066 <i>Petroica boodang</i> (Scarlet Robin)			
452.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
453.	24165 <i>Petropseudes dahli</i> (Rock Ringtail Possum, Wogoit)		P3	
454.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
455.	25698 <i>Phalacrocorax melanoleucos</i> (Little Pied Cormorant)			
456.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
457.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
458.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
459.	25587 <i>Phaps elegans</i> (Brush Bronzewing)			
460.	25508 <i>Phascogale tapoatafa</i> (Brush-tailed Phascogale)			S

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
461.	48070 <i>Phascogale tapoatafa</i> subsp. <i>wambenger</i> (South-western Brush-tailed Phascogale, Wambenger)		S	
462.	<i>Phenasteron longiconductor</i>			
463.	<i>Phreodrilidae</i> sp.			
464.	<i>Phryganoporus nigrinus</i>			
465.	48071 <i>Phylidonyris niger</i> (White-cheeked Honeyeater)			
466.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
467.	<i>Physidae</i> sp.			
468.	<i>Pinkfloydia harveii</i>			
469.	<i>Planorbidae</i> sp.			
470.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
471.	<i>Platorish gelorup</i>			
472.	25720 <i>Platycercus icterotis</i> (Western Rosella)			
473.	24745 <i>Platycercus icterotis</i> subsp. <i>icterotis</i> (Western Rosella)			
474.	24747 <i>Platycercus spurius</i> (Red-capped Parrot)			
475.	25721 <i>Platycercus zonarius</i> (Australian Ringneck, Ring-necked Parrot)			
476.	24750 <i>Platycercus zonarius</i> subsp. <i>semitorquatus</i> (Twenty-eight Parrot)			
477.	<i>Platynectes</i> sp.			
478.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
479.	25704 <i>Podiceps cristatus</i> (Great Crested Grebe)			
480.	<i>Podonomopsis</i> sp. 1			
481.	<i>Poecilopta smaragdinea</i>			
482.	25510 <i>Pogona minor</i> (Dwarf Bearded Dragon)			
483.	24907 <i>Pogona minor</i> subsp. <i>minor</i> (Dwarf Bearded Dragon)			
484.	24681 <i>Poliocephalus poliocephalus</i> (Hoary-headed Grebe)			
485.	<i>Polypedilum</i> nr. <i>convexum</i> (SAP)			
486.	<i>Polypedilum nubifer</i>			
487.	<i>Polypedilum watsoni</i>			
488.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
489.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
490.	24767 <i>Porphyrio porphyrio</i> subsp. <i>bellus</i> (Purple Swamphen)			
491.	24771 <i>Porzana tabuensis</i> (Spotless Crane)			
492.	24164 <i>Potorous platyops</i> (Broad-faced Potoroo)		X	
493.	<i>Prionosternum nitidiceps</i>			
494.	<i>Prionosternum scutatum</i>			
495.	<i>Procladius</i> DEC sp. P1 (formerly <i>P. paludicola</i> P1 no U-claws)			
496.	<i>Procladius paludicola</i>			
497.	<i>Procladius</i> sp.			
498.	<i>Procordulia affinis</i>			
499.	24166 <i>Pseudocheirus occidentalis</i> (Western Ringtail Possum, ngwayir)		T	
500.	<i>Pseudolampona jarrahdale</i>			
501.	25511 <i>Pseudonaja affinis</i> (Dugite)			
502.	25259 <i>Pseudonaja affinis</i> subsp. <i>affinis</i> (Dugite)			
503.	42416 <i>Pseudonaja mengdeni</i> (Western Brown Snake)			
504.	25264 <i>Pseudonaja nuchalis</i> (Gwardar, Northern Brown Snake)			
505.	25433 <i>Pseudophryne guentheri</i> (Crawling Toadlet)			
506.	24702 <i>Pterodroma brevirostris</i> (Kerguelen Petrel)			
507.	24703 <i>Pterodroma lessonii</i> (White-headed Petrel)			
508.	24173 <i>Pteropus scapulatus</i> (Little Red Flying-fox)			
509.	<i>Purpureicephalus spurius</i>			
510.	24245 <i>Rattus rattus</i> (Black Rat)	Y		
511.	<i>Raveniella cirrata</i>			
512.	<i>Raveniella peckorum</i>			
513.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
514.	<i>Rhantus suturalis</i>			
515.	<i>Rheotanytarsus</i> sp. (SFM)			
516.	<i>Rheotanytarsus trivittatus</i>			
517.	<i>Rheotanytarsus underwoodi</i>			
518.	48096 <i>Rhipidura albiscapa</i> (Grey Fantail)			
519.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
520.	24454 <i>Rhipidura leucophrys</i> subsp. <i>leucophrys</i> (Willie Wagtail)			
521.	<i>Richardsonianidae</i> sp.			
522.	<i>Riekoperla occidentalis</i>			
523.	<i>Riethia</i> v4			
524.	<i>Riethia</i> v5			
525.	<i>Sandalodes scopifer</i>			
526.	<i>Scirtidae</i> sp.			
527.	<i>Scolopendra laeta</i>			
528.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
529.	24145 <i>Setonix brachyurus</i> (Quokka)		T	
530.	<i>Simaetha thoracica</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
531.	<i>Simuliidae sp.</i>			Y
532.	<i>Siphonotus michaelsoni</i>			Y
533.	30948 <i>Smicromis brevirostris</i> (Weebill)			
534.	24108 <i>Sminthopsis crassicaudata</i> (Fat-tailed Dunnart)			
535.	24111 <i>Sminthopsis gilberti</i> (Gilbert's Dunnart)			
536.	<i>Sondra aurea</i>			
537.	<i>Sondra tristicula</i>			
538.	24645 <i>Stagonopleura oculata</i> (Red-eared Firetail)			
539.	24522 <i>Sterna bergii</i> (Crested Tern)			
540.	<i>Sternopriscus browni</i>			
541.	<i>Sternopriscus marginatus</i>			
542.	<i>Sternopriscus minimus</i>			
543.	<i>Sternopriscus sp.</i>			
544.	<i>Stictocladus occidentalis</i>			
545.	24329 <i>Stictonetta naevosa</i> (Freckled Duck)			
546.	<i>Storena formosa</i>			
547.	<i>Storosa tetrica</i>			
548.	<i>Stratiomyidae sp.</i>			
549.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
550.	25589 <i>Streptopelia chinensis</i> (Spotted Turtle-Dove)	Y		
551.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
552.	<i>Supunna funerea</i>			
553.	<i>Supunna picta</i>			
554.	24259 <i>Sus scrofa</i> (Pig)	Y		
555.	<i>Symphyotognatha picta</i>			
556.	33992 <i>Synemon gratiosa</i> (Graceful Sunmoth)		P4	
557.	<i>Synothele durokoppin</i>			
558.	<i>Synothele longbottomi</i>			
559.	<i>Synothele michaelsoni</i>			
560.	<i>Synsphyronus mimulus</i>			
561.	<i>Tabanidae sp.</i>			
562.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
563.	24682 <i>Tachybaptus novaehollandiae subsp. novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
564.	24207 <i>Tachyglossus aculeatus</i> (Short-beaked Echidna)			
565.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck, Mountain Duck)			
566.	30870 <i>Taeniopygia guttata</i> (Zebra Finch)			
567.	<i>Tamopsis darlingtoniana</i>			
568.	<i>Tandanus bostocki</i>			
569.	<i>Tanypodinae sp.</i>			
570.	<i>Tanytarsus aff manleyensis</i>			
571.	<i>Tanytarsus b1</i>			
572.	<i>Tanytarsus fuscithorax/semibarbitarsus</i>			
573.	<i>Tanytarsus nr K5</i>			
574.	<i>Tanytarsus palmatus</i>			
575.	<i>Tanytarsus sp. I (SAP)</i>			
576.	24167 <i>Tarsipes rostratus</i> (Honey Possum, Noolbenger)			
577.	<i>Taschorema pallescens</i>			
578.	<i>Tasmanicosa leuckartii</i>			
579.	<i>Tasmanocoenis tillyardi</i>			
580.	<i>Temnocephalidea sp.</i>			
581.	<i>Tetragnatha maeandrata</i>			Y
582.	<i>Tetragnatha valida</i>			
583.	<i>Thienemanniella sp. (V19) (SAP)</i>			
584.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
585.	25203 <i>Tiliqua occipitalis</i> (Western Bluetongue)			
586.	25519 <i>Tiliqua rugosa</i>			
587.	25207 <i>Tiliqua rugosa subsp. rugosa</i>			
588.	<i>Tillia davisae</i>			Y
589.	<i>Tinytrema yarra</i>			
590.	<i>Tipulidae sp.</i>			
591.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
592.	<i>Trachycosmus sculpilis</i>			
593.	<i>Trachytrema castaneum</i>			
594.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
595.	25521 <i>Trichosurus vulpecula</i> (Common Brushtail Possum)			
596.	24157 <i>Trichosurus vulpecula subsp. arnhemensis</i> (northern brushtail possum (Kimberley))		T	
597.	24158 <i>Trichosurus vulpecula subsp. vulpecula</i> (Common Brushtail Possum)			
598.	24808 <i>Tringa nebularia</i> (Common Greenshank, greenshank)			IA

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599.	<i>Triplectides australis</i>			
600.	<i>Triplectides</i> sp. AV1 (SFM)			
601.	<i>Triplectides</i> sp. AV21 (SFM)			
602.	48147 <i>Turnix varius</i> (Painted Button-quail)			
603.	24852 <i>Tyto alba</i> subsp. <i>delicatula</i> (Barn Owl)			
604.	25764 <i>Tyto novaehollandiae</i> (Masked Owl)			
605.	24855 <i>Tyto novaehollandiae</i> subsp. <i>novaehollandiae</i> (Masked Owl (southwest))		P3	
606.	24983 <i>Underwoodisaurus milii</i> (Barking Gecko)			
607.	<i>Urodacus novaehollandiae</i>			
608.	<i>Urodacus planimanus</i>			
609.	<i>Urodacus woodwardii</i>			
610.	24386 <i>Vanellus tricolor</i> (Banded Lapwing)			
611.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
612.	25225 <i>Varanus rosenbergi</i> (Heath Monitor)			
613.	25526 <i>Varanus tristis</i> (Racehorse Monitor)			
614.	<i>Veliidae</i> sp.			
615.	<i>Venator immansueta</i>			
616.	24206 <i>Vespadelus regulus</i> (Southern Forest Bat)			
617.	24040 <i>Vulpes vulpes</i> (Red Fox)	Y		
618.	34113 <i>Westralunio carteri</i> (Carter's Freshwater Mussel)		T	
619.	<i>Wheenyoides cooki</i>			
620.	<i>Xanthagrion erythroneurum</i>			
621.	<i>Zebraplatys fractivittata</i>			
622.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye, Silvereye)			

Fungi

623.	<i>Agaricus</i> sp.			
624.	<i>Aleurina ferruginea</i>			
625.	18195 <i>Amanita carneiphylla</i>		P3	
626.	48636 <i>Amanita djarilmari</i>			
627.	43543 <i>Amanita fibrillopes</i>		P3	
628.	46334 <i>Amanita kalamundae</i> (Kalamunda Lepidella)		P3	
629.	38755 <i>Amanita ochroterrea</i>			
630.	38756 <i>Amanita umbrinella</i>			
631.	43542 <i>Amanita wadjukiorum</i>		P3	
632.	38757 <i>Amanita xanthocephala</i>			
633.	38760 <i>Arcangeliella daucina</i>			
634.	<i>Armillaria luteobubalina</i>			
635.	<i>Austroboletus occidentalis</i>			
636.	<i>Austrogautieria manjimupana</i>			
637.	42106 <i>Austroparmelina conlabrosa</i>			
638.	38764 <i>Austropaxillus muelleri</i>			
639.	46074 <i>Boletellus ananiceps</i>			
640.	<i>Boletellus obscurecoccineus</i>			
641.	<i>Boletus</i> sp.			
642.	27597 <i>Buellia disciformis</i>			
643.	<i>Caloplaca</i> sp.			
644.	38767 <i>Campanella gregaria</i>			
645.	41264 <i>Chrysothrix xanthina</i>			
646.	27663 <i>Cladia aggregata</i>			
647.	27664 <i>Cladia corallaizon</i>			
648.	27665 <i>Cladia ferdinandii</i>			
649.	27666 <i>Cladia inflata</i>			
650.	48177 <i>Cladia muelleri</i>			
651.	27669 <i>Cladia sullivanii</i>			
652.	27673 <i>Cladonia capitellata</i>			
653.	28208 <i>Cladonia cervicornis</i> subsp. <i>verticillata</i>			
654.	27685 <i>Cladonia macilenta</i>			
655.	27688 <i>Cladonia ochrochlora</i>			
656.	27697 <i>Cladonia tessellata</i>			
657.	38771 <i>Coltriciella dependens</i>			
658.	<i>Cortinarius australiensis</i>			
659.	<i>Cortinarius erythraeus</i>			
660.	38874 <i>Cortinarius globuliformis</i>			
661.	48174 <i>Cortinarius hallowellensis</i>			
662.	38776 <i>Cortinarius phalarus</i>			
663.	<i>Cortinarius rotundisporus</i>			
664.	<i>Cortinarius sinapicolor</i>			
665.	38780 <i>Crepidotus eucalyptorum</i>			
666.	38781 <i>Dacryopinax spathularia</i>			
667.	<i>Dermocybe austroveneta</i>			

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668.	41686 <i>Descomyces albellus</i>			
669.	38785 <i>Descomyces angustisporus</i>			
670.	27742 <i>Ephebe lanata</i>			
671.	<i>Fistulina hepatica</i>			
672.	27746 <i>Flavoparmelia marchantii</i>			
673.	27748 <i>Flavoparmelia rutidota</i>			
674.	<i>Fomitopsis lilacinogilva</i>			
675.	<i>Gymnopilus allantopus</i>			
676.	44813 <i>Hohenbuehelia ligulata</i>			
677.	38794 <i>Hydnum repandum</i>			
678.	38796 <i>Hypholoma australe</i>			
679.	44718 <i>Hypocrea gelatinosa</i>			
680.	27787 <i>Hypogymnia subphysodes</i>			
681.	44926 <i>Ileodictyon gracile</i>			
682.	27789 <i>Imshaugia aleurites</i>			
683.	48508 <i>Inocybe brunneidisca</i>			
684.	48509 <i>Inocybe bulbinella</i>			
685.	48510 <i>Inocybe cacaocolor</i>			
686.	41481 <i>Inocybe fulvilubrica</i>			
687.	48527 <i>Inocybe invadens</i>			
688.	40870 <i>Inocybe rufuloides</i>	Y		
689.	48547 <i>Inocybe serrata</i>			
690.	48549 <i>Inocybe subferruginea</i>			
691.	48550 <i>Inocybe subflavospora</i>			
692.	38800 <i>Labyrinthomyces varius</i>			
693.	<i>Laccaria lateritia</i>			
694.	38804 <i>Lactarius eucalypti</i>			
695.	48820 <i>Lepra subventosa</i>			
696.	27835 <i>Leprocaulon microscopicum</i>			
697.	31280 <i>Lichenomphalia chromacea</i>			
698.	31333 <i>Lichenomphalia umbellifera</i>			
699.	38809 <i>Marasmius crinisequi</i>			
700.	47234 <i>Mesophellia glauca</i>			
701.	47236 <i>Mesophellia parva</i>			
702.	47237 <i>Mesophellia trabalis</i>			
703.	<i>Mycena carmeliana</i>			
704.	<i>Nidula emodensis</i>			
705.	30457 <i>Notocladonia cochleata</i>			
706.	44868 <i>Notoparmelia erumpens</i>			
707.	27884 <i>Ochrolechia subpallascens</i>			
708.	38816 <i>Omphalotus nidiformis</i>			
709.	27892 <i>Pannoparmelia wilsonii</i>			
710.	<i>Panus fasciatus</i>			
711.	27905 <i>Paraporpidia glauca</i>			
712.	27922 <i>Parmotrema chinense</i>			
713.	30458 <i>Parmotrema reticulatum</i>			
714.	27947 <i>Pertusaria gibberosa</i>			
715.	27948 <i>Pertusaria leioplacella</i>			
716.	<i>Peziza sp.</i>			
717.	<i>Phlebia subceracea</i>			
718.	<i>Pholiota communis</i>			
719.	<i>Pholiota highlandensis</i>			
720.	<i>Phytophthora cinnamomi</i>			
721.	48975 <i>Pisolithus microcarpus</i>			
722.	<i>Pisolithus sp.</i>			
723.	38824 <i>Pleurotus australis</i>			
724.	<i>Pluteus atomarginatus</i>			
725.	38825 <i>Pluteus pauperculus</i>			
726.	29385 <i>Pseudephebe pubescens</i>			
727.	38830 <i>Psilocybe coprophila</i>			
728.	27998 <i>Psora crenata</i>			
729.	<i>Punctularia strigosozonata</i>			
730.	28224 <i>Ramalina inflata</i> subsp. <i>australis</i>			
731.	<i>Ramaria lorithamnus</i>			
732.	33646 <i>Ramboldia blastidiata</i>			Y
733.	41243 <i>Ramboldia laeta</i>			
734.	<i>Rickenella fibula</i>			
735.	48909 <i>Russula clelandii</i>			
736.	48906 <i>Russula delica</i>			
737.	38837 <i>Russula flocktoniae</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
738.	48733 <i>Russula pisiglaea</i>			
739.	48907 <i>Russula purpureoflava</i>			
740.	<i>Scleroderma albidum</i>			
741.	28060 <i>Siphula coriacea</i>			
742.	38840 <i>Stereum hirsutum</i>			
743.	<i>Stropharia semiglobata</i>			
744.	38842 <i>Suillus luteus</i>	Y		
745.	28070 <i>Thysanothecium hookeri</i>			
746.	28071 <i>Thysanothecium scutellatum</i>			
747.	38845 <i>Trechispora farinacea</i>			
748.	<i>Tricholoma saponaceum</i>			
749.	<i>Tricholomopsis rutilans</i>			
750.	<i>Tubaria rufolva</i>			
751.	<i>Uromycladium tepperianum</i>			
752.	28087 <i>Usnea inermis</i>			
753.	28227 <i>Usnea scabrida</i> subsp. <i>scabrida</i>			
754.	29034 <i>Xanthoparmelia brattii</i>			
755.	28110 <i>Xanthoparmelia burmeisteri</i>			
756.	18006 <i>Xanthoparmelia darlingensis</i>		P1	
757.	28123 <i>Xanthoparmelia digitiformis</i>			
758.	28129 <i>Xanthoparmelia elixii</i>			
759.	28134 <i>Xanthoparmelia flavescens</i> <i>reagens</i>			
760.	29981 <i>Xanthoparmelia fracticollis</i>			Y
761.	28144 <i>Xanthoparmelia isidiigera</i>			
762.	28154 <i>Xanthoparmelia monadnockensis</i>			
763.	28160 <i>Xanthoparmelia norstrigosa</i>			Y
764.	28162 <i>Xanthoparmelia notata</i>			
765.	28165 <i>Xanthoparmelia parvoincerta</i>			
766.	28174 <i>Xanthoparmelia scabrosa</i>			
767.	28327 <i>Xanthoparmelia semiviridis</i>			
768.	<i>Xanthoparmelia</i> sp.			
769.	29018 <i>Xanthoparmelia subimitatrix</i>		P3	
770.	28179 <i>Xanthoparmelia substrigosa</i>			
771.	28182 <i>Xanthoparmelia tasmanica</i>			
772.	28356 <i>Xanthoparmelia verrucella</i>			

Plantae

773.	? <i>Hypolaena exsulca</i>			Y
774.	? <i>Persoonia saccata</i>			Y
775.	3207 <i>Acacia alata</i> (<i>Winged Wattle</i>)			
776.	15429 <i>Acacia alata</i> var. <i>alata</i>			
777.	15466 <i>Acacia applanata</i>			
778.	3233 <i>Acacia barbinervis</i>			
779.	15469 <i>Acacia barbinervis</i> subsp. <i>barbinervis</i>			
780.	3247 <i>Acacia browniana</i>			
781.	3254 <i>Acacia celastrifolia</i> (<i>Glowing Wattle</i>)			
782.	16975 <i>Acacia decurrens</i>	Y		
783.	3294 <i>Acacia dentifera</i>			
784.	3307 <i>Acacia divergens</i>			
785.	3310 <i>Acacia drewiana</i>			
786.	11926 <i>Acacia drewiana</i> subsp. <i>drewiana</i>			
787.	11192 <i>Acacia drummondii</i> subsp. <i>elegans</i>			
788.	3320 <i>Acacia ephedroides</i>			
789.	3331 <i>Acacia extensa</i> (<i>Wiry Wattle</i>)			
790.	18286 <i>Acacia floribunda</i>	Y		
791.	3373 <i>Acacia horridula</i>		P3	
792.	3374 <i>Acacia huegelii</i>			
793.	3382 <i>Acacia incrassata</i>			
794.	3383 <i>Acacia incurva</i>			
795.	18217 <i>Acacia iteaphylla</i>	Y		
796.	3409 <i>Acacia lasiocarpa</i> (<i>Panjang</i>)			
797.	11519 <i>Acacia lasiocarpa</i> var. <i>bracteolata</i>			
798.	14932 <i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant (G.J. Keighery 5026)		P1	
799.	3410 <i>Acacia lateriticola</i>			
800.	15476 <i>Acacia latipes</i> subsp. <i>latipes</i>			
801.	3442 <i>Acacia microbotrya</i> (<i>Manna Wattle, Kalyang</i>)			
802.	3451 <i>Acacia multispicata</i>			
803.	3454 <i>Acacia nervosa</i> (<i>Rib Wattle</i>)			
804.	3464 <i>Acacia obovata</i>			
805.	14129 <i>Acacia oncinophylla</i> subsp. <i>oncinophylla</i>		P3	
806.	17860 <i>Acacia podalyriifolia</i>			

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		Y		
807.	3496 <i>Acacia preissiana</i>			
808.	3502 <i>Acacia pulchella</i> (Prickly Moses)			
809.	15481 <i>Acacia pulchella</i> var. <i>glaberrima</i>			
810.	15483 <i>Acacia pulchella</i> var. <i>pulchella</i>			
811.	15480 <i>Acacia pulchella</i> var. <i>reflexa</i>			
812.	3527 <i>Acacia saligna</i> (Orange Wattle, Kudjong)			
813.	30033 <i>Acacia saligna</i> subsp. <i>lindleyi</i>			
814.	30032 <i>Acacia saligna</i> subsp. <i>saligna</i>			
815.	3541 <i>Acacia sessilis</i>			
816.	<i>Acacia</i> sp.			
817.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
818.	16151 <i>Acacia subflexuosa</i> subsp. <i>subflexuosa</i>			
819.	3574 <i>Acacia teretifolia</i>			
820.	3576 <i>Acacia tetragonocarpa</i>			
821.	3581 <i>Acacia trigonophylla</i>			
822.	3591 <i>Acacia urophylla</i>			
823.	15487 <i>Acacia varia</i> var. <i>varia</i>			
824.	3602 <i>Acacia willdenowiana</i> (Grass Wattle)			
825.	3184 <i>Acaena echinata</i> (Sheep's Burr)			
826.	1205 <i>Acanthocarpus canaliculatus</i>			
827.	1208 <i>Acanthocarpus preissii</i>			
828.	6203 <i>Actinotus glomeratus</i>			
829.	6205 <i>Actinotus leucocephalus</i> (Flannel Flower)			
830.	14970 <i>Adenanthos barbiger</i>			
831.	1775 <i>Adenanthos cygnorum</i> (Common Woollybush)			
832.	1790 <i>Adenanthos meisneri</i>			
833.	1791 <i>Adenanthos obovatus</i> (Basket Flower)			
834.	25 <i>Adiantum aethiopicum</i> (Common Maidenhair)			
835.	23474 <i>Agrostocrinum hirsutum</i>			
836.	1261 <i>Agrostocrinum scabrum</i> (Blue Grass Lily)			
837.	184 <i>Aira caryophyllea</i> (Silvery Hairgrass)	Y		
838.	185 <i>Aira cupaniana</i> (Silvery Hairgrass)	Y		
839.	187 <i>Aira praecox</i> (Early Hairgrass)	Y		
840.	48513 <i>Aizoon pubescens</i>	Y		
841.	1728 <i>Allocasuarina fraseriana</i> (Sheoak, Kondil)			
842.	1731 <i>Allocasuarina huegeliana</i> (Rock Sheoak, Kwowl)			
843.	1732 <i>Allocasuarina humilis</i> (Dwarf Sheoak)			
844.	1734 <i>Allocasuarina microstachya</i>			
845.	1739 <i>Allocasuarina thuyoides</i> (Horned Sheoak)			
846.	2652 <i>Alternanthera nodiflora</i> (Common Joyweed)			
847.	4585 <i>Amperea ericoides</i>			
848.	13101 <i>Amperea simulans</i>			
849.	13380 <i>Amphibromus nervosus</i>			
850.	194 <i>Amphipogon amphipogonoides</i>			
851.	197 <i>Amphipogon debilis</i>			
852.	198 <i>Amphipogon laguroides</i>			
853.	20184 <i>Amphipogon laguroides</i> subsp. <i>laguroides</i>			
854.	199 <i>Amphipogon strictus</i> (Greybeard Grass)			
855.	200 <i>Amphipogon turbinatus</i>			
856.	13267 <i>Amyema linophylla</i> subsp. <i>linophylla</i>			
857.	2380 <i>Amyema miquelii</i> (Stalked Mistletoe)			
858.	1059 <i>Anarthria humilis</i>			
859.	1060 <i>Anarthria laevis</i>			
860.	6300 <i>Andersonia aristata</i> (Rice Flower)			
861.	6312 <i>Andersonia involucrata</i>			
862.	6314 <i>Andersonia lehmanniana</i>			
863.	11471 <i>Andersonia lehmanniana</i> subsp. <i>lehmanniana</i>			
864.	41731 <i>Andersonia</i> sp. <i>Audax</i> (F. Hort, B. Hort & J. Hort 3179)		P3	
865.	41740 <i>Andersonia</i> sp. <i>Saxatilis</i> (F. & J. Hort 3324)		P1	
866.	7829 <i>Angianthus drummondii</i>		P3	
867.	7833 <i>Angianthus preissianus</i>			
868.	1409 <i>Anigozanthos humilis</i> (Catspaw)			
869.	1411 <i>Anigozanthos manglesii</i> (Mangles Kangaroo Paw, Kurulbrang)			
870.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
871.	29487 <i>Anigozanthos manglesii</i> var. <i>x angustifolius</i>			
872.	<i>Anigozanthos</i> sp.			
873.	1416 <i>Anigozanthos viridis</i> (Green Kangaroo Paw, Kurulbardang)			
874.	11566 <i>Anigozanthos viridis</i> subsp. <i>viridis</i>			
875.	6946 <i>Anthocercis gracilis</i> (Slender Tailflower)			
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876.	7411 <i>Anthotium humile</i> (Dwarf Anthotium)			
877.	12724 <i>Anthotium junciforme</i>			
878.	202 <i>Anthoxanthum odoratum</i> (Sweet Vernal Grass)	Y		
879.	3686 <i>Aotus cordifolia</i>			
880.	3688 <i>Aotus gracillima</i>			
881.	3692 <i>Aotus procumbens</i>			
882.	1116 <i>Aphelia brizula</i>			
883.	1117 <i>Aphelia cyperoides</i>			
884.	1119 <i>Aphelia nutans</i>			
885.	43548 <i>Aphelia</i> sp. Albany (B.G. Briggs 596)			
886.	17845 <i>Apodasmia ceramophila</i>			
887.	141 <i>Aponogeton hexatepalus</i> (Stalked Water Ribbons)		P4	
888.	7838 <i>Arctotheca calendula</i> (Cape Weed, African Marigold)	Y		
889.	207 <i>Aristida contorta</i> (Bunched Kerosene Grass)			
890.	222 <i>Aristida ramosa</i> (Purple Wiregrass)	Y		
891.	<i>Aristida</i> sp.			
892.	1264 <i>Arnocrinum preissii</i>			
893.	6580 <i>Asclepias curassavica</i> (Redhead Cottonbush)	Y		
894.	8779 <i>Asparagus asparagoides</i> (Bridal Creeper)	Y		
895.	<i>Astartea</i> aff. <i>fascicularis</i> sthct			
896.	20350 <i>Astartea affinis</i> (West-coast <i>Astartea</i>)			
897.	20249 <i>Astartea leptophylla</i> (River-bank <i>Astartea</i>)			
898.	20283 <i>Astartea scoparia</i> (Common <i>Astartea</i>)			
899.	<i>Asteraceae</i> sp.			
900.	<i>Asterella drummondii</i>			
901.	7851 <i>Asteridea pulverulenta</i> (Common Bristle Daisy)			
902.	4400 <i>Asterolasia pallida</i>			
903.	6323 <i>Astroloma ciliatum</i> (Candle Cranberry)			
904.	6328 <i>Astroloma glaucescens</i>			
905.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
906.	6337 <i>Astroloma stomarrhena</i> (Red Swamp Cranberry)			
907.	17233 <i>Austrostipa campylachne</i>			
908.	17234 <i>Austrostipa compressa</i>			
909.	17237 <i>Austrostipa elegantissima</i>			
910.	17253 <i>Austrostipa semibarbata</i>			
911.	<i>Austrostipa semibarbata</i> / <i>campylachne</i>			Y
912.	17254 <i>Austrostipa tenuifolia</i>			
913.	17257 <i>Austrostipa variabilis</i>			
914.	231 <i>Avellinia michelii</i>	Y		
915.	233 <i>Avena barbata</i> (Bearded Oat)	Y		
916.	235 <i>Avena sativa</i> (Common Oat)	Y		
917.	18279 <i>Babiana angustifolia</i>	Y		
918.	18280 <i>Babiana nana</i>	Y		
919.	36441 <i>Babingtonia camphorosmae</i> (Camphor Myrtle)			
920.	45402 <i>Babingtonia urbana</i> (Coastal Plain <i>Babingtonia</i>)		P3	
921.	32681 <i>Banksia armata</i> (Prickly <i>Dryandra</i>)			
922.	1800 <i>Banksia attenuata</i> (Slender <i>Banksia</i> , <i>Piara</i>)			
923.	32678 <i>Banksia bipinnatifida</i> subsp. <i>bipinnatifida</i>			
924.	32576 <i>Banksia dallanneyi</i> (Couch <i>Honeypot</i>)			
925.	32580 <i>Banksia dallanneyi</i> subsp. <i>dallanneyi</i> var. <i>dallanneyi</i>			
926.	32577 <i>Banksia dallanneyi</i> subsp. <i>dallanneyi</i> var. <i>mellicula</i>			
927.	1819 <i>Banksia grandis</i> (Bull <i>Banksia</i> , <i>Pulgarla</i>)			
928.	1822 <i>Banksia ilicifolia</i> (Holly-leaved <i>Banksia</i>)			
929.	32214 <i>Banksia kippistiana</i>			
930.	1830 <i>Banksia littoralis</i> (Swamp <i>Banksia</i> , <i>Pungura</i>)			
931.	1834 <i>Banksia menziesii</i> (Firewood <i>Banksia</i>)			
932.	32202 <i>Banksia nivea</i> (<i>Honeypot Dryandra</i> , <i>Pudjarn</i>)			
933.	32159 <i>Banksia polycephala</i> (Many-headed <i>Dryandra</i>)			
934.	32080 <i>Banksia sessilis</i> var. <i>sessilis</i>			
935.	1852 <i>Banksia telmatiaea</i> (Swamp Fox <i>Banksia</i>)			
936.	32053 <i>Banksia undata</i> (<i>Urchin Dryandra</i>)			
937.	32055 <i>Banksia undata</i> var. <i>splendens</i>			
938.	32054 <i>Banksia undata</i> var. <i>undata</i>			
939.	32315 <i>Barbula calycina</i>			
940.	32321 <i>Bartramia breutelii</i>			
941.	32323 <i>Bartramia pseudostricta</i>			
942.	739 <i>Baumea acuta</i> (Pale <i>Twig-rush</i>)			
943.	740 <i>Baumea arthropphylla</i>			
944.	743 <i>Baumea juncea</i> (Bare <i>Twigrush</i>)			
945.	744 <i>Baumea laxa</i>			

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946.	745 <i>Baumea preissii</i>			
947.	746 <i>Baumea riparia</i>			
948.	747 <i>Baumea rubiginosa</i>			
949.	748 <i>Baumea vaginalis</i> (Sheath Twigrush)			
950.	5387 <i>Beaufortia macrostemon</i> (Darling Range <i>Beaufortia</i>)			
951.	7046 <i>Bellardia trixago</i> (<i>Bellardia</i>)	Y		
952.	48868 <i>Bellardia viscosa</i>	Y		
953.	4598 <i>Beyeria lechenaultii</i> (Pale Turpentine Bush)			
954.	3157 <i>Billardiera floribunda</i> (White-flowered <i>Billardiera</i>)			
955.	25788 <i>Billardiera fraseri</i> (Elegant Pronaya)			
956.	25798 <i>Billardiera fusiformis</i> (Australian Bluebell)			
957.	3165 <i>Billardiera variifolia</i>			
958.	1417 <i>Blancoa canescens</i> (Winter Bell)			
959.	4413 <i>Boronia crenulata</i> (Aniseed <i>Boronia</i>)			
960.	11503 <i>Boronia crenulata</i> subsp. <i>crenulata</i> var. <i>crenulata</i>			
961.	16636 <i>Boronia crenulata</i> subsp. <i>viminea</i>			
962.	4420 <i>Boronia fastigiata</i> (Bushy <i>Boronia</i>)			
963.	4429 <i>Boronia molloyae</i> (Tall <i>Boronia</i>)			
964.	4438 <i>Boronia ramosa</i>			
965.	11564 <i>Boronia ramosa</i> subsp. <i>ramosa</i>			
966.	16639 <i>Boronia scabra</i> subsp. <i>scabra</i>			
967.	4444 <i>Boronia tenuis</i> (Blue <i>Boronia</i>)		P4	
968.	1267 <i>Borya constricta</i>			
969.	1272 <i>Borya scirpoidea</i>			
970.	1273 <i>Borya sphaerocephala</i> (Pincushions)			
971.	48782 <i>Bossiaea angustifolia</i>			
972.	3704 <i>Bossiaea aquifolium</i> (Water Bush, Nedik)			
973.	14396 <i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i>			
974.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
975.	14290 <i>Bossiaea modesta</i>		P2	
976.	3714 <i>Bossiaea ornata</i> (Broad Leaved Brown Pea)			
977.	3718 <i>Bossiaea rufa</i>			
978.	10915 <i>Brachychiton populneus</i> (Kurrajong)	Y		
979.	6341 <i>Brachyloma preissii</i> (Globe Heath)			
980.	8661 <i>Brachypodium distachyon</i> (False Brome)	Y		
981.	7867 <i>Brachyscome bellidioides</i>			
982.	7871 <i>Brachyscome ciliaris</i>			
983.	7878 <i>Brachyscome iberidifolia</i>			
984.	7883 <i>Brachyscome pusilla</i>			
985.	32327 <i>Breutelia affinis</i>			
986.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
987.	245 <i>Briza minor</i> (Shivery Grass)	Y		
988.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
989.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
990.	1366 <i>Bulbine semibarbata</i> (Leek Lily)			
991.	1383 <i>Burchardia bairdiae</i>			
992.	12770 <i>Burchardia congesta</i>			
993.	1385 <i>Burchardia multiflora</i> (Dwarf <i>Burchardia</i>)			
994.	1276 <i>Caesia micrantha</i> (Pale Grass Lily)			
995.	1277 <i>Caesia occidentalis</i>			
996.	<i>Caesia</i> sp.			
997.	1586 <i>Caladenia discoidea</i> (Dancing Orchid)			
998.	1590 <i>Caladenia ferruginea</i> (Rusty Spider Orchid)			
999.	1592 <i>Caladenia flava</i> (Cowslip Orchid)			
1000.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
1001.	1596 <i>Caladenia huegelii</i> (Grand Spider Orchid)		T	
1002.	1599 <i>Caladenia latifolia</i> (Pink Fairy Orchid)			
1003.	15365 <i>Caladenia longicauda</i> subsp. <i>longicauda</i>			
1004.	1605 <i>Caladenia marginata</i> (White Fairy Orchid)			
1005.	1613 <i>Caladenia reptans</i> (Little Pink Fairy Orchid)			
1006.	15377 <i>Caladenia reptans</i> subsp. <i>reptans</i>			
1007.	15379 <i>Caladenia serotina</i>			
1008.	<i>Caladenia</i> sp.			
1009.	15380 <i>Caladenia splendens</i>			
1010.	16365 <i>Calandrinia</i> sp. <i>Kenwick</i> (G.J. Keighery 10905)			
1011.	1213 <i>Calectasia cyanea</i> (Blue Tinsel Lily)		T	
1012.	1214 <i>Calectasia grandiflora</i> (Blue Tinsel Lily)			
1013.	19309 <i>Calectasia narragara</i>			
1014.	5394 <i>Callistemon glaucus</i>			
1015.	5395 <i>Callistemon phoeniceus</i> (Lesser Bottlebrush, <i>Dubarda</i>)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1016.	4717 <i>Callitriche stagnalis</i> (Common Starwort)	Y		
1017.	36520 <i>Callitris acuminata</i> (Dwarf Cypress)			
1018.	36600 <i>Callitris pyramidalis</i> (Swamp Cypress)			
1019.	11333 <i>Calothamnus graniticus</i> subsp. <i>leptophyllus</i>		P4	
1020.	5411 <i>Calothamnus hirsutus</i>			
1021.	5415 <i>Calothamnus lateralis</i>			
1022.	35797 <i>Calothamnus lateralis</i> var. <i>lateralis</i>			
1023.	5426 <i>Calothamnus quadrifidus</i> (One-sided Bottlebrush, Kwowdjard)			
1024.	35758 <i>Calothamnus quadrifidus</i> subsp. <i>homalophyllus</i> (Murchison Clawflower)			
1025.	35816 <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>			
1026.	5428 <i>Calothamnus rupestris</i> (Mouse Ears)			
1027.	5429 <i>Calothamnus sanguineus</i> (Silky-leaved Blood flower, Pindak)			
1028.	5431 <i>Calothamnus torulosus</i>			
1029.	5437 <i>Calytrix acutifolia</i>			
1030.	5439 <i>Calytrix angulata</i> (Yellow Starflower)			
1031.	5441 <i>Calytrix aurea</i>			
1032.	5450 <i>Calytrix depressa</i>			
1033.	5458 <i>Calytrix flavescens</i> (Summer Starflower)			
1034.	5460 <i>Calytrix fraseri</i> (Pink Summer Calytrix)			
1035.	5485 <i>Calytrix variabilis</i>			
1036.	32461 <i>Campylopus bicolor</i> var. <i>bicolor</i>			
1037.	32336 <i>Campylopus clavatus</i>			
1038.	32338 <i>Campylopus introflexus</i>	Y		
1039.	3005 <i>Cardamine hirsuta</i> (Common Bittercress)	Y		
1040.	7909 <i>Carduus pycnocephalus</i> (Slender Thistle)	Y		
1041.	759 <i>Carex tereticaulis</i>		P3	
1042.	43241 <i>Carex thecata</i>			
1043.	2795 <i>Carpobrotus edulis</i> (Hottentot Fig)	Y		
1044.	1162 <i>Cartonema philydroides</i>			
1045.	2951 <i>Cassytha flava</i> (Dodder Laurel)			
1046.	2952 <i>Cassytha glabella</i> (Tangled Dodder Laurel)			
1047.	11501 <i>Cassytha glabella</i> forma <i>casuarinae</i>			
1048.	2954 <i>Cassytha micrantha</i>			
1049.	2956 <i>Cassytha pomiformis</i> (Dodder Laurel)			
1050.	2957 <i>Cassytha racemosa</i> (Dodder Laurel)			
1051.	11799 <i>Cassytha racemosa</i> forma <i>racemosa</i>			
1052.	18321 <i>Casuarina glauca</i>	Y		
1053.	1742 <i>Casuarina obesa</i> (Swamp Sheoak, Kuli)			
1054.	6539 <i>Centaurium erythraea</i> (Common Centaury)	Y		
1055.	1121 <i>Centrolepis aristata</i> (Pointed Centrolepis)			
1056.	1123 <i>Centrolepis caespitosa</i>			
1057.	1125 <i>Centrolepis drummondiana</i>			
1058.	1129 <i>Centrolepis glabra</i> (Smooth Centrolepis)			
1059.	1130 <i>Centrolepis humillima</i> (Dwarf Centrolepis)			
1060.	1131 <i>Centrolepis inconspicua</i>			
1061.	1132 <i>Centrolepis mutica</i>			
1062.	1133 <i>Centrolepis pilosa</i>			
1063.	1134 <i>Centrolepis polygyna</i> (Wiry Centrolepis)			
1064.	<i>Cephaloziella varians</i>			
1065.	2889 <i>Cerastium glomeratum</i> (Mouse Ear Chickweed)	Y		
1066.	17685 <i>Chaetanthus aristatus</i>			
1067.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
1068.	11299 <i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>			
1069.	5498 <i>Chamaelaucium uncinatum</i> (Geraldton Wax)			
1070.	31 <i>Cheilanthes austrotenuifolia</i>			
1071.	34 <i>Cheilanthes distans</i> (Bristly Cloak Fern)			
1072.	12818 <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>			
1073.	3169 <i>Cheiranthra preissiana</i>			
1074.	<i>Chiloscyphus semiteres</i> var. <i>semiteres</i>			
1075.	267 <i>Chloris gayana</i> (Rhodes Grass)	Y		
1076.	17706 <i>Chordifex sinuosus</i>			
1077.	763 <i>Chorizandra enodis</i> (Black Bristlerush)			
1078.	8971 <i>Chorizema cordatum</i>			
1079.	3753 <i>Chorizema dicksonii</i> (Yellow-eyed Flame Pea)			
1080.	12765 <i>Chorizema nanum</i>			
1081.	3761 <i>Chorizema rhombeum</i>			
1082.	11900 <i>Chrysanthemoides monilifera</i> subsp. <i>monilifera</i>	Y		
1083.	6543 <i>Cicendia filiformis</i> (Slender Cicendia)	Y		
1084.	7935 <i>Cichorium intybus</i> (Chicory)	Y		
1085.	7937 <i>Cirsium vulgare</i> (Spear Thistle, Scotch Thistle)	Y		

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1086.	2929 <i>Clematis pubescens</i> (Common Clematis)			
1087.	4550 <i>Comesperma calymega</i> (Blue-spike Milkwort)			
1088.	4551 <i>Comesperma ciliatum</i>			
1089.	4564 <i>Comesperma virgatum</i> (Milkwort)			
1090.	15041 <i>Conospermum canaliculatum</i>			
1091.	1863 <i>Conospermum capitatum</i>			
1092.	16853 <i>Conospermum capitatum</i> subsp. <i>glabratum</i>			
1093.	1875 <i>Conospermum huegelii</i> (Slender Smokebush)			
1094.	1882 <i>Conospermum stoechadis</i> (Common Smokebush)			
1095.	15520 <i>Conospermum stoechadis</i> subsp. <i>sclerophyllum</i>			
1096.	15611 <i>Conospermum stoechadis</i> subsp. <i>stoechadis</i> (Common Smokebush)			
1097.	6347 <i>Conostephium minus</i> (Pink-tipped Pearl flower)			
1098.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
1099.	6349 <i>Conostephium preissii</i>			
1100.	1418 <i>Conostylis aculeata</i> (Prickly Conostylis)			
1101.	11826 <i>Conostylis aculeata</i> subsp. <i>aculeata</i>			
1102.	12109 <i>Conostylis aculeata</i> subsp. <i>preissii</i>			
1103.	1420 <i>Conostylis androstemma</i> (Trumpets)			
1104.	1423 <i>Conostylis aurea</i> (Golden Conostylis)			
1105.	12035 <i>Conostylis caricina</i> subsp. <i>caricina</i>			
1106.	1436 <i>Conostylis juncea</i>			
1107.	1438 <i>Conostylis laxiflora</i>			
1108.	1447 <i>Conostylis pusilla</i>			
1109.	1453 <i>Conostylis serrulata</i>			
1110.	1454 <i>Conostylis setigera</i> (Bristly Cottonhead)			
1111.	11597 <i>Conostylis setigera</i> subsp. <i>setigera</i>			
1112.	1455 <i>Conostylis setosa</i> (White Cottonhead)			
1113.	<i>Conostylis</i> sp.			
1114.	7939 <i>Conyza bonariensis</i> (Flaxleaf Fleabane)	Y		
1115.	7941 <i>Conyza parva</i>	Y		
1116.	<i>Conyza</i> sp.			
1117.	<i>Conyza</i> sp. Mud07			Y
1118.	2891 <i>Corrigiola litoralis</i> (Strapwort)	Y		
1119.	17104 <i>Corymbia calophylla</i> (Marri)			
1120.	17105 <i>Corymbia haematoxylon</i> (Mountain Marri)			
1121.	1285 <i>Corynotheca micrantha</i> (Sand Lily)			
1122.	7943 <i>Cotula australis</i> (Common Cotula)			
1123.	7945 <i>Cotula coronopifolia</i> (Waterbuttons)	Y		
1124.	7946 <i>Cotula cotuloides</i> (Smooth Cotula)			
1125.	7947 <i>Cotula turbinata</i> (Funnel Weed)	Y		
1126.	13354 <i>Craspedia variabilis</i>			
1127.	3136 <i>Crassula alata</i>	Y		
1128.	17701 <i>Crassula closiana</i>			
1129.	3137 <i>Crassula colorata</i> (Dense Stonecrop)			
1130.	11563 <i>Crassula colorata</i> var. <i>colorata</i>			
1131.	3138 <i>Crassula decumbens</i> (Rufous Stonecrop)			
1132.	11349 <i>Crassula decumbens</i> var. <i>decumbens</i>			
1133.	3139 <i>Crassula exserta</i>			
1134.	20271 <i>Crassula extrorsa</i>			
1135.	3142 <i>Crassula natans</i>	Y		
1136.	15706 <i>Crassula natans</i> var. <i>minus</i>	Y		
1137.	3144 <i>Crassula peduncularis</i> (Purple Stonecrop)			
1138.	7953 <i>Crepis foetida</i> (Foetid Hawksbeard)	Y		
1139.	29054 <i>Crepis foetida</i> subsp. <i>foetida</i> (Stinking Hawksbeard)	Y		
1140.	35838 <i>Cristonia biloba</i> subsp. <i>biloba</i>			
1141.	4792 <i>Cryptandra arbutiflora</i> (Waxy Cryptandra)			
1142.	13470 <i>Cryptandra arbutiflora</i> var. <i>arbutiflora</i>			
1143.	4804 <i>Cryptandra nutans</i>			
1144.	6663 <i>Cuscuta epithymum</i> (Lesser Dodder, Greater Dodder)	Y		
1145.	15404 <i>Cyanicula sericea</i>			
1146.	51 <i>Cyathea cooperi</i>	Y		
1147.	768 <i>Cyathochaeta avenacea</i>			
1148.	40660 <i>Cycnogeton huegelii</i>			
1149.	40661 <i>Cycnogeton lineare</i>			
1150.	283 <i>Cynodon dactylon</i> (Couch)	Y		
1151.	815 <i>Cyperus tenellus</i> (Tiny Flatsedge)	Y		
1152.	10964 <i>Cyrtostylis robusta</i>			
1153.	17692 <i>Cyrtogonidium leptocarpoides</i>			
1154.	7420 <i>Dampiera alata</i> (Winged-stem Dampiera)			
1155.	7444 <i>Dampiera hederacea</i> (Karri Dampiera)			

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1156.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
1157.	7462 <i>Dampiera pedunculata</i>			
1158.	5508 <i>Darwinia citriodora</i> (Lemon-scented Darwinia)			
1159.	5531 <i>Darwinia thymoides</i>			
1160.	18193 <i>Darwinia thymoides</i> subsp. <i>thymoides</i>			
1161.	1218 <i>Dasypogon bromeliifolius</i> (Pineapple Bush)			
1162.	1220 <i>Dasypogon obliquifolius</i>			
1163.	6960 <i>Datura ferox</i> (Fierce Thornapple)	Y		
1164.	6218 <i>Daucus glochidiatus</i> (Australian Carrot)			
1165.	3793 <i>Daviesia angulata</i>			
1166.	15656 <i>Daviesia brachyphylla</i>			
1167.	3799 <i>Daviesia cordata</i> (Bookleaf)			
1168.	16579 <i>Daviesia decipiens</i>			
1169.	3805 <i>Daviesia decurrens</i> (Prickly Bitter-pea)			
1170.	19747 <i>Daviesia decurrens</i> subsp. <i>decurrens</i>			
1171.	3815 <i>Daviesia horrida</i> (Prickly Bitter-pea)			
1172.	16585 <i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>			
1173.	3832 <i>Daviesia physodes</i>			
1174.	3835 <i>Daviesia preissii</i>			
1175.	3839 <i>Daviesia rhombifolia</i>			
1176.	3845 <i>Daviesia triflora</i>			
1177.	17663 <i>Desmocladius asper</i>			
1178.	15831 <i>Desmocladius castaneus</i>			
1179.	17691 <i>Desmocladius fasciculatus</i>			
1180.	16595 <i>Desmocladius flexuosus</i>			
1181.	46362 <i>Desmocladius lateriflorus</i>			
1182.	1259 <i>Dianella revoluta</i> (Blueberry Lily)			
1183.	11636 <i>Dianella revoluta</i> var. <i>divaricata</i>			
1184.	306 <i>Dichelachne crinita</i> (Longhair Plumegrass)			
1185.	1287 <i>Dichopogon capillipes</i>			
1186.	17838 <i>Dielsia stenostachya</i>			
1187.	3863 <i>Dillwynia dillwynioides</i>		P3	
1188.	20367 <i>Dillwynia laxiflora</i>			
1189.	1509 <i>Dioscorea hastifolia</i> (Warrine, Warram)			
1190.	18541 <i>Diplopeltis huegelii</i> subsp. <i>huegelii</i>			
1191.	18589 <i>Diplopeltis huegelii</i> subsp. <i>lehmannii</i>			
1192.	19649 <i>Disa bracteata</i>	Y		
1193.	7054 <i>Dischisma arenarium</i>	Y		
1194.	7055 <i>Dischisma capitatum</i> (Woolly-headed <i>Dischisma</i>)	Y		
1195.	7961 <i>Dittrichia graveolens</i> (Stinkwort)	Y		
1196.	12943 <i>Diuris brumalis</i>			
1197.	10791 <i>Diuris carinata</i> (Bee Orchid)			
1198.	11049 <i>Diuris corymbosa</i>			
1199.	1632 <i>Diuris emarginata</i> (Tall Donkey Orchid)			
1200.	1634 <i>Diuris laxiflora</i> (Bee Orchid)			
1201.	1635 <i>Diuris longifolia</i> (Common Donkey Orchid)			
1202.	12939 <i>Diuris magnifica</i>			
1203.	46859 <i>Diuris ostrina</i>			
1204.	1637 <i>Diuris purdiei</i> (Purdie's Donkey Orchid)		T	
1205.	1638 <i>Diuris setacea</i> (Bristly Donkey Orchid)			
1206.	4757 <i>Dodonaea ceratocarpa</i>			
1207.	4775 <i>Dodonaea pinifolia</i>			
1208.	1639 <i>Drakaea elastica</i> (Glossy-leaved Hammer Orchid)		T	
1209.	1640 <i>Drakaea glyptodon</i> (King-in-his-carriage)			
1210.	11156 <i>Drakaea livida</i>			
1211.	3092 <i>Drosera bulbosa</i> (Red-leaved Sundew)			
1212.	48724 <i>Drosera collina</i>			
1213.	48751 <i>Drosera drummondii</i>			
1214.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
1215.	48747 <i>Drosera geniculata</i>			
1216.	3097 <i>Drosera gigantea</i> (Giant Sundew)			
1217.	3098 <i>Drosera glanduligera</i> (Pimpernel Sundew)			
1218.	3101 <i>Drosera heterophylla</i> (Swamp Rainbow)			
1219.	13197 <i>Drosera hyperostigma</i>			
1220.	48769 <i>Drosera indumenta</i>			
1221.	3105 <i>Drosera leucoblasta</i> (Wheel Sundew)			
1222.	3106 <i>Drosera macrantha</i> (Bridal Rainbow)			
1223.	12243 <i>Drosera manni</i>			
1224.	3108 <i>Drosera marchantii</i>			
1225.	3109 <i>Drosera menziesii</i> (Pink Rainbow)			

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1226.	48710 <i>Drosera micrantha</i>			
1227.	3110 <i>Drosera microphylla</i> (Golden Rainbow)			
1228.	3113 <i>Drosera neesii</i> (Jewel Rainbow)			
1229.	3114 <i>Drosera nitidula</i> (Shining Sundew)			
1230.	3115 <i>Drosera occidentalis</i> (Western Sundew)		P4	
1231.	13189 <i>Drosera oreopodium</i>			
1232.	3118 <i>Drosera pallida</i> (Pale Rainbow)			
1233.	3123 <i>Drosera platystigma</i> (Black-eyed Sundew)			
1234.	29178 <i>Drosera porrecta</i>			
1235.	3124 <i>Drosera pulchella</i> (Pretty Sundew)			
1236.	8911 <i>Drosera rosulata</i>			
1237.	<i>Drosera</i> sp. "climbing"			
1238.	49090 <i>Drosera</i> sp. Branched styles (S.C. Coffey 193)			
1239.	8913 <i>Drosera squamosa</i>			
1240.	3131 <i>Drosera stolonifera</i> (Leafy Sundew)			
1241.	3133 <i>Drosera subhirtella</i> (Sunny Rainbow)			
1242.	33500 <i>Dysphania ambrosioides</i> (Mexican Tea)	Y		
1243.	11368 <i>Dysphania glomulifera</i> subsp. <i>glomulifera</i>			
1244.	33480 <i>Dysphania pumilio</i> (Clammy Goosefoot)			
1245.	32351 <i>Eccremidium pulchellum</i>			
1246.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
1247.	349 <i>Ehrharta longiflora</i> (Annual Veldt Grass)	Y		
1248.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
1249.	1644 <i>Elythranthera emarginata</i> (Pink Enamel Orchid)			
1250.	32356 <i>Entosthodon subnudus</i>			
1251.	11756 <i>Epilobium billardioreanum</i> subsp. <i>cinereum</i> (Variable Willow Herb)			
1252.	6132 <i>Epilobium ciliatum</i>	Y		
1253.	373 <i>Eragrostis brownii</i> (Brown's Lovegrass)			
1254.	376 <i>Eragrostis curvula</i> (African Lovegrass)	Y		
1255.	379 <i>Eragrostis elongata</i> (Clustered Lovegrass)			
1256.	13949 <i>Eremaea asterocarpa</i>			
1257.	13950 <i>Eremaea asterocarpa</i> subsp. <i>asterocarpa</i>			
1258.	5541 <i>Eremaea pauciflora</i>			
1259.	14104 <i>Eremaea pauciflora</i> var. <i>pauciflora</i>			
1260.	7189 <i>Eremophila clarkei</i> (Turpentine Bush)			
1261.	<i>Eremophila</i> sp.			
1262.	1646 <i>Eriochilus dilatatus</i> (White Bunny Orchid)			
1263.	15412 <i>Eriochilus dilatatus</i> subsp. <i>multiflorus</i>			
1264.	4332 <i>Erodium botrys</i> (Long Storksbill)	Y		
1265.	4335 <i>Erodium cygnorum</i> (Blue Heronsbill)			
1266.	6219 <i>Eryngium pinnatifidum</i> (Blue Devils)			
1267.	41801 <i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)		P3	
1268.	15446 <i>Eryngium pinnatifidum</i> subsp. <i>pinnatifidum</i>			
1269.	5616 <i>Eucalyptus decurva</i> (Slender Mallee)			
1270.	5659 <i>Eucalyptus gomphocephala</i> (Tuart, Duart)			
1271.	5688 <i>Eucalyptus laeliae</i> (Darling Range Ghost Gum)			
1272.	5690 <i>Eucalyptus lane-poolei</i> (Salmon White Gum)			
1273.	5708 <i>Eucalyptus marginata</i> (Jarrah, Djara)			
1274.	13547 <i>Eucalyptus marginata</i> subsp. <i>marginata</i> (Jarrah)			
1275.	13548 <i>Eucalyptus marginata</i> subsp. <i>thalassica</i> (Blue-leaved Jarrah)			
1276.	5739 <i>Eucalyptus patens</i> (Swan River Blackbutt, Dwuda)			
1277.	5763 <i>Eucalyptus rudis</i> (Flooded Gum, Kulurda)			
1278.	13512 <i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>		P4	
1279.	13511 <i>Eucalyptus rudis</i> subsp. <i>rudis</i>			
1280.	5790 <i>Eucalyptus todtiana</i> (Coastal Blackbutt)			
1281.	5797 <i>Eucalyptus wandoo</i> (Wandoo, Wondu)			
1282.	12906 <i>Eucalyptus wandoo</i> subsp. <i>wandoo</i>			
1283.	3872 <i>Euchilopsis linearis</i> (Swamp Pea)			
1284.	15137 <i>Euchiton sphaericus</i>			
1285.	13753 <i>Euphorbia dallachyana</i>			
1286.	4627 <i>Euphorbia helioscopia</i> (Sun Spurge)	Y		
1287.	29940 <i>Euphorbia maculata</i>	Y		
1288.	34757 <i>Euphorbia prostrata</i>	Y		
1289.	4648 <i>Euphorbia terracina</i> (Geraldton Carnation Weed)	Y		
1290.	3879 <i>Eutaxia parvifolia</i>			
1291.	3880 <i>Eutaxia virgata</i>			
1292.	835 <i>Evandra pauciflora</i>			
1293.	1747 <i>Ficus carica</i> (Common Fig)	Y		
1294.	32365 <i>Fissidens leptocladus</i>			
1295.	32367 <i>Fissidens megalotis</i>			

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1296.	32469 <i>Fissidens taylorii</i> var. <i>taylorii</i>			
1297.	18392 <i>Freesia alba</i> x <i>leichtlinii</i>	Y		
1298.	2969 <i>Fumaria capreolata</i> (Whiteflower Fumitory)	Y		
1299.	31532 <i>Fumaria muralis</i> subsp. <i>muralis</i>	Y		
1300.	32370 <i>Funaria hygrometrica</i>			
1301.	900 <i>Gahnia aristata</i>			
1302.	902 <i>Gahnia decomposita</i>			
1303.	907 <i>Gahnia trifida</i> (Coast Saw-sedge)			
1304.	7321 <i>Galium divaricatum</i>	Y		
1305.	7323 <i>Galium murale</i> (Small Goosegrass)	Y		
1306.	20247 <i>Gamochoeta calviceps</i>	Y		
1307.	434 <i>Gastridium phleoides</i> (Nitgrass)	Y		
1308.	20475 <i>Gastrolobium capitatum</i>			
1309.	20513 <i>Gastrolobium dilatatum</i>			
1310.	20473 <i>Gastrolobium ebracteolatum</i>			
1311.	3923 <i>Gastrolobium spathulatum</i> (Poison Bush)			
1312.	3924 <i>Gastrolobium spinosum</i> (Prickly Poison)			
1313.	3933 <i>Gastrolobium villosum</i> (Crinkle-leaved Poison)			
1314.	32372 <i>Gemmabryum australe</i>			
1315.	32383 <i>Gemmabryum sullivani</i>			
1316.	3936 <i>Genista linifolia</i> (Flaxleaf Broom)	Y		
1317.	4340 <i>Geranium retrorsum</i>			
1318.	1518 <i>Gladiolus angustus</i> (Long Tubed Painted Lady)	Y		
1319.	1520 <i>Gladiolus caryophyllaceus</i> (Wild Gladiolus)	Y		
1320.	1524 <i>Gladiolus undulatus</i> (Wild Gladiolus)	Y		
1321.	33620 <i>Glischrocaryon angustifolium</i>			
1322.	6143 <i>Glischrocaryon aureum</i> (Common Popflower)			
1323.	17043 <i>Glyceria declinata</i>	Y		
1324.	12624 <i>Gnephosis angianthoides</i>			
1325.	7991 <i>Gnephosis drummondii</i>			
1326.	6587 <i>Gomphocarpus fruticosus</i> (Narrowleaf Cottonbush)	Y		
1327.	3945 <i>Gompholobium aristatum</i>			
1328.	3948 <i>Gompholobium capitatum</i>			
1329.	10909 <i>Gompholobium confertum</i>			
1330.	19216 <i>Gompholobium cyaninum</i>			
1331.	3950 <i>Gompholobium knightianum</i>			
1332.	3951 <i>Gompholobium marginatum</i>			
1333.	3954 <i>Gompholobium polymorphum</i>			
1334.	3955 <i>Gompholobium preissii</i>			
1335.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
1336.	6146 <i>Gonocarpus benthamii</i>			
1337.	16746 <i>Gonocarpus benthamii</i> subsp. <i>benthamii</i>			
1338.	6149 <i>Gonocarpus cordiger</i>			
1339.	6159 <i>Gonocarpus nodulosus</i>			
1340.	6160 <i>Gonocarpus paniculatus</i>			
1341.	6161 <i>Gonocarpus pithyoides</i>			
1342.	8614 <i>Goodenia claytoniacea</i>			
1343.	29362 <i>Goodenia coerulea</i>			
1344.	12551 <i>Goodenia micrantha</i>			
1345.	7538 <i>Goodenia pulchella</i>			
1346.	14282 <i>Gratiola pubescens</i>			
1347.	1964 <i>Grevillea bipinnatifida</i> (Fuchsia Grevillea)			
1348.	19628 <i>Grevillea bipinnatifida</i> subsp. <i>bipinnatifida</i>			
1349.	13085 <i>Grevillea centristigma</i>			
1350.	14407 <i>Grevillea crowleyae</i>		P2	
1351.	1992 <i>Grevillea diversifolia</i> (Variable-leaved Grevillea)			
1352.	13429 <i>Grevillea diversifolia</i> subsp. <i>diversifolia</i>			
1353.	1997 <i>Grevillea endlicheriana</i> (Spindly Grevillea)			
1354.	13450 <i>Grevillea manglesii</i> subsp. <i>manglesii</i>			
1355.	13452 <i>Grevillea manglesii</i> subsp. <i>ornithopoda</i>		P2	
1356.	2066 <i>Grevillea pilulifera</i> (Woolly-flowered Grevillea)			
1357.	13086 <i>Grevillea pimeleoides</i>		P4	
1358.	15990 <i>Grevillea pulchella</i> subsp. <i>ascendens</i>			
1359.	2080 <i>Grevillea quercifolia</i> (Oak-leaf Grevillea)			
1360.	2122 <i>Grevillea wilsonii</i> (Native Fuchsia)			
1361.	32386 <i>Grimmia laevigata</i>			
1362.	32473 <i>Grimmia pulvinata</i> var. <i>africana</i>			
1363.	2788 <i>Gyrostemon subnudus</i>			
1364.	1464 <i>Haemodorum brevisepalum</i>			
1365.	1465 <i>Haemodorum discolor</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1366.	1468 <i>Haemodorum laxum</i>			
1367.	1472 <i>Haemodorum simplex</i>			
1368.	1474 <i>Haemodorum sparsiflorum</i>			
1369.	1475 <i>Haemodorum spicatum</i> (Mardja)			
1370.	438 <i>Hainardia cylindrica</i> (Common Barbgrass)	Y		
1371.	2128 <i>Hakea amplexicaulis</i> (Prickly Hakea)			
1372.	2137 <i>Hakea ceratophylla</i> (Horned Leaf Hakea)			
1373.	2152 <i>Hakea cyclocarpa</i> (Ramshorn)			
1374.	2166 <i>Hakea incrassata</i> (Marble Hakea)			
1375.	2175 <i>Hakea lissocarpha</i> (Honey Bush)			
1376.	2179 <i>Hakea marginata</i>			
1377.	45333 <i>Hakea neospathulata</i>			
1378.	2197 <i>Hakea prostrata</i> (Harsh Hakea)			
1379.	2203 <i>Hakea ruscifolia</i> (Candle Hakea)			
1380.	2206 <i>Hakea stenocarpa</i> (Narrow-fruited Hakea)			
1381.	2212 <i>Hakea sulcata</i> (Furrowed Hakea)			
1382.	2214 <i>Hakea trifurcata</i> (Two-leaf Hakea)			
1383.	2215 <i>Hakea undulata</i> (Wavy-leaved Hakea)			
1384.	2216 <i>Hakea varia</i> (Variable-leaved Hakea)			
1385.	6686 <i>Halgania corymbosa</i>		P3	
1386.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
1387.	32392 <i>Hedwigidium integrifolium</i>			
1388.	439 <i>Hemarthria uncinata</i> (Matgrass)			
1389.	6839 <i>Hemiandra pungens</i> (Snakebush)			
1390.	6855 <i>Hemigenia humilis</i>			
1391.	6856 <i>Hemigenia incana</i> (Silky Hemigenia)			
1392.	29632 <i>Hemigenia parviflora</i>			
1393.	6864 <i>Hemigenia platyphylla</i>		P4	
1394.	6866 <i>Hemigenia pritzelii</i>			
1395.	41020 <i>Hemiphora bartlingii</i> (Woolly Dragon)			
1396.	1293 <i>Hensmania turbinata</i>			
1397.	5108 <i>Hibbertia acerosa</i> (Needle Leaved Guinea Flower)			
1398.	5109 <i>Hibbertia amplexicaulis</i>			
1399.	5112 <i>Hibbertia aurea</i>			
1400.	5114 <i>Hibbertia commutata</i>			
1401.	20051 <i>Hibbertia diamesogenos</i>			
1402.	5129 <i>Hibbertia glomerata</i>			
1403.	19778 <i>Hibbertia glomerata</i> subsp. <i>darlingensis</i>			
1404.	5134 <i>Hibbertia huegelii</i>			
1405.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
1406.	45534 <i>Hibbertia hypericoides</i> subsp. <i>hypericoides</i>			
1407.	5139 <i>Hibbertia lasiopus</i> (Large Hibbertia)			
1408.	5148 <i>Hibbertia mylnei</i>			
1409.	5150 <i>Hibbertia nymphaea</i>			
1410.	5152 <i>Hibbertia ovata</i>			
1411.	5155 <i>Hibbertia pilosa</i> (Hairy Guinea Flower)			
1412.	5161 <i>Hibbertia quadricolor</i>			
1413.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
1414.	43280 <i>Hibbertia sericosepala</i>			
1415.	5169 <i>Hibbertia serrata</i> (Serrate Leaved Guinea Flower)			
1416.	<i>Hibbertia</i> sp.			
1417.	5171 <i>Hibbertia spicata</i>			
1418.	11481 <i>Hibbertia spicata</i> subsp. <i>spicata</i>			
1419.	5172 <i>Hibbertia stellaris</i> (Orange Stars)			
1420.	48381 <i>Hibbertia striata</i>			
1421.	5173 <i>Hibbertia subvaginata</i>			
1422.	5176 <i>Hibbertia vaginata</i>			
1423.	445 <i>Holcus setiger</i> (Annual Fog)	Y		
1424.	6222 <i>Homalosciadium homalocarpum</i>			
1425.	449 <i>Hordeum leporinum</i> (Barley Grass)	Y		
1426.	450 <i>Hordeum marinum</i>	Y		
1427.	3964 <i>Hovea chorizemifolia</i> (Holly-leaved Hovea)			
1428.	3966 <i>Hovea pungens</i> (Devil's Pins, Puyenak)			
1429.	3968 <i>Hovea trisperma</i> (Common Hovea)			
1430.	12907 <i>Hovea trisperma</i> var. <i>grandiflora</i>			
1431.	12859 <i>Hovea trisperma</i> var. <i>trisperma</i>			
1432.	12741 <i>Hyalosperma cotula</i>			
1433.	12742 <i>Hyalosperma demissum</i>			
1434.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
1435.	5218 <i>Hybanthus debillissimus</i>			

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1436.	5221 <i>Hybanthus floribundus</i>			
1437.	12007 <i>Hybanthus floribundus</i> subsp. <i>floribundus</i>			
1438.	6223 <i>Hydrocotyle alata</i>			
1439.	6226 <i>Hydrocotyle callicarpa</i> (Small Pennywort)			
1440.	6229 <i>Hydrocotyle diantha</i>			
1441.	6236 <i>Hydrocotyle pilifera</i>			
1442.	5180 <i>Hypericum gramineum</i> (Small St John's Wort)			
1443.	5181 <i>Hypericum japonicum</i> (Matted St John's Wort)			
1444.	5817 <i>Hypocalymma angustifolium</i> (White Myrtle, Kudjid)			
1445.	35074 <i>Hypocalymma angustifolium</i> subsp. <i>Dandaragan plateau</i> (S. Patrick 702A)			
1446.	35070 <i>Hypocalymma angustifolium</i> subsp. <i>Swan Coastal Plain</i> (G.J. Keighery 16777)			
1447.	5825 <i>Hypocalymma robustum</i> (Swan River Myrtle)			
1448.	8086 <i>Hypochaeris glabra</i> (Smooth Catsear)	Y		
1449.	9352 <i>Hypochaeris radicata</i> (Flat Weed, Cats-ear)	Y		
1450.	1070 <i>Hypolaena exsulca</i>			
1451.	1071 <i>Hypolaena fastigiata</i>			
1452.	7 <i>Isoetes australis</i>			
1453.	11 <i>Isoetes drummondii</i> (Quillwort)			
1454.	910 <i>Isolepis cernua</i> (Nodding Club-rush)			
1455.	20200 <i>Isolepis cernua</i> var. <i>setiformis</i>			
1456.	911 <i>Isolepis congrua</i>			
1457.	912 <i>Isolepis cyperoides</i>			
1458.	14540 <i>Isolepis hystrix</i>	Y		
1459.	917 <i>Isolepis marginata</i> (Coarse Club-rush)			
1460.	919 <i>Isolepis oldfieldiana</i>			
1461.	924 <i>Isolepis stellata</i> (Star Club-rush)			
1462.	2221 <i>Isopogon asper</i>			
1463.	8844 <i>Isopogon crithmifolius</i>			
1464.	2227 <i>Isopogon divergens</i> (Spreading Coneflower)			
1465.	29775 <i>Isopogon drummondii</i>		P3	
1466.	2237 <i>Isopogon sphaerocephalus</i> (Drumstick Isopogon)			
1467.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
1468.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			
1469.	1532 <i>Ixia maculata</i> (Yellow Ixia)	Y		
1470.	3997 <i>Jacksonia alata</i>			
1471.	4012 <i>Jacksonia furcellata</i> (Grey Stinkwood)			
1472.	20462 <i>Jacksonia gracillima</i>		P3	
1473.	4018 <i>Jacksonia lehmannii</i>			
1474.	4025 <i>Jacksonia restioides</i>			
1475.	4029 <i>Jacksonia sternbergiana</i> (Stinkwood, Kapur)			
1476.	<i>Jamesoniella colorata</i>			
1477.	1298 <i>Johnsonia pubescens</i> (Pipe Lily)			
1478.	19272 <i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>		P2	
1479.	19632 <i>Johnsonia pubescens</i> subsp. <i>pubescens</i>			
1480.	1177 <i>Juncus articulatus</i> (Jointed Rush)	Y		
1481.	1178 <i>Juncus bufonius</i> (Toad Rush)	Y		
1482.	1180 <i>Juncus capitatus</i> (Capitate Rush)	Y		
1483.	1184 <i>Juncus holoschoenus</i> (Jointleaf Rush)			
1484.	11922 <i>Juncus kraussii</i> subsp. <i>australiensis</i>			
1485.	1186 <i>Juncus microcephalus</i>	Y		
1486.	1188 <i>Juncus pallidus</i> (Pale Rush)			
1487.	1189 <i>Juncus pauciflorus</i> (Loose Flower Rush)			
1488.	1190 <i>Juncus planifolius</i> (Broadleaf Rush)			
1489.	1191 <i>Juncus polyanthemus</i>	Y		
1490.	1195 <i>Juncus subsecundus</i> (Finger Rush)			
1491.	1196 <i>Juncus usitatus</i> (Common Rush)	Y		
1492.	4036 <i>Kennedia carinata</i>			
1493.	4037 <i>Kennedia coccinea</i> (Coral Vine)			
1494.	4041 <i>Kennedia microphylla</i>			
1495.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
1496.	4045 <i>Kennedia stirlingii</i> (Bushy Kennedia)			
1497.	1221 <i>Kingia australis</i> (Kingia, Pulonok)			
1498.	5832 <i>Kunzea ericifolia</i> (Spearwood, Pondil)			
1499.	15498 <i>Kunzea glabrescens</i> (Spearwood)			
1500.	5835 <i>Kunzea micrantha</i>			
1501.	17461 <i>Kunzea micrantha</i> subsp. <i>micrantha</i>			
1502.	17785 <i>Kunzea micrantha</i> subsp. <i>petiolata</i>			
1503.	5841 <i>Kunzea recurva</i>			
1504.	3667 <i>Labichea lanceolata</i> (Tall Labichea)			
1505.	11289 <i>Labichea lanceolata</i> subsp. <i>lanceolata</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1506.	3669 <i>Labichea punctata</i> (Lance-leaved Cassia)			
1507.	13562 <i>Lachenalia aloides</i>	Y		
1508.	20019 <i>Lachnagrostis filiformis</i>			
1509.	19955 <i>Lachnagrostis plebeia</i>			
1510.	8096 <i>Lactuca serriola</i> (Prickly Lettuce)	Y		
1511.	18585 <i>Lagenophora huegelii</i>			
1512.	467 <i>Lagurus ovatus</i> (Hare's Tail Grass)	Y		
1513.	14083 <i>Lambertia multiflora</i> var. <i>darlingensis</i>			
1514.	5033 <i>Lasiopetalum floribundum</i> (Free Flowering Lasiopetalum)			
1515.	5034 <i>Lasiopetalum glabratum</i>			
1516.	45081 <i>Lasiopetalum glutinosum</i> subsp. <i>glutinosum</i>		P3	
1517.	45082 <i>Lasiopetalum glutinosum</i> subsp. <i>latifolium</i>			
1518.	17000 <i>Lasiopetalum pterocarpum</i>		T	
1519.	4052 <i>Latrobea tenella</i>			
1520.	38323 <i>Lavandula stoechas</i> subsp. <i>stoechas</i>	Y		
1521.	1304 <i>Laxmannia minor</i>			
1522.	1307 <i>Laxmannia ramosa</i> (Branching Lily)			
1523.	11911 <i>Laxmannia ramosa</i> subsp. <i>ramosa</i>			
1524.	11464 <i>Laxmannia sessiliflora</i> subsp. <i>australis</i>			
1525.	1309 <i>Laxmannia squarrosa</i>			
1526.	7568 <i>Lechenaultia biloba</i> (Blue Leschenaultia)			
1527.	7572 <i>Lechenaultia expansa</i>			
1528.	7574 <i>Lechenaultia floribunda</i> (Free-flowering Leschenaultia)			
1529.	44490 <i>Leontodon rhagadioloides</i>	Y		
1530.	1075 <i>Lepidobolus preissianus</i>			
1531.	18074 <i>Lepidobolus preissianus</i> subsp. <i>preissianus</i>			
1532.	<i>Lepidosperma</i> aff. <i>coastale</i> (#134)			Y
1533.	<i>Lepidosperma</i> aff. <i>pubisquameum</i> (#166)			
1534.	<i>Lepidosperma</i> aff. <i>resinosum</i>			
1535.	925 <i>Lepidosperma angustatum</i>			
1536.	42741 <i>Lepidosperma apricola</i>			
1537.	41620 <i>Lepidosperma asperatum</i>			
1538.	929 <i>Lepidosperma carphoides</i> (Black Rapier Sedge)			
1539.	930 <i>Lepidosperma costale</i>			
1540.	<i>Lepidosperma eastern terete</i> scps (BJK&NG 232)			
1541.	932 <i>Lepidosperma effusum</i> (Spreading Sword-sedge)			
1542.	936 <i>Lepidosperma leptostachyum</i>			
1543.	937 <i>Lepidosperma longitudinale</i> (Pithy Sword-sedge)			
1544.	938 <i>Lepidosperma persecans</i>			
1545.	939 <i>Lepidosperma pruinosum</i>			
1546.	940 <i>Lepidosperma pubisquameum</i>			
1547.	<i>Lepidosperma pubisquameum</i> "flat form"			
1548.	941 <i>Lepidosperma resinosum</i>			
1549.	942 <i>Lepidosperma rostratum</i>		T	
1550.	944 <i>Lepidosperma scabrum</i>			
1551.	<i>Lepidosperma</i> sp.			
1552.	<i>Lepidosperma</i> sp. <i>Baldivis</i>			Y
1553.	29141 <i>Lepidosperma</i> sp. <i>Gosnells</i> (A. Markey 1145)			
1554.	29150 <i>Lepidosperma</i> sp. <i>Margaret River</i> (B.J. Lepschi 1841)			
1555.	<i>Lepidosperma</i> sp. <i>Mud3</i>			Y
1556.	945 <i>Lepidosperma squamatum</i>			
1557.	946 <i>Lepidosperma striatum</i>			
1558.	948 <i>Lepidosperma tetraquetrum</i>			
1559.	949 <i>Lepidosperma tuberculatum</i>			
1560.	1653 <i>Leporella fimbriata</i> (Hare Orchid)			
1561.	1077 <i>Leptocarpus canus</i> (Hoary Twine-rush)			
1562.	1078 <i>Leptocarpus coangustatus</i>			
1563.	46375 <i>Leptocarpus decipiens</i>			
1564.	46380 <i>Leptocarpus kraussii</i>			
1565.	46382 <i>Leptocarpus roycei</i>			
1566.	2342 <i>Leptomeria cunninghamii</i>			
1567.	2344 <i>Leptomeria empetriformis</i>			
1568.	2355 <i>Leptomeria squarrolosa</i>			
1569.	5847 <i>Leptospermum erubescens</i> (Roadside Teatree)			
1570.	5850 <i>Leptospermum laevigatum</i> (Coast Teatree)	Y		
1571.	1085 <i>Lepyrodia glauca</i>			
1572.	1086 <i>Lepyrodia heleocharoides</i>		P3	
1573.	1088 <i>Lepyrodia macra</i> (Large Scale Rush)			
1574.	1090 <i>Lepyrodia muirii</i>			
1575.	15562 <i>Lepyrodia riparia</i>			

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1576.	<i>Lethocolea pansa</i>			
1577.	6360 <i>Leucopogon australis</i> (Spiked Beard-heath)			
1578.	6367 <i>Leucopogon capitellatus</i>			
1579.	6374 <i>Leucopogon conostephioides</i>			
1580.	6396 <i>Leucopogon glabellus</i>			
1581.	6400 <i>Leucopogon gracillimus</i>			
1582.	6416 <i>Leucopogon nutans</i> (Drooping Leucopogon)			
1583.	6427 <i>Leucopogon parviflorus</i> (Coast Beard-heath)			
1584.	6434 <i>Leucopogon polymorphus</i>			
1585.	6436 <i>Leucopogon propinquus</i>			
1586.	6439 <i>Leucopogon pulchellus</i> (Beard-heath)			
1587.	28302 <i>Leucopogon</i> sp. Parkerville (A. Meebold 11654)			
1588.	6445 <i>Leucopogon squarrosus</i>			
1589.	6447 <i>Leucopogon strictus</i>			
1590.	6451 <i>Leucopogon tenuis</i>			
1591.	6454 <i>Leucopogon verticillatus</i> (Tassel Flower)			
1592.	7675 <i>Levenhookia pulcherrima</i> (Beautiful Stylewort)		P2	
1593.	7676 <i>Levenhookia pusilla</i> (Midget Stylewort)			
1594.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
1595.	59 <i>Lindsaea linearis</i> (Screw Fern)			
1596.	4362 <i>Linum marginale</i> (Wild Flax)			
1597.	4363 <i>Linum trigynum</i> (French Flax)	Y		
1598.	9289 <i>Lobelia anceps</i> (Angled Lobelia)			
1599.	7402 <i>Lobelia gibbosa</i> (Tall Lobelia)			
1600.	7403 <i>Lobelia heterophylla</i> (Wing-seeded Lobelia)			
1601.	7405 <i>Lobelia rarifolia</i>			
1602.	7406 <i>Lobelia rhombifolia</i> (Tufted Lobelia)			
1603.	7407 <i>Lobelia rhytidisperma</i> (Wrinkled-seeded Lobelia)			
1604.	7408 <i>Lobelia tenuior</i> (Slender Lobelia)			
1605.	9356 <i>Logfia gallica</i>	Y		
1606.	475 <i>Lolium multiflorum</i> (Italian Ryegrass)	Y		
1607.	476 <i>Lolium perenne</i> (Perennial Ryegrass)	Y		
1608.	478 <i>Lolium rigidum</i> (Wimmera Ryegrass)	Y		
1609.	<i>Lolium</i> sp.			
1610.	<i>Lomandra ?caespitosa</i>			
1611.	1222 <i>Lomandra brittanii</i>			
1612.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
1613.	1225 <i>Lomandra drummondii</i>			
1614.	1228 <i>Lomandra hermaphrodita</i>			
1615.	1229 <i>Lomandra integra</i>			
1616.	1232 <i>Lomandra micrantha</i> (Small-flower Mat-rush)			
1617.	14542 <i>Lomandra micrantha</i> subsp. <i>micrantha</i>			
1618.	1234 <i>Lomandra nigricans</i>			
1619.	1236 <i>Lomandra odora</i> (Tiered Matrush)			
1620.	1239 <i>Lomandra preissii</i>			
1621.	1240 <i>Lomandra purpurea</i> (Purple Mat Rush)			
1622.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
1623.	1244 <i>Lomandra sonderi</i>			
1624.	<i>Lomandra</i> sp.			
1625.	1245 <i>Lomandra spartea</i>			
1626.	1246 <i>Lomandra suaveolens</i>			
1627.	7365 <i>Lonicera japonica</i> (Japanese Honeysuckle)	Y		
1628.	4059 <i>Lotus angustissimus</i> (Narrowleaf Trefoil)	Y		
1629.	<i>Lotus</i> sp. Mud3			Y
1630.	8564 <i>Lotus subbiflorus</i>	Y		
1631.	4063 <i>Lotus uliginosus</i> (Greater Lotus)	Y		
1632.	1092 <i>Loxocarya cinerea</i>			
1633.	4066 <i>Lupinus cosentinii</i>	Y		
1634.	4067 <i>Lupinus luteus</i> (Yellow Lupin)	Y		
1635.	1198 <i>Luzula meridionalis</i> (Field Woodrush)			
1636.	1097 <i>Lyginia barbata</i>			
1637.	<i>Lyginia barbata</i> /imberbis			
1638.	18049 <i>Lyginia imberbis</i>			
1639.	36375 <i>Lysimachia arvensis</i> (Pimpernel)	Y		
1640.	36373 <i>Lysimachia minima</i>	Y		
1641.	6456 <i>Lysinema ciliatum</i> (Curry Flower)			
1642.	6458 <i>Lysinema elegans</i>			
1643.	34736 <i>Lysinema pentapetalum</i>			
1644.	2838 <i>Macarthuria apetala</i>			
1645.	2839 <i>Macarthuria australis</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1646.	85 <i>Macrozamia riedlei</i> (<i>Zamia</i> , <i>Djiridji</i>)			
1647.	17637 <i>Marianthus candidus</i> (<i>White Marianthus</i>)			
1648.	17636 <i>Marianthus coeruleopunctatus</i> (<i>Blue-spotted Marianthus</i>)			
1649.	17635 <i>Marianthus drummondianus</i>			
1650.	17630 <i>Marianthus tenuis</i>			
1651.	34676 <i>Meionectes brownii</i> (<i>Swamp Raspwort</i>)			
1652.	33638 <i>Meionectes tenuifolia</i>		P3	
1653.	37580 <i>Melaleuca acutifolia</i>			
1654.	36296 <i>Melaleuca armillaris</i> subsp. <i>armillaris</i>	Y		
1655.	5925 <i>Melaleuca lateriflora</i> (<i>Gorada</i>)			
1656.	5926 <i>Melaleuca lateritia</i> (<i>Robin Redbreast Bush</i>)			
1657.	20297 <i>Melaleuca osullivanii</i>			
1658.	18394 <i>Melaleuca parviceps</i>			
1659.	5946 <i>Melaleuca pauciflora</i>			
1660.	5952 <i>Melaleuca preissiana</i> (<i>Moonah</i>)			
1661.	5958 <i>Melaleuca radula</i> (<i>Graceful Honeymyrtle</i>)			
1662.	5959 <i>Melaleuca rhapsiophylla</i> (<i>Swamp Paperbark</i>)			
1663.	5964 <i>Melaleuca seriata</i>			
1664.	5975 <i>Melaleuca subtrigona</i>			
1665.	5978 <i>Melaleuca teretifolia</i> (<i>Banbar</i>)			
1666.	5980 <i>Melaleuca thymoides</i>			
1667.	5983 <i>Melaleuca trichophylla</i>			
1668.	5984 <i>Melaleuca uncinata</i> (<i>Broom Bush</i> , <i>Kwidjard</i>)			
1669.	5987 <i>Melaleuca viminea</i> (<i>Mohan</i>)			
1670.	13280 <i>Melaleuca viminea</i> subsp. <i>viminea</i>			
1671.	14985 <i>Melinis repens</i>	Y		
1672.	953 <i>Mesomelaena graciliceps</i>			
1673.	955 <i>Mesomelaena pseudostygia</i>			
1674.	956 <i>Mesomelaena stygia</i>			
1675.	11473 <i>Mesomelaena stygia</i> subsp. <i>stygia</i>			
1676.	957 <i>Mesomelaena tetragona</i> (<i>Semaphore Sedge</i>)			
1677.	485 <i>Microlaena stipoides</i> (<i>Weeping Grass</i>)			
1678.	11747 <i>Microlaena stipoides</i> var. <i>stipoides</i>			
1679.	1658 <i>Microtis atrata</i> (<i>Swamp Mignonette Orchid</i>)			
1680.	10954 <i>Microtis media</i> (<i>Tall Mignonette Orchid</i>)			
1681.	15419 <i>Microtis media</i> subsp. <i>media</i>			
1682.	8106 <i>Millotia tenuifolia</i> (<i>Soft Millotia</i>)			
1683.	14337 <i>Millotia tenuifolia</i> var. <i>laevis</i>		P2	
1684.	14344 <i>Millotia tenuifolia</i> var. <i>tenuifolia</i> (<i>Soft Millotia</i>)			
1685.	4090 <i>Mirbelia dilatata</i> (<i>Holly-leaved Mirbelia</i>)			
1686.	4091 <i>Mirbelia floribunda</i> (<i>Purple Mirbelia</i>)			
1687.	4100 <i>Mirbelia spinosa</i>			
1688.	7085 <i>Misopates orontium</i> (<i>Lesser Snapdragon</i>)	Y		
1689.	2894 <i>Moenchia erecta</i> (<i>Erect Chickweed</i>)	Y		
1690.	7410 <i>Monopsis debilis</i>	Y		
1691.	37440 <i>Monopsis debilis</i> var. <i>depressa</i>	Y		
1692.	4662 <i>Monotaxis grandiflora</i> (<i>Diamond of the Desert</i>)			
1693.	19585 <i>Monotaxis grandiflora</i> var. <i>grandiflora</i>			
1694.	4666 <i>Monotaxis occidentalis</i>			
1695.	19179 <i>Moraea flaccida</i> (<i>One-leaf Cape Tulip</i>)	Y		
1696.	6192 <i>Myriophyllum drummondii</i>			
1697.	49026 <i>Nandina domestica</i>	Y		Y
1698.	492 <i>Neurachne alopecuroidea</i> (<i>Foxtail Mulga Grass</i>)			
1699.	2401 <i>Nuytsia floribunda</i> (<i>Christmas Tree</i> , <i>Mudja</i>)			
1700.	6137 <i>Oenothera affinis</i> (<i>Longflower Evening Primrose</i>)	Y		
1701.	35416 <i>Oenothera lindheimeri</i>	Y		
1702.	6140 <i>Oenothera mollissima</i>	Y		
1703.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		
1704.	2365 <i>Olex benthamiana</i>			
1705.	8133 <i>Olearia elaeophila</i>			
1706.	32716 <i>Olearia lehmanniana</i>			
1707.	8143 <i>Olearia paucidentata</i> (<i>Autumn Scrub Daisy</i>)			
1708.	8149 <i>Olearia rudis</i> (<i>Rough Daisybush</i>)			
1709.	18254 <i>Opercularia apiciflora</i>			
1710.	7346 <i>Opercularia echinocephala</i> (<i>Bristly Headed Stink Weed</i>)			
1711.	7348 <i>Opercularia hispidula</i> (<i>Hispid Stinkweed</i>)			
1712.	18255 <i>Opercularia vaginata</i> (<i>Dog Weed</i>)			
1713.	46316 <i>Orianthera serpyllifolia</i> subsp. <i>angustifolia</i>			
1714.	46315 <i>Orianthera serpyllifolia</i> subsp. <i>serpyllifolia</i>			
1715.	4113 <i>Ornithopus compressus</i> (<i>Yellow Serradella</i>)	Y		

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1716.	4114 <i>Ornithopus pinnatus</i> (Slender Serradella)	Y		
1717.	7122 <i>Orobanche minor</i> (Lesser Broomrape)	Y		
1718.	11749 <i>Orthrosanthus laxus</i> var. <i>laxus</i> (Morning Iris)			
1719.	168 <i>Ottelia ovalifolia</i> (Swamp Lily)			
1720.	4349 <i>Oxalis corniculata</i> (Yellow Wood Sorrel)	Y		
1721.	30375 <i>Oxalis exilis</i>			
1722.	4352 <i>Oxalis glabra</i>	Y		
1723.	4354 <i>Oxalis incarnata</i>	Y		
1724.	4355 <i>Oxalis perennans</i>			
1725.	4356 <i>Oxalis pes-caprae</i> (Soursob)	Y		
1726.	4358 <i>Oxalis purpurea</i> (Largeflower Wood Sorrel)	Y		
1727.	507 <i>Panicum miliaceum</i> (Millet Panic)	Y		
1728.	23974 <i>Paracaleana gracilicordata</i>		P1	
1729.	23475 <i>Paracaleana granitica</i>		P1	
1730.	1667 <i>Paracaleana nigrita</i> (Flying Duck Orchid)			
1731.	20101 <i>Paragonis grandiflora</i>			
1732.	3618 <i>Paraserianthes lophantha</i> (Albizia)			
1733.	17114 <i>Paraserianthes lophantha</i> subsp. <i>lophantha</i>			
1734.	7089 <i>Parentucellia latifolia</i> (Common Bartsia)	Y		
1735.	6573 <i>Parsonsia diaphanophleba</i>		P4	
1736.	527 <i>Paspalum dilatatum</i>	Y		
1737.	528 <i>Paspalum distichum</i> (Water Couch)	Y		
1738.	1542 <i>Patersonia babianoides</i>			
1739.	1546 <i>Patersonia juncea</i> (Rush Leaved Patersonia)			
1740.	1550 <i>Patersonia occidentalis</i> (Purple Flag, Koma)			
1741.	30471 <i>Patersonia occidentalis</i> var. <i>angustifolia</i>			
1742.	30476 <i>Patersonia occidentalis</i> var. <i>latifolia</i>			
1743.	30472 <i>Patersonia occidentalis</i> var. <i>occidentalis</i>			
1744.	1551 <i>Patersonia pygmaea</i> (Pygmy Patersonia)			
1745.	1552 <i>Patersonia rudis</i> (Hairy Flag)			
1746.	14433 <i>Patersonia rudis</i> subsp. <i>rudis</i>			
1747.	11550 <i>Patersonia umbrosa</i> var. <i>xanthina</i> (Yellow Flags)			
1748.	43760 <i>Pauridia occidentalis</i>			
1749.	4346 <i>Pelargonium littorale</i>			
1750.	11139 <i>Pelargonium x domesticum</i>	Y		
1751.	40423 <i>Pentameris airoides</i> (False Hairgrass)	Y		
1752.	40424 <i>Pentameris airoides</i> subsp. <i>airoides</i>	Y		
1753.	6245 <i>Pentapeltis peltigera</i>			
1754.	6006 <i>Pericalymma ellipticum</i> (Swamp Teatree)			
1755.	16477 <i>Pericalymma ellipticum</i> var. <i>ellipticum</i>			
1756.	16478 <i>Pericalymma ellipticum</i> var. <i>floridum</i>			
1757.	15501 <i>Pericalymma spongiocaula</i>			
1758.	2255 <i>Persoonia angustiflora</i>			
1759.	2262 <i>Persoonia elliptica</i> (Spreading Snottygobble)			
1760.	2267 <i>Persoonia longifolia</i> (Snottygobble)			
1761.	2273 <i>Persoonia saccata</i> (Snottygobble)			
1762.	2284 <i>Petrophile biloba</i> (Granite Petrophile)			
1763.	20391 <i>Petrophile juncifolia</i>			
1764.	2299 <i>Petrophile linearis</i> (Pixie Mops)			
1765.	2301 <i>Petrophile macrostachya</i>			
1766.	2308 <i>Petrophile seminuda</i>			
1767.	2309 <i>Petrophile serruriae</i>			
1768.	2311 <i>Petrophile squamata</i>			
1769.	20053 <i>Petrophile squamata</i> subsp. <i>northern</i> (J. Monks 40)			
1770.	2312 <i>Petrophile striata</i>			
1771.	19825 <i>Petrorhagia dubia</i>	Y		
1772.	547 <i>Phalaris angusta</i>	Y		
1773.	552 <i>Phalaris paradoxa</i> (Paradoxa Grass)	Y		
1774.	32409 <i>Philonotis australiensis</i>			
1775.	18529 <i>Philothea spicata</i> (Pepper and Salt)			
1776.	1172 <i>Philydrella drummondii</i>			
1777.	1173 <i>Philydrella pygmaea</i> (Butterfly Flowers)			
1778.	14306 <i>Philydrella pygmaea</i> subsp. <i>pygmaea</i>			
1779.	1478 <i>Phlebocarya ciliata</i>			
1780.	1479 <i>Phlebocarya filifolia</i>			
1781.	554 <i>Phleum pratense</i> (Timothy)	Y		
1782.	16825 <i>Phyllangium divergens</i>			
1783.	16177 <i>Phyllangium paradoxum</i>			
1784.	4675 <i>Phyllanthus calycinus</i> (False Boronia)			
1785.	4 <i>Phylloglossum drummondii</i> (Pigmy Clubmoss)			

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1786.	13405 <i>Phyllopodium cordatum</i>	Y		
1787.	4141 <i>Phyllota gracilis</i>			
1788.	78 <i>Pilularia novae-hollandiae</i> (Austral Pillwort)			
1789.	5231 <i>Pimelea angustifolia</i> (Narrow-leaved Pimelea)			
1790.	5232 <i>Pimelea argentea</i> (Silvery Leaved Pimelea)			
1791.	11667 <i>Pimelea brevistyla</i> subsp. <i>brevistyla</i>			
1792.	11928 <i>Pimelea ciliata</i> subsp. <i>ciliata</i>			
1793.	5251 <i>Pimelea imbricata</i>			
1794.	11404 <i>Pimelea imbricata</i> var. <i>major</i>			
1795.	11402 <i>Pimelea imbricata</i> var. <i>piligera</i>			
1796.	11182 <i>Pimelea lehmanniana</i> subsp. <i>nervosa</i>			
1797.	5259 <i>Pimelea preissii</i>			
1798.	5260 <i>Pimelea rara</i> (Summer Pimelea)		P4	
1799.	5266 <i>Pimelea suaveolens</i> (Scented Banjine)			
1800.	12041 <i>Pimelea suaveolens</i> subsp. <i>suaveolens</i>			
1801.	5269 <i>Pimelea sylvestris</i>			
1802.	87 <i>Pinus pinaster</i> (Pinaster Pine)	Y		
1803.	8163 <i>Pithocarpa corymbulosa</i> (Corymbose Pithocarpa)		P3	
1804.	8165 <i>Pithocarpa pulchella</i> (Beautiful Pithocarpa)			
1805.	18353 <i>Pithocarpa pulchella</i> var. <i>pulchella</i>			
1806.	6253 <i>Platysace filiformis</i>			
1807.	6255 <i>Platysace juncea</i>			
1808.	32413 <i>Pleurodium ecklonii</i>			
1809.	571 <i>Poa annua</i> (Winter Grass)	Y		
1810.	573 <i>Poa drummondiana</i> (Knotted Poa)			
1811.	577 <i>Poa poliformis</i> (Coastal Poa)			
1812.	578 <i>Poa porphyroclados</i>			
1813.	17016 <i>Podalyria sericea</i>	Y		
1814.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
1815.	8177 <i>Podolepis lessonii</i>			
1816.	<i>Podotheca ?gnaphalioides</i>			
1817.	8182 <i>Podotheca angustifolia</i> (Sticky Longheads)			
1818.	8183 <i>Podotheca chrysantha</i> (Yellow Podotheca)			
1819.	8184 <i>Podotheca gnaphalioides</i> (Golden Long-heads)			
1820.	8188 <i>Pogonolepis stricta</i>			
1821.	2419 <i>Polygonum aviculare</i> (Wireweed)	Y		
1822.	582 <i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
1823.	583 <i>Polypogon tenellus</i>			
1824.	<i>Polypompholyx tenella</i> scps			
1825.	4690 <i>Poranthera huegelii</i>			
1826.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
1827.	<i>Poranthera microphylla</i> /moorokatta			
1828.	110 <i>Potamogeton drummondii</i>			
1829.	111 <i>Potamogeton ochreateus</i> (Blunt Pondweed)			
1830.	15424 <i>Praecoxanthus aphyllus</i>			
1831.	1668 <i>Prasophyllum brownii</i>			
1832.	1669 <i>Prasophyllum cyphochilum</i> (Pouched Leek Orchid)			
1833.	1670 <i>Prasophyllum drummondii</i> (Swamp Leek Orchid)			
1834.	1672 <i>Prasophyllum fimbria</i> (Fringed Leek Orchid)			
1835.	1676 <i>Prasophyllum hians</i> (Yawning Leek Orchid)			
1836.	1677 <i>Prasophyllum macrostachyum</i> (Laughing Leek Orchid)			
1837.	1680 <i>Prasophyllum parvifolium</i> (Autumn Leek Orchid)			
1838.	10853 <i>Prasophyllum plumiforme</i>			
1839.	17211 <i>Prunus cerasifera</i>	Y		
1840.	57 <i>Pteridium esculentum</i> (Bracken)			
1841.	13255 <i>Pterochaeta paniculata</i>			
1842.	<i>Pterostylis</i> aff. <i>nana</i>			
1843.	<i>Pterostylis</i> aff. <i>nana</i> long sepal			Y
1844.	15426 <i>Pterostylis aspera</i>			
1845.	48675 <i>Pterostylis atosanguinea</i>			
1846.	1686 <i>Pterostylis barbata</i> (Bird Orchid)			
1847.	10875 <i>Pterostylis concava</i>			
1848.	1687 <i>Pterostylis dilatata</i>			
1849.	1693 <i>Pterostylis recurva</i> (Jug Orchid)			
1850.	12217 <i>Pterostylis sanguinea</i>			
1851.	18655 <i>Pterostylis</i> sp. <i>crinkled leaf</i> (G.J. Keighery 13426)			
1852.	1698 <i>Pterostylis vittata</i> (Banded Greenhood)			
1853.	2718 <i>Ptilotus drummondii</i> (Narrowleaf Mulla Mulla)			
1854.	2720 <i>Ptilotus esquamatus</i>			
1855.	2742 <i>Ptilotus manglesii</i> (Pom Poms, Mulamula)			

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1856.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
1857.	32417 <i>Ptychostomum angustifolium</i>			
1858.	4177 <i>Pultenaea ochreatea</i>			
1859.	4181 <i>Pultenaea reticulata</i>			
1860.	8195 <i>Quinetia urvillei</i>			
1861.	32480 <i>Racopilum cuspidigerum</i> var. <i>convolutaceum</i>			
1862.	2933 <i>Ranunculus muricatus</i> (Sharp Buttercup)	Y		
1863.	2938 <i>Ranunculus trilobus</i> (Buttercup)	Y		
1864.	3061 <i>Raphanus raphanistrum</i> (Wild Radish)	Y		
1865.	6012 <i>Regelia ciliata</i>			
1866.	11341 <i>Rhagodia baccata</i> subsp. <i>baccata</i>			
1867.	13300 <i>Rhodanthe citrina</i>			
1868.	15035 <i>Rhodanthe corymbosa</i>			
1869.	13234 <i>Rhodanthe manglesii</i>			
1870.	31927 <i>Ricinocarpus graniticus</i>			
1871.	1556 <i>Romulea rosea</i> (Guildford Grass)	Y		
1872.	11544 <i>Romulea rosea</i> var. <i>australis</i> (Guildford Grass)	Y		
1873.	32424 <i>Rosulabryum albolimbatum</i>			
1874.	20506 <i>Rubus anglocandicans</i>	Y		
1875.	3191 <i>Rubus ulmifolius</i> (Blackberry)	Y		
1876.	23990 <i>Rubus ulmifolius</i> var. <i>ulmifolius</i>	Y		
1877.	2429 <i>Rumex acetosella</i> (Sorrel)	Y		
1878.	2430 <i>Rumex brownii</i> (Swamp Dock)	Y		
1879.	2432 <i>Rumex conglomeratus</i> (Clustered Dock)	Y		
1880.	2433 <i>Rumex crispus</i> (Curled Dock)	Y		
1881.	2440 <i>Rumex pulcher</i> (Fiddle Dock)	Y		
1882.	40425 <i>Rytidosperma caespitosum</i>			
1883.	40426 <i>Rytidosperma occidentale</i>			
1884.	40430 <i>Rytidosperma pilosum</i>			
1885.	40427 <i>Rytidosperma setaceum</i>			
1886.	6929 <i>Salvia verbenaca</i> (Wild Sage)	Y		
1887.	7602 <i>Scaevola calliptera</i>			
1888.	7613 <i>Scaevola glandulifera</i> (Viscid Hand-flower)			
1889.	7619 <i>Scaevola lanceolata</i> (Long-leaved Scaevola)			
1890.	7634 <i>Scaevola phlebopetala</i> (Velvet Fanflower)			
1891.	7635 <i>Scaevola pilosa</i> (Hairy Fan-flower)			
1892.	13182 <i>Scaevola repens</i> var. <i>repens</i>			
1893.	17055 <i>Schinus molle</i>	Y		
1894.	6263 <i>Schoenolaena juncea</i>			
1895.	<i>Schoenus</i> aff. <i>brevisetis</i> (Mud2, #135)			
1896.	972 <i>Schoenus armeria</i>			
1897.	975 <i>Schoenus bifidus</i>			
1898.	978 <i>Schoenus brevisetis</i>			
1899.	979 <i>Schoenus caespititius</i>			
1900.	980 <i>Schoenus capillifolius</i>		P3	
1901.	982 <i>Schoenus clandestinus</i>			
1902.	984 <i>Schoenus curvifolius</i>			
1903.	985 <i>Schoenus discifer</i>			
1904.	986 <i>Schoenus efoliatus</i>			
1905.	991 <i>Schoenus grammatophyllus</i>			
1906.	994 <i>Schoenus humilis</i>			
1907.	996 <i>Schoenus laevigatus</i>			
1908.	1002 <i>Schoenus nanus</i> (Tiny Bog Rush)			
1909.	1006 <i>Schoenus odontocarpus</i>			
1910.	1007 <i>Schoenus pedicellatus</i>			
1911.	1008 <i>Schoenus pennisetis</i>		P3	
1912.	17614 <i>Schoenus plumosus</i>			
1913.	1011 <i>Schoenus rigens</i>			
1914.	1013 <i>Schoenus sculptus</i> (Gimlet Bog-rush)			
1915.	17731 <i>Schoenus</i> sp. <i>Waroona</i> (G.J. Keighery 12235)		P3	
1916.	<i>Schoenus</i> sp. aff. <i>breviculmis</i> sthct			Y
1917.	18164 <i>Schoenus</i> sp. <i>smooth culms</i> (K.R. Newbey 7823)			
1918.	1016 <i>Schoenus subbarbatus</i> (Bearded Bog-rush)			
1919.	1017 <i>Schoenus subbulbosus</i>			
1920.	1019 <i>Schoenus subflavus</i> (Yellow Bog-rush)			
1921.	1020 <i>Schoenus sublateralis</i>			
1922.	1023 <i>Schoenus tenellus</i>			
1923.	1026 <i>Schoenus unispiculatus</i>			
1924.	17409 <i>Schoenus varicellae</i>			
1925.	6033 <i>Scholtzia involucreta</i> (Spiked Scholtzia)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1926.	6 <i>Selaginella gracillima</i> (Tiny Clubmoss)			
1927.	32433 <i>Sematophyllum homomallum</i>			
1928.	8203 <i>Senecio diaschides</i>			
1929.	8212 <i>Senecio leucoglossus</i>		P4	
1930.	20663 <i>Senecio multicaulis</i> subsp. <i>multicaulis</i>			
1931.	25884 <i>Senecio pinnatifolius</i> var. <i>latilobus</i>			
1932.	8217 <i>Senecio quadridentatus</i>			
1933.	608 <i>Setaria italica</i> (Italian Millet)	Y		
1934.	613 <i>Setaria verticillata</i> (Whorled Pigeon Grass)	Y		
1935.	4980 <i>Sida hookeriana</i>			
1936.	2909 <i>Silene gallica</i> (French Catchfly)	Y		
1937.	11803 <i>Silene gallica</i> var. <i>quinquevulnera</i>	Y		
1938.	8224 <i>Siloxerus filifolius</i>			
1939.	8225 <i>Siloxerus humifusus</i> (Procumbent Siloxerus)			
1940.	14583 <i>Siloxerus multiflorus</i>			
1941.	6988 <i>Solanum americanum</i> (Glossy Nightshade)	Y		
1942.	7020 <i>Solanum linnaeanum</i> (Apple of Sodom)	Y		
1943.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
1944.	8230 <i>Sonchus asper</i> (Rough Sowthistle)	Y		
1945.	8231 <i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
1946.	617 <i>Sorghum halepense</i> (Johnson Grass)	Y		
1947.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
1948.	1558 <i>Sparaxis bulbifera</i>	Y		
1949.	2912 <i>Spergula arvensis</i> (Corn Spurry)	Y		
1950.	4205 <i>Sphaerolobium linophyllum</i>			
1951.	4207 <i>Sphaerolobium medium</i>			
1952.	4211 <i>Sphaerolobium vimineum</i> (Leafless Globe Pea)			
1953.	41623 <i>Sphaeromorphaea australis</i>	Y		
1954.	1700 <i>Spiculaea ciliata</i> (Elbow Orchid)			
1955.	635 <i>Sporobolus virginicus</i> (Marine Couch)			
1956.	6930 <i>Stachys arvensis</i> (Staggerweed)	Y		
1957.	20666 <i>Stachystemon</i> sp. <i>Keysbrook</i> (R. Archer 17/11/99)		P1	
1958.	4716 <i>Stachystemon vermicularis</i>			
1959.	4733 <i>Stackhousia monogyna</i>			
1960.	9070 <i>Stackhousia pubescens</i> (Downy Stackhousia)			
1961.	43540 <i>Stackhousia</i> sp. <i>Red-blotched corolla</i> (A. Markey 911)		P3	
1962.	2918 <i>Stellaria media</i> (Chickweed)	Y		
1963.	16197 <i>Stenanthemum emarginatum</i>			
1964.	3080 <i>Stenopetalum robustum</i>			
1965.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
1966.	18564 <i>Stylidium aceratum</i>		P3	
1967.	<i>Stylidium</i> aff. <i>androsaceum</i>			
1968.	7684 <i>Stylidium amoenum</i> (Lovely Triggerplant)			
1969.	17669 <i>Stylidium amoenum</i> var. <i>caulescens</i>			
1970.	30278 <i>Stylidium androsaceum</i>			
1971.	25831 <i>Stylidium araeophyllum</i> (Stilt Walker)			
1972.	<i>Stylidium araeophyllum</i> / <i>neurophyllum</i>			
1973.	7692 <i>Stylidium breviscapum</i> (Boomerang Triggerplant)			
1974.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
1975.	7694 <i>Stylidium bulbiferum</i> (Circus Triggerplant)			
1976.	7696 <i>Stylidium calcaratum</i> (Book Triggerplant)			
1977.	7699 <i>Stylidium carnosum</i> (Fleshy-leaved Triggerplant)			
1978.	7702 <i>Stylidium ciliatum</i> (Golden Triggerplant)			
1979.	7712 <i>Stylidium despectum</i> (Dwarf Triggerplant)			
1980.	7713 <i>Stylidium dichotomum</i> (Pins-and-needles)			
1981.	7716 <i>Stylidium diuroides</i> (Donkey Triggerplant)			
1982.	11808 <i>Stylidium diuroides</i> subsp. <i>diuroides</i>			
1983.	7717 <i>Stylidium divaricatum</i> (Daddy-long-legs)			
1984.	7718 <i>Stylidium diversifolium</i> (Touch-me-not)			
1985.	7719 <i>Stylidium ecome</i> (Foot Triggerplant)			
1986.	7721 <i>Stylidium emarginatum</i> (Biddy-four-legs)			
1987.	19251 <i>Stylidium eriopodum</i>			
1988.	7736 <i>Stylidium hispidum</i> (White Butterfly Triggerplant)			
1989.	7742 <i>Stylidium inundatum</i> (Hundreds and Thousands)			
1990.	7745 <i>Stylidium junceum</i> (Reed Triggerplant)			
1991.	13083 <i>Stylidium lateriticola</i>			
1992.	7749 <i>Stylidium leptophyllum</i> (Needle-leaved Triggerplant)			
1993.	7752 <i>Stylidium lineatum</i> (Sunny Triggerplant)			
1994.	7756 <i>Stylidium longitubum</i> (Jumping Jacks)		P4	
1995.	25829 <i>Stylidium neurophyllum</i> (Coastal Plain Triggerplant)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1996.	7768 <i>Stylidium obtusatum</i> (Pinafore Triggerplant)			
1997.	7772 <i>Stylidium perpusillum</i> (Tiny Triggerplant)			
1998.	7773 <i>Stylidium petiolare</i> (Horn Triggerplant)			
1999.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			
2000.	7782 <i>Stylidium pulchellum</i> (Thumbelina Triggerplant)			
2001.	7783 <i>Stylidium pycnostachyum</i> (Downy Triggerplant)			
2002.	33106 <i>Stylidium recurvum</i>			
2003.	7785 <i>Stylidium repens</i> (Matted Triggerplant)			
2004.	<i>Stylidium roseo-alatum</i>			
2005.	7790 <i>Stylidium roseoalatum</i> (Pink-wing Triggerplant)			
2006.	25806 <i>Stylidium scarosum</i>			
2007.	7798 <i>Stylidium schoenoides</i> (Cow Kicks)			
2008.	<i>Stylidium</i> sp.			
2009.	14736 <i>Stylidium</i> sp. Boulder Rock (A.H. Burbidge 2536)			
2010.	45594 <i>Stylidium tenue</i> subsp. <i>majusculum</i> (Showy Fountain Triggerplant)			
2011.	23511 <i>Stylidium thesioides</i> (Delicate Triggerplant)			
2012.	7806 <i>Stylidium utricularioides</i> (Pink Fan Triggerplant)			
2013.	40947 <i>Stylidium xanthellum</i>			
2014.	1260 <i>Styphandra glauca</i> (Blind Grass)			
2015.	48293 <i>Styphelia ciliosa</i>			
2016.	48297 <i>Styphelia filifolia</i>		P3	
2017.	6476 <i>Styphelia tenuiflora</i> (Common Pinheath)			
2018.	25902 <i>Symphotrichum squamatum</i> (Bushy Starwort)	Y		
2019.	2321 <i>Synaphea acutiloba</i> (Granite Synaphea)			
2020.	16883 <i>Synaphea damopsis</i>			
2021.	12914 <i>Synaphea decorticans</i>			
2022.	2323 <i>Synaphea gracillima</i>			
2023.	16865 <i>Synaphea odocoileops</i>		P1	
2024.	2324 <i>Synaphea petiolaris</i> (Synaphea)			
2025.	16864 <i>Synaphea petiolaris</i> subsp. <i>petiolaris</i>			
2026.	2325 <i>Synaphea pinnata</i> (Helena Synaphea)			
2027.	18590 <i>Synaphea</i> sp. Fairbridge Farm (D. Papenfus 696)		T	
2028.	30751 <i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)		T	
2029.	28354 <i>Synaphea</i> sp. Serpentine (G.R. Brand 103)		T	
2030.	29186 <i>Synaphea</i> sp. Udumung (A.S. George 17058)			
2031.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
2032.	32439 <i>Syntrichia papillosa</i>			
2033.	20024 <i>Tagetes erecta</i> (Marigold)	Y		
2034.	20135 <i>Taxandria linearifolia</i>			
2035.	2820 <i>Tetragonia decumbens</i> (Sea Spinach)	Y		
2036.	1033 <i>Tetralia australiensis</i>		T	
2037.	1034 <i>Tetralia capillaris</i> (Hair Sedge)			
2038.	1036 <i>Tetralia octandra</i>			
2039.	35579 <i>Tetralia</i> sp. Jarrah Forest (R. Davis 7391)			
2040.	667 <i>Tetralia laevis</i> (Forest Ricegrass)			
2041.	4535 <i>Tetralia hirsuta</i> (Black Eyed Susan)			
2042.	48342 <i>Tetralia hirsuta</i> subsp. <i>hirsuta</i>			
2043.	48341 <i>Tetralia hirsuta</i> subsp. <i>viminea</i>			
2044.	4536 <i>Tetralia hispidissima</i>			
2045.	4537 <i>Tetralia nuda</i>			
2046.	<i>Thelymitra</i> aff. <i>pauciflora</i>			
2047.	1701 <i>Thelymitra antennifera</i> (Vanilla Orchid)			
2048.	10856 <i>Thelymitra benthamiana</i> (Leopard Orchid)			
2049.	1702 <i>Thelymitra campanulata</i> (Shirt Orchid)			
2050.	1705 <i>Thelymitra crinita</i> (Blue Lady Orchid)			
2051.	1707 <i>Thelymitra flexuosa</i> (Twisted Sun Orchid)			
2052.	23991 <i>Thelymitra frenchii</i>			
2053.	11143 <i>Thelymitra graminea</i>			
2054.	11053 <i>Thelymitra macrophylla</i>			
2055.	<i>Thelymitra</i> sp.			
2056.	1715 <i>Thelymitra spiralis</i> (Curlylocks)			
2057.	20731 <i>Thelymitra vulgaris</i>			
2058.	673 <i>Themeda triandra</i>			
2059.	5080 <i>Thomasia foliosa</i>			
2060.	5084 <i>Thomasia grandiflora</i> (Large Flowered Thomasia)			
2061.	5087 <i>Thomasia macrocarpa</i> (Large Fruited Thomasia)			
2062.	5091 <i>Thomasia paniculata</i>			
2063.	5092 <i>Thomasia pauciflora</i> (Few Flowered Thomasia)			
2064.	32486 <i>Thuidium sparsum</i> var. <i>hastatum</i>			
2065.	1317 <i>Thysanotus anceps</i>		P3	

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
2066.	1318 <i>Thysanotus arbuscula</i>			
2067.	1319 <i>Thysanotus arenarius</i>			
2068.	1328 <i>Thysanotus dichotomus</i> (Branching Fringe Lily)			
2069.	1330 <i>Thysanotus fastigiatus</i>			
2070.	1338 <i>Thysanotus manglesianus</i> (Fringed Lily)			
2071.	<i>Thysanotus manglesianus/patersonii</i> complex			
2072.	1339 <i>Thysanotus multiflorus</i> (Many-flowered Fringe Lily)			
2073.	1343 <i>Thysanotus patersonii</i>			
2074.	1351 <i>Thysanotus sparteus</i>			
2075.	1354 <i>Thysanotus tenellus</i>			
2076.	1357 <i>Thysanotus thyrsoides</i>			
2077.	1358 <i>Thysanotus triandrus</i>			
2078.	8248 <i>Tolpis barbata</i> (Yellow Hawkweed)	Y		
2079.	19041 <i>Trachymene coerulea</i> subsp. <i>coerulea</i>			
2080.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
2081.	1481 <i>Tribonanthes australis</i> (Southern Tiurmdin)			
2082.	1482 <i>Tribonanthes brachypetala</i> (Nodding Tiurmdin)			
2083.	1483 <i>Tribonanthes longipetala</i> (Branching Tiurmdin)			
2084.	1485 <i>Tribonanthes violacea</i> (Violet Tiurmdin)			
2085.	4383 <i>Tribulus terrestris</i> (Caltrop)	Y		
2086.	8251 <i>Trichocline spathulata</i> (Native Gerbera)			
2087.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
2088.	1362 <i>Tricoryne humilis</i>			
2089.	1363 <i>Tricoryne tenella</i>			
2090.	1038 <i>Tricostularia neesii</i>			
2091.	4289 <i>Trifolium angustifolium</i> (Narrowleaf Clover)	Y		
2092.	17145 <i>Trifolium angustifolium</i> var. <i>angustifolium</i>	Y		
2093.	4291 <i>Trifolium arvense</i> (Hare's Foot Clover)	Y		
2094.	17542 <i>Trifolium arvense</i> var. <i>arvense</i>	Y		
2095.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
2096.	17763 <i>Trifolium campestre</i> var. <i>campestre</i> (Hop Clover)	Y		
2097.	4293 <i>Trifolium cernuum</i> (Drooping Flower Clover)	Y		
2098.	4295 <i>Trifolium dubium</i> (Suckling Clover)	Y		
2099.	4297 <i>Trifolium glomeratum</i> (Cluster Clover)	Y		
2100.	17758 <i>Trifolium hybridum</i> var. <i>hybridum</i>	Y		
2101.	17541 <i>Trifolium incarnatum</i> var. <i>incarnatum</i>	Y		
2102.	4304 <i>Trifolium ornithopodioides</i> (Birdsfoot Fenugreek)	Y		
2103.	4313 <i>Trifolium subterraneum</i> (Subterranean Clover)	Y		
2104.	18587 <i>Triglochin nana</i>			
2105.	4737 <i>Tripterococcus brunonis</i> (Winged Stackhousia)			
2106.	46394 <i>Triquetrella paradoxa</i>			
2107.	1139 <i>Triphuria bibracteata</i>			
2108.	1141 <i>Triphuria submersa</i>			
2109.	1561 <i>Tritonia crocata</i>	Y		
2110.	11665 <i>Trymalium ledifolium</i> var. <i>ledifolium</i>			
2111.	13479 <i>Trymalium ledifolium</i> var. <i>rosmarinifolium</i>			
2112.	33418 <i>Trymalium odoratissimum</i> subsp. <i>odoratissimum</i>			
2113.	8255 <i>Ursinia anthemoides</i> (Ursinia)	Y		
2114.	38388 <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	Y		
2115.	7148 <i>Utricularia multifida</i>			
2116.	7153 <i>Utricularia tenella</i>			
2117.	7157 <i>Utricularia violacea</i> (Violet Bladderwort)			
2118.	7665 <i>Velleia trinervis</i>			
2119.	8257 <i>Vellereophyton dealbatum</i> (White Cudweed)	Y		
2120.	7107 <i>Verbascum virgatum</i> (Twiggy Mullein)	Y		
2121.	6070 <i>Verticordia acerosa</i>			
2122.	15431 <i>Verticordia acerosa</i> var. <i>acerosa</i>			
2123.	12388 <i>Verticordia acerosa</i> var. <i>preissii</i>			
2124.	6076 <i>Verticordia densiflora</i> (Compacted Featherflower)			
2125.	12411 <i>Verticordia densiflora</i> var. <i>cespitosa</i>			
2126.	15432 <i>Verticordia densiflora</i> var. <i>densiflora</i>			
2127.	6088 <i>Verticordia huegelii</i> (Variegated Featherflower)			
2128.	12429 <i>Verticordia huegelii</i> var. <i>decumbens</i>			
2129.	15433 <i>Verticordia huegelii</i> var. <i>huegelii</i>			
2130.	12430 <i>Verticordia huegelii</i> var. <i>stylosa</i>			
2131.	14714 <i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>		P4	
2132.	6107 <i>Verticordia pennigera</i>			
2133.	6110 <i>Verticordia plumosa</i> (Plumed Featherflower)			
2134.	12448 <i>Verticordia plumosa</i> var. <i>ananeotes</i>		T	
2135.	12449 <i>Verticordia plumosa</i> var. <i>brachyphylla</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
2136.	15618 <i>Verticordia plumosa</i> var. <i>plumosa</i>			
2137.	4320 <i>Vicia hirsuta</i> (Hairy Vetch)	Y		
2138.	4322 <i>Vicia sativa</i> (Common Vetch)	Y		
2139.	12070 <i>Vicia sativa</i> subsp. <i>sativa</i>	Y		
2140.	4325 <i>Viminaria juncea</i> (Swishbush, Koweda)			
2141.	6575 <i>Vinca major</i> (Blue Periwinkle)	Y		
2142.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
2143.	11018 <i>Vulpia muralis</i>	Y		
2144.	724 <i>Vulpia myuros</i> (Rat's Tail Fescue)	Y		
2145.	33101 <i>Vulpia myuros</i> forma <i>myuros</i>	Y		
2146.	7384 <i>Wahlenbergia capensis</i> (Cape Bluebell)	Y		
2147.	7386 <i>Wahlenbergia gracilentia</i> (Annual Bluebell)			
2148.	7389 <i>Wahlenbergia preissii</i>			
2149.	8282 <i>Waitzia suaveolens</i> (Fragrant Waitzia)			
2150.	17910 <i>Washingtonia filifera</i>	Y		
2151.	13103 <i>Watsonia borbonica</i>	Y		
2152.	1566 <i>Watsonia marginata</i>	Y		
2153.	1567 <i>Watsonia meriana</i> (Bulbil Watsonia)	Y		
2154.	18108 <i>Watsonia meriana</i> var. <i>bulbillifera</i>	Y		
2155.	18118 <i>Watsonia meriana</i> var. <i>meriana</i>	Y		
2156.	<i>Watsonia</i> sp. <i>Mud09</i>			Y
2157.	32455 <i>Weissia controversa</i>			
2158.	32456 <i>Weissia rutilans</i>			
2159.	1394 <i>Wurmbea dioica</i> (Early Nancy)			
2160.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
2161.	1249 <i>Xanthorrhoea acanthostachya</i>			
2162.	1253 <i>Xanthorrhoea gracilis</i> (Graceful Grass Tree, Mimidi)			
2163.	1256 <i>Xanthorrhoea preissii</i> (Grass tree, Palga)			
2164.	<i>Xanthorrhoea</i> sp.			
2165.	<i>Xanthosia</i> ? <i>huegelii</i>			Y
2166.	6283 <i>Xanthosia atkinsoniana</i>			
2167.	6284 <i>Xanthosia candida</i>			
2168.	6285 <i>Xanthosia ciliata</i>			
2169.	6287 <i>Xanthosia fruticulosa</i>			
2170.	6289 <i>Xanthosia huegelii</i>			
2171.	6293 <i>Xanthosia singuliflora</i>			
2172.	44861 <i>Xerochrysum macranthum</i>			
2173.	2331 <i>Xylomelum occidentale</i> (Woody Pear, Djandin)			
2174.	15819 <i>Xyris atrovirida</i>			
2175.	1049 <i>Zantedeschia aethiopica</i> (Arum Lily)	Y		
Protozoa				
2176.	38979 <i>Badhamia utricularis</i>			
2177.	39038 <i>Leocarpus fragilis</i>			
2178.	39058 <i>Perichaena depressa</i>			
2179.	39083 <i>Stemonitis fusca</i>			
2180.	39086 <i>Stemonitis smithii</i>			Y
2181.	39098 <i>Trichia favoginea</i>			
2182.	39100 <i>Trichia persimilis</i>			
2183.	39103 <i>Tubifera ferruginosa</i>			

Conservation Codes

- T - Rare or likely to become extinct
- X - Presumed extinct
- IA - Protected under international agreement
- S - Other specially protected fauna
- 1 - Priority 1
- 2 - Priority 2
- 3 - Priority 3
- 4 - Priority 4
- 5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D Aboriginal Sites of Significance

List of Registered Aboriginal Sites

Search Criteria

23 Registered Aboriginal Sites in LGA - Shire Of Serpentine-Jarrahdale

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

South West Settlement ILUA Disclaimer

Your heritage enquiry is on land **within or adjacent to** the following Indigenous Land Use Agreement(s): Gnaala Karla Booja People ILUA.

On 8 June 2015, six identical Indigenous Land Use Agreements (ILUAs) were executed across the South West by the Western Australian Government and, respectively, the Yued, Whadjuk People, Gnaala Karla Booja, Ballardong People, South West Boojarah #2 and Wagyl Kaip & Southern Noongar groups, and the South West Aboriginal Land and Sea Council (SWALSC).

The ILUAs bind the parties (including 'the State', which encompasses all State Government Departments and certain State Government agencies) to enter into a Noongar Standard Heritage Agreement (NSHA) when conducting Aboriginal Heritage Surveys in the ILUA areas, unless they have an existing heritage agreement. It is also intended that other State agencies and instrumentalities enter into the NSHA when conducting Aboriginal Heritage Surveys in the ILUA areas. It is recommended a NSHA is entered into, and an 'Activity Notice' issued under the NSHA, if there is a risk that an activity will 'impact' (i.e. by excavating, damaging, destroying or altering in any way) an Aboriginal heritage site. The Aboriginal Heritage Due Diligence Guidelines, which are referenced by the NSHA, provide guidance on how to assess the potential risk to Aboriginal heritage.

Likewise, from 8 June 2015 the Department of Mines, Industry Regulation and Safety (DMIRS) in granting Mineral, Petroleum and related Access Authority tenures within the South West Settlement ILUA areas, will place a condition on these tenures requiring a heritage agreement or a NSHA before any rights can be exercised.

If you are a State Government Department, Agency or Instrumentality, or have a heritage condition placed on your mineral or petroleum title by DMIRS, you should seek advice as to the requirement to use the NSHA for your proposed activity. The full ILUA documents, maps of the ILUA areas and the NSHA template can be found at <https://www.dpc.wa.gov.au/swnts/South-West-Native-Title-Settlement/Pages/default.aspx>.

Further advice can also be sought from the Department of Planning, Lands and Heritage at heritageenquiries@dplh.wa.gov.au.

Copyright

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Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

List of Registered Aboriginal Sites

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This is a unique ID assigned by the Department of Planning, Lands and Heritage to the place.

Status:

- **Registered Site:** The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972*.
- **Other Heritage Place which includes:**
 - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972*.
 - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972*.

Access and Restrictions:

- **File Restricted = No:** Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact heritageenquiries@dplh.wa.gov.au.
- **Boundary Restricted = No:** Place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- **Restrictions:**
 - **No Restrictions:** *Anyone* can view the information.
 - **Male Access Only:** Only *males* can view restricted information.
 - **Female Access Only:** Only *females* can view restricted information.

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
396	SOUTH-EAST CORRIDOR 07 / CARDUP SIDING	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403514mE 6432467mN Zone 50 [Reliable]	S02959
448	SOUTH-EAST CORRIDOR 01	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403350mE 6431996mN Zone 50 [Reliable]	S02953
449	SOUTH-EAST CORRIDOR 02	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403039mE 6429389mN Zone 50 [Reliable]	S02954
450	SOUTH-EAST CORRIDOR 03	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	402915mE 6428941mN Zone 50 [Reliable]	S02955
3512	WUNGONG BROOK	No	No	No Gender Restrictions	Registered Site	Mythological	*Registered Knowledge Holder names available from DAA	406692mE 6438431mN Zone 50 [Reliable]	S02602
3582	SERPENTINE RIVER	Yes	Yes	No Gender Restrictions	Registered Site	Ceremonial, Mythological	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	S02407
16089	BYFORD 01	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407178mE 6433329mN Zone 50 [Unreliable]	
16090	BYFORD 02	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407169mE 6433099mN Zone 50 [Unreliable]	
16091	BYFORD 03	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407119mE 6432899mN Zone 50 [Unreliable]	
16092	BYFORD 04	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407049mE 6432879mN Zone 50 [Unreliable]	
16094	BYFORD 06	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406479mE 6433489mN Zone 50 [Unreliable]	
16095	BYFORD 07	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406579mE 6433489mN Zone 50 [Unreliable]	

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

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16096	BYFORD 08	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406429mE 6432829mN Zone 50 [Unreliable]	
16097	BYFORD 09	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Shell	*Registered Knowledge Holder names available from DAA	406539mE 6433359mN Zone 50 [Unreliable]	
16099	BYFORD 11	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406599mE 6433399mN Zone 50 [Unreliable]	
16100	BYFORD 12	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407153mE 6432454mN Zone 50 [Unreliable]	
16101	BYFORD 13	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407100mE 6432337mN Zone 50 [Unreliable]	
16102	BYFORD 14	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406931mE 6432348mN Zone 50 [Reliable]	
16104	BYFORD 16	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406729mE 6432419mN Zone 50 [Unreliable]	
18187	Tonkin highway - mundijong road scatter # 11	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	402958mE 6428173mN Zone 50 [Reliable]	
18188	Tonkin highway - mundijong road scatter # 12	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	402961mE 6428042mN Zone 50 [Reliable]	
18191	Tonkin highway - mundijong road scatter # 15	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406725mE 6424750mN Zone 50 [Reliable]	
23917	Byford Archaeological Survey 004	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403917mE 6432563mN Zone 50 [Reliable]	

List of Other Heritage Places

Search Criteria

64 Other Heritage Places in LGA - Shire Of Serpentine-Jarrahdale

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

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3192	SERPENTINE DAM.	No	No	No Gender Restrictions	Stored Data / Not a Site	Other: SIGN SHOWS ABORIGINAL DESIGN	*Registered Knowledge Holder names available from DAA	415639mE 6415649mN Zone 50 [Unreliable]	S00577
3310	CARDUP.	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter, Camp	*Registered Knowledge Holder names available from DAA	404190mE 6432718mN Zone 50 [Unreliable]	S00206
3313	MUNDIJONG.	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Camp	*Registered Knowledge Holder names available from DAA	406065mE 6426234mN Zone 50 [Unreliable]	S00209
3506	DIRK BROOK.	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit, Other: ?	*Registered Knowledge Holder names available from DAA	404239mE 6413049mN Zone 50 [Reliable]	S02581
3563	JARRAHDALE	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Quarry	*Registered Knowledge Holder names available from DAA	428639mE 6412649mN Zone 50 [Unreliable]	S02455
3590	WHITBY	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407195mE 6427120mN Zone 50 [Unreliable]	S02416
3591	YARRABAH	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406870mE 6425980mN Zone 50 [Unreliable]	S02417
3648	SOLDIERS ROAD,MUNDIJONG.	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit, BP Dating: 1620BP	*Registered Knowledge Holder names available from DAA	404684mE 6428480mN Zone 50 [Reliable]	S02329
4324	GAS PIPELINE 83	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	390639mE 6417649mN Zone 50 [Unreliable]	S00815
16093	BYFORD 05	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406878mE 6432931mN Zone 50 [Reliable]	
16098	BYFORD 10	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406729mE 6433489mN Zone 50 [Unreliable]	
16103	BYFORD 15	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406819mE 6432419mN Zone 50 [Unreliable]	

Aboriginal Heritage Inquiry System

List of Other Heritage Places

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16105	BYFORD 17	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406789mE 6432669mN Zone 50 [Unreliable]	
16106	BYFORD 18	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406893mE 6432675mN Zone 50 [Reliable]	
16107	BYFORD 19	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406911mE 6432560mN Zone 50 [Reliable]	
16108	CARDUP BROOK	No	No	No Gender Restrictions	Stored Data / Not a Site	Mythological	*Registered Knowledge Holder names available from DAA	407530mE 6431805mN Zone 50 [Reliable]	
16784	Field Site 1	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404289mE 6412949mN Zone 50 [Reliable]	
17923	IF #2	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403038mE 6427638mN Zone 50 [Reliable]	
18189	Tonkin highway - mundijong road scatter # 13	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403043mE 6427990mN Zone 50 [Reliable]	
18190	Tonkin Highway - Mundijong Road Scatter # 14	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404475mE 6425300mN Zone 50 [Reliable]	
18192	Tonkin highway - mundijong road scatter # 16	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407050mE 6424150mN Zone 50 [Reliable]	
21305	Byford Village Isolated Finds	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter, Other: Multiple Isolated Finds	*Registered Knowledge Holder names available from DAA	406780mE 6433772mN Zone 50 [Unreliable]	
23914	Byford Archaeological Survey 001	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter, Modified Tree	*Registered Knowledge Holder names available from DAA	405373mE 6432652mN Zone 50 [Reliable]	
23915	Byford Archaeological Survey 002	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404363mE 6432537mN Zone 50 [Reliable]	

List of Other Heritage Places

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
23916	Byford Archaeological Survey 003	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403847mE 6432559mN Zone 50 [Reliable]	
23918	Byford Archaeological Survey 005	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404185mE 6433441mN Zone 50 [Reliable]	
23919	Byford Archaeological Survey 006	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	403254mE 6433533mN Zone 50 [Reliable]	
23920	BAS/ISO - 001	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404022mE 6432479mN Zone 50 [Reliable]	
23921	BAS/ISO - 002	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404809mE 6432444mN Zone 50 [Reliable]	
23922	BAS/ISO - 003	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404364mE 6434301mN Zone 50 [Reliable]	
23923	BAS/ISO - 004	No	No	No Gender Restrictions	Stored Data / Not a Site		*Registered Knowledge Holder names available from DAA	404343mE 6434232mN Zone 50 [Reliable]	
23924	BAS/ISO - 005	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404386mE 6434106mN Zone 50 [Reliable]	
23925	BAS/ISO - 006	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	404377mE 6434111mN Zone 50 [Reliable]	
24756	TH 02-03-04/01	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	402149mE 6438656mN Zone 50 [Reliable]	
24979	Nettleton Road 19-09-07/001	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406625mE 6434289mN Zone 50 [Reliable]	
24980	Nettleton Road 19-09-07/002	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406896mE 6433922mN Zone 50 [Reliable]	

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24981	Nettleton Road 19-09-07/003	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406992mE 6434247mN Zone 50 [Reliable]	
24982	Nettleton Road Isolated Finds	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406980mE 6434342mN Zone 50 [Reliable]	
24983	Nettleton Road 1-06	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	406895mE 6434284mN Zone 50 [Reliable]	
24984	Nettleton Road 2-06	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407280mE 6434370mN Zone 50 [Reliable]	
24985	Nettleton Road 3-06	No	No	No Gender Restrictions	Stored Data / Not a Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	407357mE 6434486mN Zone 50 [Reliable]	
24991	Beenyup Brook	No	No	No Gender Restrictions	Stored Data / Not a Site	Mythological, Natural Feature	*Registered Knowledge Holder names available from DAA	407501mE 6433928mN Zone 50 [Reliable]	
26171	KEY08-01	No	No	No Gender Restrictions	Lodged	Modified Tree, Other: marker	*Registered Knowledge Holder names available from DAA	403989mE 6410511mN Zone 50 [Reliable]	
26172	KEY08-02	No	No	No Gender Restrictions	Lodged	Modified Tree, Other: marker	*Registered Knowledge Holder names available from DAA	404041mE 6410403mN Zone 50 [Reliable]	
28186	Nyitting Booya Binja	Yes	Yes	Male Access Only	Lodged	Artefacts / Scatter, Arch Deposit, Camp	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	
28355	MY08-27	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	425397mE 6409021mN Zone 50 [Reliable]	
28356	MY08-28	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	425590mE 6409766mN Zone 50 [Reliable]	
28357	MY08-29	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Historical	*Registered Knowledge Holder names available from DAA	425638mE 6410264mN Zone 50 [Reliable]	

Aboriginal Heritage Inquiry System

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28358	MY08-30	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	419085mE 6411955mN Zone 50 [Reliable]	
28359	MY08-31	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	420029mE 6411089mN Zone 50 [Reliable]	
28362	MY08-34	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	415002mE 6410754mN Zone 50 [Reliable]	
28364	MY08-36	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	412164mE 6408586mN Zone 50 [Reliable]	
28369	MY08-41	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	422901mE 6410723mN Zone 50 [Reliable]	
28370	MY08-42	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Grinding Patches / Grooves	*Registered Knowledge Holder names available from DAA	420374mE 6411276mN Zone 50 [Reliable]	
28371	MY08-43	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	420452mE 6411254mN Zone 50 [Reliable]	
32591	MJ-01	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit	*Registered Knowledge Holder names available from DAA	404402mE 6428854mN Zone 50 [Reliable]	
32614	MJ-05	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit	*Registered Knowledge Holder names available from DAA	404499mE 6428524mN Zone 50 [Reliable]	
32615	MJ-04	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit	*Registered Knowledge Holder names available from DAA	403317mE 6428377mN Zone 50 [Reliable]	
32616	MJ-03	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit	*Registered Knowledge Holder names available from DAA	403046mE 6428302mN Zone 50 [Reliable]	
32617	MJ-06	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit	*Registered Knowledge Holder names available from DAA	403112mE 6426496mN Zone 50 [Reliable]	

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32619	MJ-02	No	No	No Gender Restrictions	Lodged	Artefacts / Scatter, Arch Deposit	*Registered Knowledge Holder names available from DAA	403470mE 6428279mN Zone 50 [Reliable]	
37115	MJ-09	No	No		Lodged		*Registered Knowledge Holder names available from DAA	404263mE 6428245mN Zone 50 [Reliable]	
37116	MJ-08	No	No		Lodged		*Registered Knowledge Holder names available from DAA	404726mE 6428247mN Zone 50 [Reliable]	
37117	MJ-07	No	No		Lodged		*Registered Knowledge Holder names available from DAA	403071mE 6426813mN Zone 50 [Reliable]	

Appendix E – List of Heritage Places

Place No	Place Name	Suburb or Town	State Registered	Municipal Inventory	National Trust	Register of Heritage Places Assessment
3866	Serpentine General Store	Serpentine	TRUE	TRUE	FALSE	
2360	Turner Cottage	Serpentine	TRUE	TRUE	TRUE	
3302	Spencer's Cottage	Serpentine	TRUE	TRUE	TRUE	
4615	Mill Manager's Residence	Jarrahdale	TRUE	TRUE	FALSE	
8604	Whitby Falls Hostel	Whitby	TRUE	TRUE	FALSE	
2357	St Stephen's Anglican Church	Serpentine	FALSE	TRUE	TRUE	
2362	St Paul's Anglican Church	Jarrahdale	FALSE	TRUE	FALSE	To be assessed
8489	St Maria Goretti Catholic Church	Jarrahdale	FALSE	TRUE	FALSE	To be assessed
8492	Buckland's Cottage	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
8601	Bishop Hale's Cottage	Serpentine	FALSE	TRUE	TRUE	
4051	Serpentine (Bridge) School (fmr)	Serpentine	FALSE	TRUE	TRUE	
8605	Jarrahdale Inn (fmr)	Mundijong	FALSE	TRUE	TRUE	To be assessed
8491	Jarrahdale Tavern	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
17807	Mill Site and Timber Store	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
8628	Jarrahdale School	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
8623	Residence	Mundijong	FALSE	TRUE	FALSE	
8621	Mundijong Post Office (fmr)	Mundijong	FALSE	TRUE	FALSE	
8619	Brick Kilns	Byford	FALSE	TRUE	FALSE	
8615	Manjedal School (fmr)	Mundijong	FALSE	TRUE	FALSE	
3922	Masonic Hall	Mundijong	FALSE	TRUE	FALSE	
8617	Road Board Building (fmr)	Mundijong	FALSE	TRUE	FALSE	
24405	Fremnells Dairy	Cardup	FALSE	TRUE	FALSE	
8626	Two Residences	Serpentine	FALSE	TRUE	FALSE	
8625	Butcher Shop	Serpentine	FALSE	TRUE	FALSE	
8624	Railway Cottage (fmr)	Mundijong	FALSE	TRUE	FALSE	
7196	Bodhinyana Buddhist Monastery	Serpentine	FALSE	TRUE	FALSE	To be assessed
8486	Italian Prisoner of War Camp	Jarrahdale	FALSE	TRUE	FALSE	
8487	Gooralong Park & Flour Mill Site	Jarrahdale	FALSE	TRUE	FALSE	
8493	Ivan Elliot's Shearing Shed	Keysbrook	FALSE	TRUE	FALSE	
17806	Old Serpentine Inn	Serpentine	FALSE	TRUE	FALSE	
8495	Old Bolinda Vale Farmhouse	Keysbrook	FALSE	TRUE	FALSE	
8633	Summerfield Cottage	Serpentine	FALSE	TRUE	FALSE	
8484	Redgum Patch	Cardup	FALSE	TRUE	FALSE	
2358	Serpentine Falls Hotel	Serpentine	FALSE	TRUE	FALSE	
8482	Manjedal Brook	Byford	FALSE	TRUE	FALSE	

8496	Whollogan's Bakers	Mundijong	FALSE	TRUE	FALSE	
8627	The Chestnuts	Jarrahdale	FALSE	TRUE	FALSE	
8498	The Nook	Mundijong	FALSE	TRUE	FALSE	
8603	Jarrahdale Road Swamp, Serpentine West	Serpentine	FALSE	TRUE	FALSE	
8497	Old Mundijong Hotel	Mundijong	FALSE	TRUE	FALSE	
8483	Millrace Farmhouse	Byford	FALSE	TRUE	FALSE	
8600	Longbottom's Cottage (Ruins)	Serpentine	FALSE	TRUE	FALSE	
8631	Brooklyn Farm	Mardella	FALSE	TRUE	FALSE	
8608	Yangeddi Swamp	Jarrahdale	FALSE	TRUE	FALSE	
8629	Hopeland School	Keysbrook	FALSE	TRUE	FALSE	
8499	McKay's House	Serpentine	FALSE	TRUE	FALSE	
8480	Nairn's House	Byford	FALSE	TRUE	FALSE	
8632	Jarrahdale Reserve	Serpentine	FALSE	TRUE	FALSE	
8479	Bateman Homestead	Byford	FALSE	TRUE	FALSE	
8602	Cheese Factory	Serpentine	FALSE	TRUE	FALSE	
8614	Teacher's Quarters (fmr)	Serpentine	FALSE	TRUE	FALSE	
8606	Wungong Farm Cottage	Darling Downs	FALSE	TRUE	FALSE	
2364	St Aidan's Anglican Church & Church Hall	Byford	FALSE	TRUE	FALSE	
2874	Old Post Office Museum Wash-house and Out- house	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
4048	Old Serpentine Cemetery	Serpentine	FALSE	TRUE	TRUE	
2359	Baldwins Cottage	Serpentine	FALSE	TRUE	TRUE	
8622	Six Mill Houses	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
17808	CALM Houses	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
17809	Workers' Cottages and Quarters	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
8611	Jarrahdale General Store	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
8630	Jarrahdale Cemetery	Jarrahdale	FALSE	TRUE	TRUE	To be assessed
3307	Lowlands Homestead	Mardella	FALSE	TRUE	TRUE	To be assessed
4050	Old Serpentine Settlement	Serpentine	FALSE	TRUE	FALSE	
3129	Mundijong Railway Station	Mundijong	FALSE	TRUE	FALSE	
8481	Burnbrae Orphanage	Byford	FALSE	TRUE	FALSE	
8478	Brickworks Railway Bridge (fmr), Byford	Byford	FALSE	TRUE	FALSE	
8488	Jarrahdale Townsite & Heritage Park	Jarrahdale	FALSE	TRUE	FALSE	To be assessed
8485	Mead's House	Karrakup	FALSE	TRUE	FALSE	To be assessed
2363	Byford Uniting Presbyterian Church	Byford	FALSE	TRUE	FALSE	
8494	Keysbrook Farmhouse	Keysbrook	FALSE	TRUE	TRUE	
2365	Mundijong Hotel	Mundijong	FALSE	TRUE	FALSE	
2366	Mundijong Uniting Church	Mundijong	FALSE	TRUE	FALSE	
11582	Anglican Rectory	Mundijong	FALSE	FALSE	FALSE	
13088	St Kevin's Church	Serpentine	FALSE	FALSE	FALSE	
4505	Cardup Bushland	Byford	FALSE	FALSE	TRUE	

4504	Brickwood Bushland	Byford	FALSE	FALSE	TRUE	
4503	Jarrahdale Railway Cutting	Jarrahdale	FALSE	FALSE	TRUE	
4385	Port Jackson Fig	Serpentine	FALSE	FALSE	TRUE	
4386	Olive & Carob Trees, Wungong Farm	Byford	FALSE	FALSE	TRUE	
4049	Reserve	Serpentine	FALSE	FALSE	TRUE	
18697	Monadnocks Conservation Park	Gleneagle Via Jarrahdale	FALSE	FALSE	TRUE	
14370	Lowlands & Riverlea Bushland - part	Serpentine	FALSE	FALSE	TRUE	
18728	Serpentine National Park	Serpentine	FALSE	FALSE	TRUE	
25575	Karnet Prison Farm Staff Housing	Serpentine	FALSE	FALSE	FALSE	
8612	Two CALM Houses	Jarrahdale	FALSE	FALSE	FALSE	To be assessed
8613	Eight CALM Houses	Jarrahdale	FALSE	FALSE	FALSE	To be assessed
8616	CALM House	Jarrahdale	FALSE	FALSE	FALSE	To be assessed
9625	Kargotich Dairy	Byford	FALSE	FALSE	FALSE	To be assessed
9250	Jarrahdale to Rockingham Railway	Jarrahdale	FALSE	FALSE	FALSE	To be assessed
4174	Serpentine Dam	Serpentine	FALSE	FALSE	FALSE	To be assessed
17287	Jarrahdale Heritage Park	Jarrahdale	FALSE	FALSE	FALSE	To be assessed
4496	Naval Armament Depot	Byford	FALSE	FALSE	FALSE	To be assessed
13052	Byford War Memorial	Byford	FALSE	FALSE	FALSE	
14036	Jarrahdale Honour Rolls, Bruno Gianetti Memorial Hall	Jarrahdale	FALSE	FALSE	FALSE	
13058	Byford Honour Roll, Byford Hall	Byford	FALSE	FALSE	FALSE	
14042	Mundijong Honour Roll, Mundijong Community Hall	Mundijong	FALSE	FALSE	FALSE	
13051	Jarrahdale War memorial	Jarrahdale	FALSE	FALSE	FALSE	
8607	Perretts Bushland	Jarrahdale	FALSE	FALSE	FALSE	
18793	Manjedal Brook Road Bridge	Whitby Falls	FALSE	FALSE	FALSE	
16615	Touchwood Cottage	Cardup	FALSE	FALSE	FALSE	
2584	Mundijong Townsite	Mundijong	FALSE	FALSE	FALSE	
25640	Karnet Prison Farm	Keysbrook	FALSE	FALSE	FALSE	
18778	Percy's Place	Byford	FALSE	FALSE	FALSE	
16796	Railway House (fmr)	Byford	FALSE	FALSE	FALSE	
14085	Serpentine Honour Roll, Clem Kentish Community Hall	Serpentine	FALSE	FALSE	FALSE	

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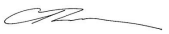
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