Operational guidelines for Lowlands Nature Reserve

2018
Swan Coastal District
Shire of Serpentine-Jarrahdale
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GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

PARKS AND WILDLIFE SERVICE

Operational Guidelines
Lowlands Nature Reserve

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Introduction

1.1 Background

The Management of Lowlands Nature Reserve falls under 'The Swan Coastal Plain South Management Plan' (Department of Parks and Wildlife 2016), a document that provides general management guidelines for reserves across the southern Swan Coastal Plain. These operational guidelines have been developed to guide on ground management activities for Lowlands Nature Reserve specifically and provide the basis for the preparation of annual works programs for the reserve.

Lowlands Nature Reserve is a Class A nature reserve (No. 51784), with the purpose of 'conservation of flora and fauna'. It was purchased by the Department of Environment & Conservation (now DBCA) in December 2013 with environmental offset funds provided by Main Roads Western Australia. On 26 March 2015 it was gazetted a nature reserve.

Lowlands Nature Reserve comprises of two separate patches of uncleared bushland (total area 1,312.2 ha). The reserve is regionally significant being the only large area of its type remaining on the Swan Coastal Plain between Perth and Bunbury (EPA 1983). The eastern block is the largest area of mature, long unburnt Banksia woodlands typical of the Bassendean complex remaining on the southern Swan Coastal Plain. It also has a combination of floristic types not known to occur elsewhere (Gibson *et al* 1994). Lowlands Reserve also provides highly valued bushland/wetland link between the bushland within the Serpentine-Jarrahdale area and along the Serpentine River to the lakes in the Peel-Yalgorup Ramsar wetlands. The riverine vegetation on the Serpentine River, which runs through the lower eastern block of the Lowlands Reserve, provides one of the few examples of essentially intact upriver riverine vegetation on the Harvey, Murray, Serpentine, Southern, Canning and Swan Rivers on the Swan Coastal Plain (Keighery and Trudgen 1992, Keighery and Keighery 1992, Gibson *et al* 1994 cited in Keighery *et al* 1995). This area of fringing vegetation retains its structural floristic integrity even through there is considerable weed invasion in some areas (Keighery *et al* 1995). The river acts as a nutrient filter and provides a healthy freshwater habitat with deep pools, logs and debris, for international birds and many mammal, fish and macro invertebrate species disappearing from other river systems.

Lowlands Nature Reserve is an important reference site for past current and ongoing scientific studies. There are permanent monitoring sites for floristic and macro invertebrates and a monitoring site for river health. The long unburnt status of the Banksia woodlands means Lowlands Nature Reserve is a valuable reference site for fire studies.

The Lowlands Nature Reserve was part of privately owned freehold land (approx. 2000ha total) which has been managed by members of the Richardson family for over 150 years. Grazing occurred throughout the property but was concentrated in the cultivated pastures. The bushland historically provided timber for the buildings, fences and bridges on the property. More recently the bushland has been retained on the property for its conservation values and was managed by the Lowlands Conservation Association. The Serpentine River was never de-snagged and river banks were never completely cleared on parts of the property, despite past thinking that these were critically important flood mitigation techniques. The Richardson family would like to see the bushland retained for conservation in perpetuity.

These guidelines have been developed in consultation with the Richardson family to obtain historical and on the ground knowledge of the reserve and the surrounding area. Consultation and engagement with the family will continue throughout the implementation of the guidelines which contribute to appropriately managing the high conservation values of the Lowlands Nature Reserve.

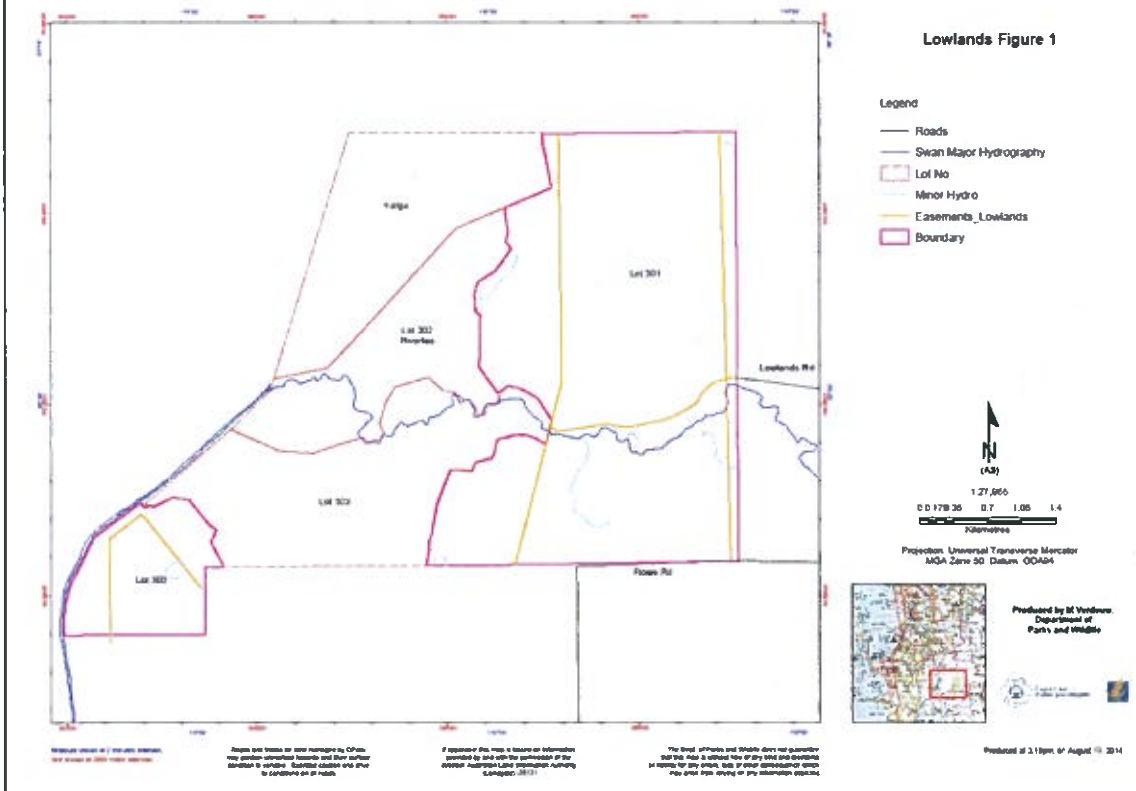
This document is valid for a period of ten years.

Lowlands Nature Reserve is located approximately 13 km west of Jarrahdale in the Shire of Serpentine-Jarrahdale. It is zoned 'Conservation' under the Shire of Serpentine-Jarrahdale town planning scheme. The eastern block is 1138.9ha (lot 301on plan 77559; referred to in this plan as Lowlands eastern block) and the western block is173.3ha (on lot 300 on plan 77559; referred to in this plan as Hymus block). The latter is henceforth referred to as Hymus block or Hymus Swamp. In between the blocks is farmland (lot 302 and 303 on plan 77559) retained by the Richardson family. Surrounding the reserve is primarily private land, a drainage reserve and a road reserve.

The Lowlands eastern block has a 20 m wide east-west accessway approximately 2.1 kilometres long as part of adjacent lot 303 connecting Lowlands Road to private homesteads. Centrally within the Lowlands eastern block, there is a north-south access track within a decommissioned 132kVA powerline easement. Within 100 m from the eastern boundary Western Power retain a 30 m easement containing an active 132 kVA powerline and access track. The Serpentine River runs through the southern portion of Lowlands eastern block. The department holds the rights to the river banks, river beds and river course in the bushland that they manage. The family have title right to the river where it traverses the farmland they have retained.

Hymus block is bounded on the west side by the high walls of the Birrega Drain and has two easements traversing the block. Western Power retains a 100 m wide easement containing two powerlines. Dampier to Bunbury Natural Gas Pipeline (DBNGP) retains a 30 m wide easement containing two underground gas pipelines and an associated access track. DBNGP have line of sight clearance requirements for the pipeline easement as well as strict policies regarding soil disturbing activities to which any party proposing works must adhere. An Optus fibre optic cable enters the reserve on the southern boundary, on the eastern side of the powerline corridor, it then turns at 90 degrees to the west running along the southern boundary within the firebreak in the reserve to exits onto the Birrega Drain reserve. White marker posts show the entrance and exit points. Figure 1 shows Lowlands Nature Reserve location, utilities and easements.

Figure 1 – Location, water courses, easements and utilities



1.3 Regional Context

Regional values are show in Map 1.

Interim Biogeographical Regionalisation for Australia (IBRA)
Lowlands Nature Reserve lies within the Swan Coastal Plain bioregion and subregion (SWA2). There are 89 bioregions in Australia. Each of these biogeographic areas incorporate divergent physical attributes of landform, geology and climate thus directly influencing overall diversity of flora and fauna.

The addition of Lowlands Nature Reserve to the National Reserve System (NRS)[1] provides an opportunity to increase the CAR[2] values of under-represented bioregions and sub-regions, and targets significant ecosystems, endemic species and landscape features.

Environmental Protection Authority (EPA) System 6 Report
The Lowlands property was identified in the EPA 1983 System 6 report as area M105 for its historical and natural values. The System 6 report stated that the '*eastern section contains a large area of woodland, apart from a little clearing and the effects of light grazing, is relatively undisturbed. This section is very valuable since it is the only large area of its type remaining of the Coastal Plain between Perth and Bunbury. Its value is much enhanced by the course of the Serpentine River which flows through it'.*

Bush Forever
Bush Forever is a government initiative aimed to retain and protect more than 51,200 ha of regionally significant vegetation complexes of the natural vegetation on the Swan Coastal Plain, or, if altered, still represents the structure and floristics of natural vegetation which provides the necessary habitat for native fauna (WAPC 2000).

There are three Bush Forever sites within the reserve (site number 368, Lowlands eastern block; and 372, Hymus swamp). The third Bush Forever site (number 371 Serpentine River) enters the reserve for only 100m on the western boundary.

Greenways
The Strategic Plan for Perth Greenways builds on and connects areas of remnant vegetation, wetlands and walking trails within the Metropolitan region. The Lowlands Nature Reserve is identified as having conservation, recreation, heritage and education values including addressing the impact of fragmented ecosystems and maintaining water quality (Tingay 1998).

The Lowlands Nature Reserve has been identified as Perth Greenways number 65 (Serpentine River corridor) and Perth Greenways number 129 (linking remnant vegetation and wetlands in Shire of Serpentine-Jarrahdale).

1.4 Key Values

Maintaining or protecting the key values of this reserve is the major focus of these guidelines. The key values are:

- 1312.2 ha of remnant bushland that provides biological refuge, remnant bushland/wetland linkage, assists in the resilience of species and communities to threatening processes including climate change, carbon sequestration and provides nutrient filter for improved water quality of the Serpentine River;

[1] The National Reserve System Program (NRS) was adopted to preserve Australia's native biodiversity on a regional scale. It is underpinned by a scientific framework to ensure that Australia progressively extends protection to examples of all ecosystems.
[2] CAR – Comprehensive, Adequate and Representative reserve system (Thackway and Cressell 1995).

- Regionally significant area of mature Banksia woodland of excellent condition, the only large area of its type remaining on the Swan Coastal Plain;
- An essentially intact riverine ecological system rare on the Swan Coastal Plain which includes fringing vegetation of structural integrity, high quality water with low nutrient load and naturally occurring woody debris that provides habitat and spawning grounds for endangered and priority and native fish species disappearing from other river systems on the Swan Coastal Plain;
- The reserve supports several conservation category wetlands;
- Populations of threatened flora species including the Grand Spider Orchid (*Caladenia huegelii*) and Glossy-leaved Hammer Orchid (*Drakaea elastica*) both Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Critically Endangered under the *Wildlife Conservation Act 1950*. The presence of priority species and several other significant flora taxa occurring along the Serpentine River that have not been collected elsewhere on the Swan Coastal Plain.
- Fauna species of conservation significance, as follows:
    - Four Specially Protected Fauna species listed under the Wildlife Conservation Act (Specially Protected Fauna Notice 2013) - the endangered Carnaby's black-cockatoo (*Calyptorhynchus latirostris*), the vulnerable forest red-tail black cockatoo (*Calyptorhynchus banksii naso*), the vulnerable chuditch (*Dasyurus geoffroii*) and the vulnerable brush-tailed phascogale (*Phascogale tapoatafa*);
    - Three species protected under the EPBC Act - the endangered Carnaby's black-cockatoo, the vulnerable forest red-tail black cockatoo and the vulnerable chuditch;
    - Priority species including the rakali or water rat (*Hydromys chrysogaster*) and the quenda or southern brown bandicoot (*Isoodon obesulus subsp fusciventer*);
    - An assemblage of aquatice fauna including the vulnerable Carter's freshwater mussel (*Westralunio carteri)* and the priority 1 pouched lamprey;
- Cultural history including a unique example of farming settlements of the south west, remnants of an old mail road, gravesites and old river crossings; and;
- Intact Banksia woodland and adjoining riverine system on the Swan Coastal Plain that presents a unique opportunity to gain an understanding of how to manage these systems and continually improve management policies and practices by learning from the operational programs.

1.5 Key Threats

The major threats in the Lowlands Nature Reserve that have potential to significantly affect the key values include:

- Altered hydrological regimes and processes, particularly decreasing water levels from a drying climate and/or inappropriate water extraction;
- Dieback plant disease, particularly the spread of *Phytophthora cinnamomi* into the Banksia woodland;
- Impacts of weed species in the wetlands and along river banks, in particular, Arum Lily (*Zantedeschia aethiopica*), Blackberry (*Rubus spp.*), and Bridal Creeper (*Asparagus asparagoide*). The possible spread into Banksia woodland of Freesia (*Freesia alba x leichtlinii*), Black Flag (*Feraria crispa*), Veldt grass (*Ehrharta longiflora*), Watsonia (*Watsonia meriana*) and Geraldton Carnation Weed (*Euphorbia terracina*);
- Feral animals including rabbits and foxes (*Vulpes vulpes*) and cats (*Felis catus*), which may impact on populations of the small to medium size native animals;
- Inappropriate fire regimes;
- Adjacent land use and future developments on adjacent properties, including inappropriate water extraction, introduction of weeds or inappropriate recreation activity;
- Private access road, landline and residential powerlines potential for weed disease and fire sources; and
- High Tension Powerlines potential for weed disease and fire sources.

Management Directions and Purpose

2.1 Management Framework

Operational guidelines are not statutory documents, unlike Management Plans. Therefore, operational activities described in this document are guided by the use of "necessary" or "compatible" operations, consistent with section 33(3) of the *Conservation and Land Management Act 1984* (CALM Act). Necessary operations are defined as, "those that are necessary for the preservation or protection of persons, property, land, waters, flora or fauna, or for the preparation of a management plan." Necessary operations apply on all reserve types. Compatible operations are, "operations approved by the Minister as being in his or her opinion compatible with the purposes for which the park or management area is managed under this Act." They only apply to National Parks and Conservation Parks, Marine Parks and Marine Conservation Areas.

2.2 Legislation, policy and agreements

The management and planning of reserves are guided by legislation and policy. These guidelines will provide broad principals and strategies for the management of the Lowlands Nature Reserve based on existing legislation and policy, as well as departmental and other guiding documents including The Swan Coastal Plain South Management Plan. In turn, this will provide guidance for supplementary work plans which will provide more detail for specific activities and management issues.

Legislation, policies, agreements and guiding documents are referred to throughout this document and detailed in Appendix A.

2.3 Core management objectives

The Lowlands Nature Reserve core management objective is to:

- Preserve the biodiversity (native flora and fauna (both terrestrial and aquatic) and the ecosystems that support them. Subsidiary objectives to achieve this are, as follows:
- To mitigate where practicable current pressures;
- To mitigate where practicable future threats;
- To restore the impacts of past pressures (including reintroducing species that have gone locally extinct within the reserve).

Key Management Priorities

- Mitigate the impacts of threatening processes on the riverine system and associated aquatic fauna
- Mitigate the impacts of threatening processes including dieback and weeds on the Banksia Woodlands, the riverine systems and the wetlands with a focus on large intact areas of vegetation.
- Mitigate the impacts of threatening processes on terrestrial fauna and their habitats

The manner in which these objectives are to be achieved is, as follows:

- Recognise the unique opportunities Lowlands Nature Reserve offers for better understanding how Banksia Woodlands and intact riverine systems should be managed on the Swan Coastal Plain.
- Design and implement adaptive management programs (where possible using adaptive rather than passive management) (see DEC 2008) that experimentally test hypotheses about management of these systems and continually improve management policies and practices based on the outcomes of these operational activities.

- Liaise, consult and engage with the local community for cooperative, effective and efficient management of the reserve. This includes the Richardson family for ongoing management advice, LGA and government agencies including Water Corporation, Department of Water and Environmental Regulation, Shire of Serpentine-Jarrahdale, Department of Fire and Emergency Services, Western Power, and Dampier-Bunbury Natural Gas Pipeline, Non-Government Organisations including Volunteer Bush Fire Brigades, Environmental Landcare Groups, universities for research and advice and adjacent neighbours.

Managing the Natural Environment

Management is focussed on conservation of biodiversity at the ecosystem, species and genetic levels and where possible, control of threatening processes. The department has responsibility for the conservation of all indigenous flora and fauna through application of the *Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950.*

3.1 The Biological Environment

Plant communities and vegetation

The vegetation and flora of Lowlands has been described in detail in Keighery et al. 1995 (Appendix). Six of the 43 floristic community types and subtypes defined by Gibson 1994 in the Swan Coastal Plain regional floristic survey have been found within the Lowlands Nature Reserve. These include FCT 21a Central Banksia/Jarrah woodland, FCT 23a Central Banksia woodland, FCT 21c Low lying Banksia woodland, FCT 5 Mixed Shrub damplands, FCT 11 Wet forests and woodlands and FCT 4 *Melaleuca preissiana* damplands. The Lowlands Nature Reserve is where a number of these floristic communities are at their most northern and southern distribution.

There are 23 permanent sites located in the Lowlands which contribute to the ongoing regional floristic surveys of the Swan Coastal Plain.

Nine vegetation associations (Map 2) have been documented and mapped across Lowlands Nature Reserve (Keighery *et al* 1995) and the vegetation condition for most of the area has been digitised (Map 3).

Banksia Woodlands

Six of the vegetation associations in the Lowlands Nature Reserve are Banksia woodland and this covers 90% of the reserve. The Banksia woodlands are characterised by two distinctive features: The maturity of the canopy trees (*B. menziesii, B attenuata, B. illicifolia, B. grandis*) and the openness of the understorey. A feature of the woodlands is the high proportion of herbaceous species. Lowlands Nature Reserve contains one of the last and largest most southern populations *of Banksia menziesii* woodlands. The rare Grand Spider Orchid is found in well drained Banksia Woodland.

Banksia Woodland over *Kunzea ericifolia* Closed Tall Scrub is the most dominate vegetation type in Hymus block and also common in the southern portion of the Lowlands eastern block. Populations of endangered Glossy-leaved hammer orchid are associated with this low lying banksia woodland.

The condition of the Banksia woodlands is generally good to very good and excellent. There are patches in poor condition, some areas with edge effects from degraded sites or pasture. The low lying Banksia woodland is considered 'susceptible' due to the susceptibility to dieback (Gibson et al 1994). Dieback has been introduced to the reserve but does not appear to be in all areas of the low lying Banksia.

Threats to the Banksia woodlands include dieback, weed invasion and inappropriate fire regimes.

Ephemeral wetland

Wetland vegetation forms a small portion of the Lowlands Nature Reserve. The Woodland over Sedgeland vegetation association and the *Melaleuca rhaphiophylla* woodland to shrubland wetland vegetation association are widespread over the swan coastal plain. Both these communities are highly diverse and contain mainly herblands, sedgelands and shrublands without tree overstorey. These communities in the Lowlands Nature Reserve contain significant populations of priority species *Dillywynia dillywyniodies* and *Stylidium longitubum.*

The condition of the two wetland vegetation associations are good to excellent. The Woodland over Sedgeland vegetation association is primarily adjacent to pasture areas and threats to the wetlands include edge effects, weeds and altered hydrology.

The claypan vegetation association, found in the northern section of the lowland eastern block, was found to be very degraded. Two sumplands in the Lowlands eastern block again were found to be partially degraded.

River-Creekline

The two vegetation associations in the Lowlands Nature Reserve have been identified by Keighery *et al* 1995 as a rare occurrence of intact upriver riverine vegetation. The Flooded Gum density gradually decreases the further from the river bank and concurrently understorey disappears. In some good condition areas the Flooded Gum maintains density up to 200m from the river bank with minimal weed species. A lot of the Serpentine River in the reserve has good overstorey but poor understory.

River-Creekline taxa rarely found on the Swan Coastal Plain occur on the alluvial banks of the Serpentine River in Lowlands Nature Reserve. This includes the priority woody climber, Lowlands Creeper (*Parsonsia diaphanophleba*), confined to relatively intact native vegetation areas of the Murray River and Serpentine, and the Maiden Hair Fern (*Adiantum aethiopicum*).

The condition of the river and creeklines is primarily good to very good to with some severe localised disturbance from weeds.

Threatened and Priority Ecological Communities

Banksia Woodlands of the Swan Coastal Plain ecological community (listed as Endangered under EPBC act Sept 2016)

The ecological community is a woodland associated with the Swan Coastal Plain of southwest Western Australia. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range

A subset of the Banksia Woodland TEC Low lying Banksia attenuata woodlands or shrublands (SCP 21c). This type occurs sporadically between Gingin and Bunbury, and is largely restricted to the Bassendean system. The type tends to occupy lower lying wetter sites and is variously dominated by Melaleuca preissiana, Banksia attenuata, Banksia menziesii, Regelia ciliata, Eucalyptus marginata *or* Corymbia calophylla. *Structurally, this community type may be either a woodland or occasionally shrubland.*

The area or its surrounds may support the critically endangered TEC Claypans of the Swan Coastal Plain'[3] .

Flora of conservation significance

[3] Information found on the EPBC Protected Matters Report for Lowlands Reserve. A report can be created on http://www.environment.gov.au/epbc/pmst/index.html.

The Lowlands Nature Reserve contains many species that are significant including two DRF and six priority species. Table 1. Both the DRF are listed under the EPBC and Wildlife Conservation Act. The approved interim recovery plans for the two DRF are found on www.Parks and Wildlife.wa.gov.au/plants-and-animals/threatened-species-and-communities/198-approved-interim-recovery-plans#flora. No recent surveys have been completed for the threatened species in the Lowlands Nature Reserve. A full survey of threatened flora is needed as low numbers may be attributed to survey times or opportunistic sightings.

Lowlands Nature Reserve includes taxa restricted in distribution or endemic to the swan coastal plain. For example Tuart (*Eucalyptus gomphocephala*) is endemic to the Swan Coastal Plain and is generally associated with limey coastal dunes and subcoastal plains. In the Lowlands Nature Reserve it occurs on the sandy soils associated with the river and is at its most eastern distribution. There are also a number of species common along the Serpentine River at Lowlands that have are rarely found elsewhere on the Swan Coastal Plain including Lowlands Creeper (*Parsonsia diaphanophleba*) and Maiden Hair Fern (*Adiantum aethiopicum).*
Keighery *et al* 1995 provides a more comprehensive list of restricted and interesting flora (Appendix).

Table 1 DRF and priority species on Lowlands Nature Reserve (WA Herbarium and Threatened species 2014 database)

TAXON	Common name	EPBC Act	CONSSTATUS	WARANK
Caladenia huegelii	Grand Spider Orchid	Endangered	Threatened	CR
Drakaea elastica	Glossy-leaved Hammer Orchid	Endangered	Threatened	CR
**Acacia lasiocarpa var. bracteolata long peduncle variant(G.J.Keighery 5026)*			P1	
Johnsonia pubescens subsp. cygnorum			P2	
Stylidium longitubum	Jumping Jacks		P3	
Dillwynia dillwynioides			P3	
Eucalyptus rudis subsp. cratyantha			P4	
Parsonsia diaphanophleba			P4	

* Acacia is found between the bushland blocks but not in bushland. Stylidium only found in Hymus block.

Threats to threatened and significant flora in the Lowlands Nature Reserve include weed invasion, particularly on the river and wetlands, dieback, inappropriate fire regimes, track clearing and maintenance, grazing by rabbits and kangaroos, edge effects, quality of habitat (*e.g.,* dieback in associated vegetation) and drying climate.

While protection of intact areas is a management priority, some restoration of plant communities will be required to protect natural values of the reserve, particularly restoration of fringing vegetation along the river. Some work (weed control and revegetation) has already been completed along the river within the reserve and private property by both the Richardson family and the department.

Priority areas for restoration works in the Lowlands Nature Reserve include:

- Restore fringing vegetation along the river with particular emphasis on understorey species in the degraded sites as recommended in Klunzinger *et al*. 2011,
- Negotiating for the development of a 2km vegetation corridor between Hymus block and the Lowlands eastern block.
- Negotiating for the realignment of the residential powerline in future development scenarios.
- Maintaining some areas of open grassland as low fuel zones and feeding habitat.
- Negotiating for the closure of unmade portion of Rowe Road reserve that passes through a wetland and SCP Flora survey quadrat.
- Restoration of degraded edges which can harbour fire weeds.
- Ensure management of Access road is non-threatening by contributing to maintenance.

Priority areas need to be mapped. Supplementary plans for revegetation, weed removal, fire management, dieback management and feral animal control will provide detailed guidance of the works required for each area of restoration.

Desired Outcome
Working within an adaptive management framework, protect and restore native plants and vegetation communities in the Banksia woodland, ephemeral wetlands and river and creekline systems.

Strategies

1. Undertake field surveys, determining the occurrence, distribution and abundance of native plants and vegetation communities with an emphasis on threatened flora and communities, priority flora, or flora of regional significance. As with other strategies listed below, this will be done to the extent that resources allow.
2. Assess the claypans as a possible TEC 'Claypans of the Swan Coastal Plain'.
3. Implement recovery and management actions for DRF species as outlined in the Swan Region Threatened Flora Management Plain and Recovery Plans. Protect priority species/vegetation communities from threatening processes (e.g. dieback, weed invasion, inappropriate fire, grazing, and management activities).
4. Complete vegetation condition assessment for the reserve.
5. Map priority restorations areas.
6. Develop revegetation plans in priority restoration areas
7. All plant material for restoration should follow 'Sourcing plant material for restoration in the Swan Region' (Munday et al. 2013)
8. Ensure all management activities are in line with dieback hygiene management plan.

Native animals and habitats

Comprehensive bird surveys have been completed at the Lowlands Nature Reserve (*e.g.*, RAOU, Birds Australia), however there has been little survey information for terrestrial vertebrates and riverine species. NatureMap 2014 and other survey records suggest Lowlands Nature Reserve has a diversity of animals including at least 46 species of birds, 7 mammals, 6 amphibians, 11 reptile, 6 fish, 3 crustacean and freshwater macroinvertebrates including marron. These species are listed in Appendix C.

The department currently has recovery plans for three species of conservation significance in the Lowlands Nature Reserve – the chuditch, Carnaby's black-cockatoo and the forest-red tailed black cockatoo. These recovery plans can be found at http://www.Parks and Wildlife.wa.gov.au/plants-and-animals/threatened-species-and-communities/197-approved-recovery-plans#recoveryplans.

Fauna surveys in nearby remnant vegetation may be used to predict species present in the area or may re-establish once opportunity is created. Species found in nearby remnant vegetation but not in the Lowlands Nature Reserve include the Honey possum (*Tarsipes rostratus*), the Peregrine Falcon (*Falco peregrinus*) and the Rainbow Bee-eater (*Merops ornatus*), which is protected under the JAMBA agreement (Ninox Wildlife Consulting 2005). Further investigations for small to medium mammals, reptiles and bats are required to determine whether other species and numbers persist in the remnant vegetation of the Lowlands Nature Reserve.

Research on the Swan Coastal Plain (such as Howe and Dell 1993) indicates that fauna have particular habitat and spatial requirements and respond poorly to the effects of fragmentation and its associated impacts such as fire, weeds, competitors and predators. Large remnant vegetation areas with a diversity of habitat types provides an important biological refuge for species and can provide buffering from threatening processes and other impacts including climate change. The primary aim for fauna management within the Lowlands Nature Reserve is the protection of existing habitats, managing threatening processes and rehabilitation of degraded areas with different vegetation community types.

Habitat connectivity and ecological linkages is also an important biodiversity conservation tool to promote species dispersal, access to areas containing seasonally variable food and other resources and refuge from major disturbances. The Lowlands Nature Reserve has been identified as an important corridor between remnant bushland vegetation in the Serpentine-Jarrahdale area and along the Serpentine River corridor (Tingay 1998). Rivers and associated vegetation are often the most contiguous ecological linkages, and wetlands can provide linkages in a regional and international context (Molloy 2009).

Threats to native fauna and their habitats in the Lowlands Nature Reserve include introduced animals such as foxes, water quality, habitat quality (*e.g.,* dieback in Banksia woodlands), weeds in the river and wetland systems and the potential of spread into Banksia woodland, fire, isolation and lack of connectivity.

Banksia woodlands

Good assemblages of insectivorous birds are found in the Lowlands Nature Reserve as well as birds uncommon on the Swan Coastal Plain, such as the Golden Whistler (*Pachycephala pectoralis)* and Wedge tailed eagle (*Aquila audax*). The Banksia woodland provides feeding habitat for the Carnaby's black-cockatoo and the forest red-tail black cockatoo, both specially protected species listed under the *Wildlife Conservation Act 1950* and EPBC Act. The large number of mature eucalypts on the reserve also provides potential breeding habitat for the cockatoos[4] .

Small to medium sized mammals such as the quenda, brush-tailed phascogale and brushtail possum were recently identified in the 2012 fauna surveys conducted by the department however numbers have been low. Reptile numbers caught in the Banksia woodlands were also lower than expected. The chuditch, is listed as specially protected fauna under the *Wildlife Conservation Act 1950* and listed under the EPBC Act and the western brush wallaby (*Macropus Irma*) has not been recorded in the reserve for the last 10 years (M Richardson pers comm 2014). Foxes and a reduced average rainfall may have contributed to the low/no numbers caught (DEC 2012).

Wetlands

The wetlands, Serpentine River and associated water courses provide significant habitat for migratory and/or marine species on the JAMBA/CAMBA/ROCKAMBA agreements such as the Great Egret (*Ardea modesta*) and Fork-tailed Swift (*Apus pacificus*). Some of the wetlands in the Lowlands Nature Reserve are the most degraded sites due to weeds and grazing.

River/Creekline

The Serpentine River in the Lowlands Nature Reserve provides a healthy freshwater habitat for many species. Kluzinger *et al* 2011 found the deep pools, complex habitat of woody debris and shading from riparian vegetation (overstorey, middle and understorey) provided cooler water temperatures, dietary and spawning requirements for many native freshwater fish, smooth marron, (Cherax cainii) , the P1 pouched lamprey and the vulnerable Carter's freshwater mussel. Many of these species are becoming uncommon in their former range due to increasing salinity and loss of riverine vegetation.

Klunzinger *et al* 2011 found the dominant river species was the introduced eastern mosquito fish, however greater numbers were found in more disturbed parts of the Serpentine River near river crossings/cattle crossings and outside of the Lowlands Nature Reserve.

Camera trappings in 2011 show rakali (water rats) using logs in the vicinity of the cross-over bridge near the homestead (DEC 2012). Water rats are a P4 species and are a good bio-indicator of aquatic system health. Threats to the water rats include drought and habitat degradation.

[4] (further information see www.Parks and Wildlife.wa.gov.au/plants-and-animals/animals/208-saving-Carnaby's-s-cockatoo or www.birdlife.org.)

Desired outcome
Working in an adaptive management framework to identify, monitor and protect the diversity of native fauna with an emphasis on threatened species.

Strategies

1. Undertake specific field research and monitoring activities, as resources allow, determining the occurrence, distribution and abundance of native fauna with a focus on small to medium sized mammals, reptiles, threatened fauna and priority fauna over different seasons. As with other strategies listed below, this will be done to the extent that resources allow.
2. Implement the management recommendations from Klunzinger et al 2011 for protection of aquatic fauna and habitat
3. Implement measures to protect threatened and priority species (*e.g.*, implement approved recovery plans).
4. Implement measures to mitigate the impacts of threatening processes on native fauna and their habitats (*e.g.* feral predation, habitat degradation from grazing or water quality).
5. Assess quality of habitat for threatened species, assess appropriate fire history and determine how to use fire to maintain the habitat.
6. Pre and post monitoring of fauna with significant management activities. Continue monitoring undertaken by Klunzinger et al 2011
7. Ensure all management activities are in line with the dieback hygiene management plan.

3.2 The Physical Environment

Climate and climate change
The region has a Mediterranean climate, characterised by warm and dry summers with cool, wet winters. However long-term climate variability is affecting the south-west of Western Australia, which is experiencing a trend of increasing temperatures and declining rainfall. At Serpentine Dam, located east of Lowlands Nature Reserve, average rainfall has decrease by 20% since 1975 (Department of Water 2007).

These climatic changes may have significant effects on the key values of the Lowlands Nature Reserve. As a result of the decreased rainfall over the Serpentine Dam, streamflow of the Serpentine River has decreased by 40% (Department of Water 2007). Other possible effects of climate change on the Lowlands include:

- Potential incidences of bushfires,
- Increase in pests and pathogens,
- Altered hydrological regimes, particularly decreasing water tables and surface water expression, which in turn affects maintenance of critical habitat (such as wetlands and rivers) for many plant and animal species of conservation value.

Whilst there is limited knowledge about the resilience of natural systems to anticipated climate changes, protecting the natural environmental and integrating the results of climate change impact studies within management strategies help to decrease its vulnerability to climate change. Strategies to improve the resilience of species and ecosystems to climate change in the Lowlands Nature Reserve include:

- Incorporating the Lowlands into the conservation reserve system,
- Preserving the large ecological refuge and restoring vegetation corridors,
- Implementing species recovery programs,
- Controlling invasive plants and animals,
- Managing diseases and inappropriate fire regimes,
- Maintaining and improving critical habitat (*e.g.*, wetlands and water quality),

- Collecting seed and revegetating,
- Potential re-introduction of threatened fauna to provide a mechanism for long-term species survival.

Desired Outcome
To improve the resilience of species and ecosystems to potential impacts of climate change.

Strategies

1. Adaptively incorporate response strategies to climate change impacts on threatened species, communities and ecosystems.

Geology, landforms and soils

Lowlands Nature Reserve is located on the Swan Coastal Plain where the Pinjarra Plain is up to 15km broad. It is bordered to the east and west by the Pinjarra Plain but the soils in the reserve are predominately Bassendean Sands. These sands occur as low lying sandy dunes and sandplain laid down over the Pinjarra Plain. The Pinjarra Plain is exposed along the Serpentine River and in the seasonally waterlogged flats associated with the drainage line to the north of the Lowlands eastern block. The Pinjarra Plain is along, near or at the surface in the ephemeral wetlands (Keighery *et al* 1995).

There are no major threats to the soils or landforms of the nature reserve from active recreation, as such activities will be restricted. The presence and maintenance of the fence around the reserve and the nature reserve status prohibits access by trail bikes and horses. Illegal activities such as trailbike and 4WD access from the Birrega Drain have the potential to cause erosion to the banks of the Serpentine River and reduce the quality of the Serpentine River.

Lowlands Nature Reserve has been identified as having high risk of acid sulfate soils (i.e. less than 3 m from the soil surface, Map 4). Acid sulphate soils are waterlogged soils that contain iron sulphide mineral, predominately as mineral pyrite. The exposure of the pyrite to air can generate sulphuric acid. Water in contact with the oxidising soil leaches metals from the soil, which then discharge into waterways as acidic water. Extensive digging, dewatering or drainage has the potential to cause considerable environmental damage if not considered by management.

Desired outcome
The area's geological features, landforms and soils are protected.

Strategies

1. Establish guidelines for sound earthwork practices and implement these for development works, if required. As with other strategies listed below, this will be done to the extent that resources allow.
2. Appropriately rehabilitate disturbed areas to a stable condition resembling as close as possible the natural ecosystem function.
3. Consider the potential for acid sulfate soils in planning and operations (*e.g.* fire, earthworks, rehabilitation and/or planting), and avoid disturbance, compaction or displacement of saturated soils at risk.
4. Work with Water Corp and surrounding neighbours to monitor and deter illegal access into the nature reserve.
5. Establish and maintain a fence around the entire Lowlands Nature Reserve.

Hydrology and wetlands

River

The Serpentine River and associated drainage lines flow through the lower Lowlands eastern block. The river is part of a system which starts with headwater streams converging and flowing into the Serpentine Dam above the Darling Scarp and finishes by flowing into a series of lakes that empty into the Peel Harvey estuary. Just north of Hymus block the river merges into the south flowing Birrega Main Drain which provides the western

boundary to the reserve. Map 4 shows the river and a number of other creeks and minor water courses on the reserve.

Results from 'Dog Hill', a longterm monitoring station just north of Hymus block on the Serpentine River, show rainfall and water level is declining (Department of Water 2010). Water ceases to flow most years during summer and autumn. Uses of water on the Serpentine include environmental, irrigation and riparian users which all influence water levels. Threats to water levels include climate change and the decreased rainfall, and inappropriate water extraction from neighbouring land users. Monitoring has been improved by the placement of a "weir" on the river west of the Bushland that has real-time electronic monitoring of quantity and quality parameters – available for perusal on the Department of Water website under Serpentine River - Lowlands gauging station 614114.

Water is periodically released by the Water Corporation, from the Serpentine Dam and North Dandalup Pipeline to maintain river integrity and riparian rights. The management of monitoring the river water is by the Department of Water and Environmental Regulation. The management of release and environmental water flow maintenance is by Water Corporation. The department, as the land manager of the reserve acknowledges that there are processes outside of the reserve that impact on how the river is managed.

Water quality

The water quality within the reserve is good compared to outside of the reserve. Klunzinger *et al* 2011 found that the Serpentine River in the Lowlands Nature Reserve remained fresh compared to the nearby Birrega Drain which became saline in hot and dry weather. The temperature of the water remained up to seven degrees cooler with deep pools, moist sediment, LWD[5], overhanging overhead, middle-story and understorey vegetation. It was also found that water flow after rainfall events was visually a lot less turbid than the Birrega Drain.

The Serpentine River which runs through the reserve provides a conductive environment for freshwater mussel recruitment, native freshwater fish and crayfish populations, many of which are disappearing from other river systems. The LWD found in the Lowlands Nature Reserve provides feeding and roosting sites for birds, habitat for the rakali, invertebrates and protection from prey. The deep pools provide a variety of flow conditions depending on the depth of the water and are important in the summer season for fauna. LWD can contribute to the reduction of nutrients entering estuaries and near shore marine environments (Water and Rivers Commission 2000).

Groundwater

There is a small amount of groundwater surface expression within the Serpentine River. Threats to the groundwater include inappropriate water extraction within the Upper Serpentine catchment. Department of Water and Environmental Regulation has long term monitoring bores within the reserve and a recent series of piezometers placed around and within the reserve areas as part of the Serpentine Drainage and Water management Plan.

Ephemeral Wetlands

Three types of wetlands have been identified in the reserves - primarily palusplain with small pockets of sumpland and dampland areas. In the Lowlands eastern block a sumpland has been excavated and provides permanent water.

The Lowlands eastern block includes one conservation category wetland. The Serpentine River that runs through the reserve has not been mapped however outside of the reserve it has been classed as conservation category wetland. If funding and resources available it would be preferred to complete an assessment of the reserve. Two conservation category wetlands are located in the Hymus block, one of which is Hymus Swamp, 3.6 ha in size. Map 4 shows the conservation category wetlands of Lowlands Nature Reserve.

Threats to the wetlands include invasion by weeds and dieback disease.

[5] Large Woody Debris

Desired outcomes
The area's natural surface and groundwater hydrological regimes are maintained.

Strategies

1. Protect water sources, wetlands and hydrological processes from damage or disturbance that may affect water quality or quantity. As with other strategies listed below, this will be done to the extent that resources allow.
2. Working with the Water Corporation, Department of Water and Environmental Regulation and other groups, monitor hydrological regimes through the measurement of water parameters taken at bores, gauging stations, weirs and other water sampling points and encourage appropriate water use.
3. Maintain fencing to prevent stock from private property encroaching on the wetlands and the river except in designated water crossing points.
4. Liaise with Water Corporation and adjacent landowners to develop and implement an integrated catchment management plan for the protection and enhancement of water quality and quantity.
5. Consider re-planting native riparian vegetation, especially shading sedge, shrubs and trees, and placing more LWD in degraded sites (*e.g.*, vegetation corridor between Lowlands eastern block and Hymus block).
6. Implement recommendations of Klunzinger *et al.* 2011.

3.3 Managing threatening processes

Environmental weeds

Weeds are a major threat to the riverine vegetation in the Lowlands Nature Reserve and the associated freshwater ecosystem of the Serpentine River. Weeds can invade and displace common and more restricted species in the fringing vegetation, reducing habitat for species such as the rakali, native fish and the Carter's Freshwater Mussel. Weeds also prevent the recruitment of seedlings, can change soil nutrients and can change fire regimes. Weeds have invaded the ephemeral wetlands of the reserve and are starting to spread into the relatively weed free Banksia woodland.

There have been 122 weed species recorded in the Lowlands Nature Reserve. The Swan region have conducted the top 20 most threatening weeds for the region and further identified the biggest weed threats to the Lowlands Nature Reserve based on invasiveness and ecological impact. Since the last significant floristic survey (Keighery *et al* 1995), at least four serious weeds have become naturalised including Blackflag (*Ferraria crispa*), Geraldton Carnation Weed (*Euphorbia terracina*), Perennial veldt grass (*Ehrharta longiflora*) and *Freesia sp.*

Declared weeds are listed under the Agriculture and Related Resources Protection Act 1976. Declared weeds and weeds of national significance found in the reserve include Apple of Sodom (*Solanum linnaeanum*), Arum Lily (*Zantedeschia aethiopica*), Blackberry (*Rubus ulmifolius*) Bridal creeper (*Asparagus asparagoides*) and Watsonia (*Watsonia meriana*).

Weeds in the entire reserve need to be mapped and managed focussing on the weeds with the highest potential invasiveness and ecological impact. Priority species include Black flag, Geraldton Carnation Weed, Perennial veldt grass, Watsonia and Bridal creeper. Appendix D provides a list of weeds found in the reserve and the priority for mapping based on invasiveness and ecological impact.

The Richardson family has been managing serious weeds across the Lowlands Nature Reserve and property. In the last 10 years Urban Nature, Swan Region, has run an adaptive project along the Serpentine River. In one of these projects, the spread of Arum lily has reduced from 75% coverage along the river bank to 5% coverage

(Brown 2014). It is important to investigate different weed management techniques (*eg.* fires, herbicide and slashing) and adapt management in line with the best technique to reduce the weed and have a minimal impact on vegetation communities involved.

Banksia Woodlands

Many weeds in the Lowlands Nature Reserve are associated with the interface between the bushland and pasture areas and reflect the disturbance associated with this interface. Further in the bushland the weeds are absent or do not occur in significant numbers (Keighery *et al* 1995). Weed threats to Banksia woodland that are currently found in the Lowlands are the Perennial veldt grass, Geraldton Carnation Weed, Arum lily, *Freesia sp.* The aggressive bulbous Black-flag is spreading rapidly from the homestead area of the adjacent property.

Disturbance of the Banksia woodland has and can aid the spread of weeds. Roads and service corridors create a channel for the movement of weeds. It is important that any soil imported from within or from outside of the reserve is free from weeds. The introduction of fire provides an opportunity for weeds to invade and weed management must be considered in any prescribed burning or wildfire situation. Keighery *et al* 1995 found that kangaroos can aid in the spread of weed seeds, however they also aid in the management of weeds by grazing on exotic grass species.

Wetlands

Compared to the rest of the bushland of the Lowlands Nature Reserve, the wetlands are the most disturbed bushland areas due to partial clearing and previous grazing and provide ideal conditions (high soil moisture and relatively fertile soils) for weed growth. Clay pans in the reserve are highly degraded. Significant weeds in the wetlands include Castor oil, Bridal creeper and Sour sob (*Oxalis pres-caprae*).

Rivers

Keighery *et al* 1995 found both herbaceous and shrub weeds in the riverine system. Severe localised disturbance along the river is due to weed invasion and are number of weeds are starting to move into the Banksia woodland from the river. The distribution of some of the most invasive weeds along the Serpentine River in the Lowlands have been mapped - Arum lily, Blackberry, Bridal creeper, *Freesia sp* (including its spread into the Banksia Woodland), Castor oil (*Ricinus communis*) and Cotton bush (*Gomphocarpus fruiticosus*). Strategic weed control including trials utilising fire has commenced based on this mapping with revegetation work in place after control. Consideration should be made to update weed the distribution along the river, including species of *Freesia sp,* Blackberry and Bridal creeper.

Desired outcome

To reduce the adverse impact of environmental weeds on key conservation values of the reserve.
To protect large intact areas from invasion by priority weeds.

Strategies

1. Implement measures to prevent the spread of new environmental weeds in particular Geraldton Carnation weed, Veldt grass, *Freesia sp* and Blackflag. As with other strategies listed below, this will be done to the extent that resources allow.
2. Identify, map (according to Parks and Wildlife Standard Operating Procedures) and monitor the location, extent and spread of priority weeds. All maps are to be stored on regional server for weed data. Prepare and implement an annual weed control program for the 1310 hectares of Parks and Wildlife bushland.
3. Consider the impacts of weed invasion on rare flora and communities and implement control measures appropriate to protect threatened species.
4. Eradicate where possible isolated outbreaks of weeds while infestations are small and easily managed.
5. Ensure all management activities consider 'Phytophthora dieback' and follow the dieback hygiene management plan.

Introduced and problem animals

The Department's Policy Statement 98 – *Management of Pest Animals* provides guidance to achieve the systematic and safe control of pest animals. Declared pest animals are listed under the *Agriculture and Related Resources Protection Act 1976*. The department has responsibilities under the *Biosecurity and Management Act 2007* to prevent new animal pests from entering Western Australia.

Problem animals are those species that have the potential to cause serious impact on natural systems through direct effects such as predation, habitat destruction, competition for food and territory and introduction of diseases, and through environmental degradation (*e.g.*, overgrazing). Problem animals can be either native species that are impacting on natural or agricultural values or feral animals (introduced species that have become established as wild or naturalised populations).

Introduced species that have been identified in the reserve include the black rat and house mouse, laughing kookaburra and laughing turtle dove, fox, cat and rabbits, introduced fish such as eastern Gambusia. Bees may be found on the reserve and have a potential to impact nesting hollows of cockatoos and other native birds.

Predation by foxes has been identified as a significant threat to small to medium size mammals on the Swan Coastal Plain and could be the reason for the small numbers now found within the Lowlands Nature Reserve (DEC 2012). Foxes can also be a threat to breeding waterbirds and other native fauna. Foxes are prevalent in the area and baiting has historically occurred in the Lowlands property by the Richardson family. Ongoing fox baiting will be implemented by the department using standard departmental 1080 sausage baits around the perimeter and along access tracks throughout the reserve (Map 5). Risk assessment has been considered and key species found in the Lowlands, including the rakali, will not be impacted. To keep in line with the department's *Good Neighbour policy* some baits will be tethered around the perimeter of the reserve, where there are adjacent neighbours, to reduce the risk of baits being moved by birds and other carriers.

Consideration should be made to monitor fox numbers during the baiting program. Sand pads are a common method to monitor fox tracks and may also pick up feral cat tracks and provide an indication of numbers. In conjunction with fox control, monitoring of native fauna, particularly small to medium size mammals should occur to determine the effectiveness of the control on native fauna numbers and species in the reserve.

Rabbits are present in the reserve and all revegetation areas should be fenced to allow plants to establish. It may be considered to control rabbit numbers (by use of 1080 oats) in the future if they are significantly impacting revegetation sites. Kangaroos are found in high numbers in the reserve and may have an impact on revegetation sites. Licenced shooting occurs on adjacent properties and numbers should be monitored.

Desired outcome
To minimise the adverse impact of introduced feral animals and problem native animals on key conservation values of the reserves.

Strategies
1. Identify and monitor the incidence, location, extent, spread and ecological effects of feral animals and problem native animals in the reserve. As with other strategies listed below, this will be done to the extent that resources allow.
2. Ensure feral animal control considers the protection of restoration areas.
3. Implement Western Shield baiting program for fox control and consider cat and rabbit control in the future if warranted.
4. Monitor feral animal numbers during control programs and undertake native fauna surveys to determine the effectiveness of the control program.
5. Establish and maintain fence lines along the river and the vegetation corridor between the two reserve blocks and in lot 302 and 303.
6. Ensure management activities to stay on existing tracks.
7. Ensure all management activities consider 'Phytophthora dieback' and follow the hygiene management plan.

Plant diseases

The most significant disease threat to plants within the reserve is 'Phytophthora dieback'. Dieback caused by soil-borne water mould *Phytophthora cinnamomi* is a key threatening process under the EPBC 1999. Management guidelines for *Phytophthora cinnamomi* are described in the Department's Manual: *Phytophthora cinnamomi* and disease caused by it, Vol 1 –Management Guidelines and Policy Statement 3 – Management of *Phytophthora* disease.

Three Phytophthora species (*P. cinnamomi, P. multivora* and *P. thermophile*) have been identified in the Lowlands Nature Reserve. *P. cinnamomi* is recognised as the most damaging. Once infected, susceptible plants are killed and, in many cases species are eliminated from the site. This could lead to dramatic and permanent changes to native plant communities and their dependant fauna. On the Lowlands Nature Reserve the low lying Banksia woodland is the most 'susceptible' to the dieback (Gibson *et al* 1994) as with seasonally inundated areas such as damp lands.

A dieback survey was conducted in 2006 (Glevan consulting 2006) and identified three separate infections. The main infection was associated with the east west access track into the adjacent properties homestead and gravel brought in to maintain the track was probably the source of the dieback. Phosphite treatment has previously been applied to the infection along the east west track to protect susceptible species. Two other infections were associated with damplands extending out from grazed open paddock on the north west side of the Lowlands eastern block. It is possible that since the survey the infections have spread.

An up to date survey of the entire reserve is required to determine the actual extend of the dieback. This survey will map the extent of the Phytophthora dieback and will also give comprehensive hygiene management practices appropriate to the reserve.

Dieback can be brought in and spread throughout the reserve by vehicles, particularly in wet conditions. Application of rigorous hygiene practices, minimal disturbance to uninfected areas, reduced traffic in wet conditions and appropriate drainage in uninfected areas will assist to reduce the risk of spread. It is important that any soil and gravel brought into the reserve is disease free. Dieback signs will be installed to indicate dieback infected areas and it is preferable, if possible, that management works occur in late summer when chances of spreading the disease are reduced. Dieback information and appropriate hygiene practices should also be given to other agencies such as Western Power and fire brigades who may utilise the site.

Desired outcome
Preventing the introduction of dieback in uninfected areas and minimise the impact of Phytophthora on those areas currently infected.

Strategies
1. Conduct a full *Phytophthora* assessment of all areas of Lowlands Nature Reserve including areas not previously surveyed. As with other strategies listed below, this will be done to the extent that resources allow.
2. Develop a long-term hygiene management plan to "protectable areas" with the implementation of signage and comprehensive hygiene practices which will be strictly adhered to.
3. Manage and implement Phytophthora controls according to Parks and Wildlife guidelines.
4. Work with other government organisations and NGO's that will access Lowlands Nature Reserve to ensure hygiene practices are followed
5. Keep vehicles to established tracks in the bushland areas of the reserve.

Fire

Parks and Wildlife's management of fire, including prescribed fire and bushfire prevention and suppression, is regulated by legislation (for example, Bush Fires Act 1954, CALM Act and precedents established under common law) and guided by Parks and Wildlife's Policy No. 19 Fire management and Parks and Wildlife's Code of Practice for Fire Management.

These operational guidelines are based on the broad principals of fire management for nature conservation documented in the Regional Fire Management Plan Swan Region 2014-2018 – Peel region.

Fire and biodiversity

Lowlands Nature Reserve provides a rare example of large intact, long un-burnt Banksia Woodlands on the Swan Coastal Plain. Historical records provided by the Richardson family indicate small patches of controlled burning occurred irregularly on firebreaks, around the homestead and along parts of the river. A number of lightning strikes have occurred over the years; however no significant or large fires have occurred to date.

Lowlands Nature Reserve offers a unique opportunity to gain a better understanding of how Banksia Woodlands and intact river systems respond to long periods without fire. The benefits of long-unburnt Banksia for the abundance of reptiles and iconic species have been documented (*e.g.*, see Valentine *et al* 2012). It is also acknowledged that areas of younger vegetation are required proximal to these mature woodlands to allow animals to access other habitat components. Burning regimes need to incorporate spatial aspects of fauna distribution and habitat to undertake appropriate burning around refugia and ecological linkages.

The department should consider seeking involvement of a variety of researchers from within and outside of the department to develop a series of projects that will provide an understanding of the conservation significance and the biodiversity values of long unburnt Banksia Woodland and how best to manage them. Experts will need to look at Lowlands Nature Reserve in context within the Swan Coastal Plain and the distribution of fire, the special set of values the reserve has, the dynamics of the system as well as how to resource the research and different fire management techniques. The development of projects will be undertaken by a scientific subcommittee and the results will flow into an adaptive fire management plan for the reserve.

Fire response plan

A fire response plan (FRP) will be developed to define strategies to respond to the event of a wildfire on the Lowlands Nature Reserve. The aim of the FRP will be to minimise the incidence and area of the reserve burnt and preserve the conservation values of the reserve. The FRP will outline risk management strategies (prevention and preparation), fire suppression response, recovery and parties responsible and involved.

Major issues to consider regarding fire prevention, preparation and response in the Lowlands Nature Reserve includes:

- Environmentally Sensitive Areas that contains DRF, a PEC and priority flora, as well as habitat and feeding areas for specially protected fauna species, large unburnt areas, sensitive riverine vegetation and conservation category wetlands;
- Minimal track access through much of the reserve with overgrown tracks,
- Possible seasonal changes in track conditions to hinder vehicle movements,
- Location of river crossings and water access points,
- Access arrangements through the surrounding properties onto the reserve,
- Presence of weeds and '*Phytophthora* dieback',
- Possible high fuel levels due to the long unburnt nature of the area and
- Homesteads, surrounding neighbours and active pastures.

Uncontrolled fire or the management of the fire can adversely affect the conservation values of Lowlands Nature Reserve by causing compaction, weed encroachment and potential spread of '*Phytophthora* dieback', altering drainage, removal of species, and reduction in water quality, particularly through the river and wetland systems.

Risk management strategies and fire response strategies will include a less invasive fire response at the stage until more information is known on fire ecology and the impacts of fire in the reserve:

- No new tracks will be created and existing tracks can be used for management access and activities.
- In the event of a wildfire, no additional access tracks will be put through areas unless absolutely necessary.
- Burn to existing tracks where possible
- Utilising aerial water bombers over ground machinery where possible,
- Weed control response after a wildfire incident.

Access tracks and water access points are mapped on Map 6.

Desired outcome
Working within an adaptive management framework, protect and enhance biodiversity across the landscape while protecting life and community assets in and near the reserve.

Strategies

1. Develop, maintain and implement an up to date fire response plan to facilitate the suppression of wildfires that threaten human life, property, or significant natural values of the reserve.
2. Develop a fire management strategy for the reserve.
3. In collaboration with Science and Nature Conservation Division and possibly experts outside of the department, develop a series of research projects aimed at answering key management questions on fire and biodiversity in Lowlands. That research should guide the adaptive fire management strategy for the reserve.
4. Maintain a strategic network of sufficient fire access roads, tracks and firebreaks in the reserve.
5. Liaise with the Department of Fire and Emergency Services (DFES), local government and neighbours to determine the requirements for a coordinated fire response.
6. Burn to existing tracks where possible.
7. No new tracks to be established as a result of fire management.
8. Unnecessary tracks to be left to regenerate.
9. Ensure all management activities consider the presence of '*Phytophthora* dieback' the follow the dieback hygiene management plan.

Cultural Heritage

4.1 Aboriginal heritage

According to the Department of Planning, Lands and Heritage (DPLH*) Register of Aboriginal site* there is one Indigenous site over the Lowlands Nature Reserve. This is the Serpentine River (site ID 3582) and is a 'ceremonial' and 'mythical' site. The importance of wetlands and rivers are well recognised by Indigenous people. The rivers and the associated creek systems, the flow of lakes, wetlands, and surrounding landscape were not only an important economic resource but were intrinsically linked to the Dreaming stories of ancestral beings (O'Connor *et al* 1995).

Under section 56(2) of the CALM Act, Parks and Wildlife is responsible for protecting and conserving the value of the land to the culture and heritage of Aboriginal people. The department will follow any protocol or agreement entered into under the SWNTS[6] agreement to protect and conserve Aboriginal heritage sites.

[6] South West Native Title Settlement

Amendments to the CALM Act (and associated regulations), together with the *Wildlife Conservation Act 1950*, allow aboriginal people to access CALM Act land to conduct traditional activities, subject to regulations. Such traditional customary purposes may be for medicinal, artistic, ceremonial or other cultural purposes. The Swan region will engage with different representative bodies and local aboriginal groups to develop local area agreements. This will facilitate cultural use in light of the amendments and support and manage customary activities including the taking of traditional food by Aboriginal people in the reserve.

Desired outcome
To enable Aboriginal people to undertake customary activities consistent with relevant legislation, regulations and policy.

Strategies
1. Ensure persons undertaking customary activities adhere to the CALM Act 1984 and Parks and Wildlife regulations and any other relevant Acts (*e.g.* the Bush Fires Act 1954).
2. Consultation with local Aboriginal community to facilitate local area arrangements for customary acts.

4.2 European heritage

The area has seen much interest, nationally and at a state level, for its regionally significant bushland but also its cultural and natural history. Keighery *et al* 1995 described the area as a unique example of a farming settlement in the south-west of Western Australia.

Lowlands Nature Reserve was part of land originally granted to Thomas Peel in the 1830s. He named it Serpentine Farm and built a wooden barn and two pug houses (i.e., straw and mud) known as Peel House. The original Peel House and wooden shearing shed is still part of the homestead on the Lowlands property today. Remnants of an old mail route, a gravesite and old river crossings can be found on the Lowlands property.

The Richardson family have been managing the now Lowlands Nature Reserve and farming the three contiguous properties (Lowlands, Riverlea and Kalga) for the last 150 years. Cattle are still worked on the surrounding properties of the reserve. In more recent times the bushland on Lowlands and Riverlea properties was managed for conservation by the Lowlands Conservation Association. Management of Lowlands Nature Reserve will be in close consultation with the Richardson family to obtain historical and on the ground knowledge of the reserve and surrounding area.

A timeline of the properties history and recognition for its natural and cultural values is found in Appendix D. Map 7 provides historical references on the properties including paddock names.

Desired outcome
To identify, protect and conserve non-indigenous heritage values in the reserve.

Strategies
1. Manage and regularly monitor threatening processes to non-indigenous cultural heritage.
2. Facilitate the collection and documentation of information on non-Indigenous cultural heritage.
3. Continue liaison and engagement with the Richardson family throughout the implementation of these guidelines.

Community involvement, research and monitoring

5.1 Visitor opportunities

Due to the nature reserve status of the Lowlands Nature Reserve, visitor opportunities are limited by gazetted purpose of 'conservation of flora and fauna'. 'Low impact' recreation is permitted, but only when it does not adversely affect the natural values and ecosystem of the reserve. Public access should be confined to walkers with no access for private vehicles, motor bikes, bicycles, mountain bikes, horses or dogs.

Any group activities will be assessed through standard departmental process.

5.2 Engaging with the Community

The Lowlands Conservation Association became an incorporated body in 1998. Funding obtained through land grants has contributed to the ongoing management of the bushland for conservation on the Lowlands Nature Reserve and along the Serpentine River. Management works have included weed control, revegetation, fencing and dieback management. The Lowlands Conservation Association may be recognised as a "friends of the Lowlands reserve" group.

Many groups have contributed over the years to protect the values of the bushland. Schools have participated in land management activities including revegetation. There are many opportunities for the community groups such as Lowlands Conservation Association, Friends of Serpentine River, Greening Australia, Conservation Volunteers Australia, Green Army and other NGO's, schools and universities to take part in protecting the conservation values of the Lowlands Nature Reserve. Land management activities can include revegetation, weed control, research and surveys.

The Lowlands Advisory Committee has been established to guide the development of these guidelines, and will provide advice in supplementary work documents and future management of Lowlands Nature Reserve. The committee is made up of departmental staff, members of the Peel Harvey Catchment Council, representative of the Shire of Serpentine Jarrahdale and members of the Richardson family.

Subcommittees will be formed when appropriate to provide scientific advice for supplementary documents and may involve other stakeholders including government departments (*e.g.*, Water Corp), universities and non-government organisations (NGOs) such as Bird Life Australia.

5.3 Off reserve management and partnerships

Principals for effective neighbour relations are described in the department's *Good neighbour policy*. The department works with other land management agencies, local government agencies, neighbouring land owners and the local community to achieve effective and coordinated management of cross-boundary issues.

Some management activities in the Lowlands Nature Reserve that need to be approached from broader land management perspective include:

- fire management including prescribe burning and wildfire,
- catchment protection and water quality,
- threatened species protection,
- feral animal control.

Desired outcome
To gain community support, understanding and involvement in management operations of the reserve.

Strategies

1. Liaise with community, adjoining landowners, Land Conservation District committees, and local government authorities to ensure an integrated approach to land management.

2. Provide opportunities for community members to take part in volunteer activities in the reserve (*e.g.* clean up days, weed removal, research and monitoring programs).

5.4 Research and monitoring

Research and monitoring can lead to a better understanding of the values of protected areas, increase knowledge, aid performance assessment and provide a basis for improving and adapting future management to achieve the best practices.

Lowlands Nature Reserve is an important reference site for past, current and ongoing scientific studies. The conservation values of the Lowlands Nature Reserve have been recognised for many years and a variety of research has contributed to the knowledge base of the reserve. Past surveys that have taken place or associated with the Lowlands Nature Reserve and surrounding area include:

- Dieback surveys and assessment,
- Fungi surveys,
- Vegetation surveys,
- Soil monitoring,
- Vertebrate fauna,
- Bird surveys,
- Aquatic fauna,
- Serpentine River management and
- Water quality and bore monitoring.

Further research will help gain a better understanding of those values identified as being most at risk and the threats most likely to have adverse impacts on key values. There are permanent monitoring sites for floristic and macro invertebrates and a monitoring site for river health. The long unburnt status of the Banksia woodlands means Lowlands Nature Reserve is a valuable reference site for fire studies. Lowlands Nature Reserve provides a good opportunity to answer broader questions on ecosystems and threatening processes.

These guidelines allow for the adaptation of management in light of new knowledge arising from research and monitoring of management activities.

Desired outcome
To conduct research and monitoring to gain a better understanding of the values of the reserve and associated threatening processes and to improve future management.

Strategies:

1. Establish a scientific subcommittee to facilitate and guide research at Lowlands
2. Collate existing information on a central database. This includes historical information and maps, biological surveys and research and significant correspondence regarding the area.
3. Work with universities and other organisations to gain a better understanding of the conservation and biological values of the area.
4. Work with universities and other organisation to gain a better understanding of threatening processes and how to best manage them.
5. Work to establish Lowlands Nature Reserve as a long-term study and research site.

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Personnel communication

K Brown 2014 –Ecologist, Swan Region, Parks and Wildlife.

M Richardson 2014 – Lowlands property owner.

Appendices

Appendix A – Legislation, Policies and guiding documents

Legislation and Policy

The management and planning for the Lowlands Nature Reserve is influenced by the following legislation and policies:

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) contains provisions relating to the protection of nationally-listed threatened species and ecological communities, listing of key threatening processes and heritage protection. Any activities that may adversely affect these must be notified to the Commonwealth Minister and assessment under the Act may be necessary.

The Conservation and Land Management Act 1984 (CALM Act) governs the declaration and management of protected areas, and imposes certain obligations relating to management planning of these areas. Section 56 of the CALM Act specifies that nature reserves are established 'to maintain and restore the natural environment, and to protect, care for, and promote the study of indigenous flora and fauna, and to preserve any feature of archaeological, historic or scientific interest'.

The Wildlife Conservation Act 1950 (Wildlife Conservation Act) governs the specific protection of native flora and fauna on all lands and waters within the State. The Wildlife Conservation Act also makes it an offence to take Declared Rare Flora without Ministerial approval. TECs are not specifically listed under the Wildlife Conservation Act but are given high priority under assessment and planning processes of the Environment Protection Authority and Western Australia Planning Commission, including Bush Forever.

The Land Administration Act 1977 creates Nature Reserves. Reserves are vested in the Conservation Commission of Western Australia and managed by the Department in accordance with the CALM Act, Wildlife Conservation Act and the policies of both the Department and the Conservation Commission.

The Dampier to Bunbury Pipeline Act 1997 (DBPA) manages the Dampier to Bunbury Natural Gas Pipeline (DBNGP) Corridor. Restrictions are administered (including activities and works) on the DBNGP corridor to protect the integrity and safety of the gas pipelines. A section 41 application must be submitted to the Department of Lands prior to works being undertaken along the DBNGP corridor.

The Environmental Protection Act 1986 provides for protection of the environment across the state. Environmentally Sensitive Areas (ESAs) are subject to definition under Section 51B of the act and may include areas requiring special management attention to protect importance scenic values, fish and wildlife resources, historical and cultural values and other natural systems or processes. The ESAs in the Lowlands Nature Reserve are associated with the Conservation Category Wetlands and Bush Forever sites.

The Environmental Protection (Swan Coastal Plain Lakes) Policy 1992. The Environmental Protection Policy (EPP) Protected Lakes are subject to definition of this policy. These lakes are protected under the policy from filling, draining, excavating, polluting and clearing. An EPP lake (4.7ha) is located in the reserve as shown in Map 1.

Departmental policies mentioned throughout this plan relate to the management of Department-managed land for matters such as weeds, fire, disease, rehabilitation, recreation and tourism, community involvement, flora, fauna, visual landscape and visitors, preparation of management plans, native title and joint management agreements (see www.Parks and Wildlife.wa.gov.au/about-us/36-policies-and-legislation).

Obligations, agreements and guiding documents

Management of certain aspects of Lowlands Nature Reserve is influenced by the following obligations, agreements and guiding documents:

Department of Parks and Wildlife (2016) Swan Coastal Plain South management plan 2016. Management plan number 85. Department of Parks and Wildlife, Perth.

The Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea-Australia Migratory Bird agreement ROKAMBA are bilateral agreements between the governments involved in order to protect shared species in the East Asian-Australasian Flyway and their habitats. Nearly 80 bird species are listed in these agreements. All marine/migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance under the Commonwealth EPBC Act.

The department's current Nature Conservation Swan Region Plan one of nine regional plans that collectively provide for a greater integration of departmental activities and functions towards achieving the primary goal of conserving Western Australia's biodiversity. Top conservation priorities of the region which relate to Lowlands Nature Reserve includes:

1. Implement a strategic approach to the management of landscape-scale threatening processes.

2. Continue to foster adaptive management and align activities with reporting requirements

3. Faciliate research across a range of issues to close knowledge gaps and improve management, whilst fostering relationships with external researchers.

4. Continue to support research and management that focuses on best practice fire management of biodiversity assets and ecosystem functionality.

5. Reintegrate hygiene management procedures (Phytophthora disease & weeds) into core business activities.

6. Review threatening processes for Ramsar wetlands, nationally listed wetlands & TECs, prioritise actions and implement monitoring and evaluation programs.

7. Seek to improve or maintain the status of threatened and priority flora and fauna through the implementation of recovery actions.

8. Facilitate an improved understanding of the recovery of critical weight range fauna, including bait uptake by target and non-target species.

9. Foster strong relationships with community groups and non-government organisations to build capacity to achieve conservation outcomes.

Appendix B – Fauna list of the Lowlands Nature Reserve

Scientific name	Common name	Significant species
Birds		
Acanthiza apicalis	Broad-tailed Thornbill	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	
Acanthorhynchus superciliosus	Western Spinebill	
Accipiter fasciatus	Brown Goshawk	
Anas gracilis	Grey Teal	
Anas superciliosa	Pacific Black Duck	
Anthochaera carunculata	Red Wattlebird	
Anthochaera lunulata	Western Little Wattlebird	
Aquila audax	Wedge-tailed Eagle	
Cacomantis flabelliformis	Fan-tailed Cuckoo	
Calyptorhynchus banksii	Red-tailed Black-Cockatoo	Vu
Calyptorhynchus latirostris	Carnaby's's Cockatoo	T
Chenonetta jubata	Australian Wood Duck	
Colluricincla harmonica	Grey Shrike-thrush	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	
Corvus coronoides	Australian Raven	
Cracticus tibicen	Australian Magpie	
Cracticus torquatus	Grey Butcherbird	
Dacelo novae.g.,uineae	Laughing Kookaburra	
Daphoenositta chrysoptera	Varied Sittella	
Eopsaltria griseogularis	Western Yellow Robin	
Falco cenchroides	Australian Kestrel	
Gerygone fusca	Western Gerygone	
Grallina cyanoleuca	Magpie-lark	
Haliastur sphenurus	Whistling Kite	
Hirundo neoxena	Welcome Swallow	
Lichenostomus ornatus	Yellow Plumed Honeyeater	
Lichenostomus virescens	Singing Honeyeater	
Lichmera indistincta	Brown Honeyeater	
Malurus splendens	Splendid Fairy-wren	
Nycticorax caledonicus	Rufous Night Heron	
Ocyphaps lophotes	Crested Pigeon	
Pachycephala pectoralis	Golden Whistler	
Pachycephala rufiventris	Rufous Whistler	
Pardalotus punctatus	Spotted Pardalote	
Pardalotus striatus	Striated Pardalote	
Petroica goodenovii	Red capped Robin	
Phaps chalcoptera	Common Bronzewing	
Phylidonyris novaehollandiae	New Holland Honeyeater	
Podargus strigoides	Tawny Frogmouth	
Rhipidura leucophrys	Willie Wagtail	
Sericornis frontalis	White-browed Scrubwren	
Smicrornis brevirostris	Weebill	
Streptopelia sene.g.,alensis	Laughing Turtle-Dove	
Threskiornis molucca	Australian White Ibis	
Threskiornis spinicollis	Straw-necked Ibis	
Zosterops lateralis	Grey-breasted White-eye	

Scientific name	Common	Significant species
	Fish	
Galaxias occidentalis	Western Minnow	
Bostockia porosa	Nightfish	
Nannoperca vittata	Western Pygmy Perch	
Pseudogobius olorum	Swan River Goby	estuarine fish
Geotria australis	Pouched Lamprey	marine migrant
Tandanus bostocki	Freshwater cobbler	
	Freshwater macroinvertebrates	
Westralunio carteri	Carters freshwater mussel	Vu
Paratya australiensis?	South west glass shrimp	
Cherax quinquecarinatus	Gilgie	
	Sweet marron	
	Amphibians	
Crinia georgiana	Quacking Frog	
Crinia insignifera	Squelching Froglet	
Crinia glauerti	Gkaurets froglet	
Helioporus eyerii	Moaning frog	
Litoria morei	Motorbike frog	
Litoria adelaidensis	Slender tree frog	
	Mammals	
Macropus fuliginosus	grey kangaroo	
Hydromys chrysogaster	Rakali	P4
Dasyurus geoffroii	Chuditch	T
Isoodon obesulus sub fusciventer	Quenda	P5
Phascogale tapoatafa	Brush tailed phascogale	Vu
Trichosurus vulpecula	Brush tailed possum	
Macropus irma	Western brush wallaby	
	Reptiles	
Hemie.g.,is quadrilineata	two toed earless skink	
Menetia greyii	Common dwarf skink	
Lerista ele.g.,ans	West Coast four toed Lerista	
Lerista distinguenda		
Morethis obscura	South western orange tailed slider	
Pseudonaja spp	Dugite	
Tiliqua rugosa	Bobtailed lizard	
Varanus gouldii	Goulds Sand Goanna	
Varanus tristis	Racehorse Goanna	
(Notechis scutatus	Western tiger snake	
Chelodina oblonga	Long neck turtle	

(data obtained from Naturemap 2014, Kluzinger *et al* 2011, DEC 2012, Burbidge 1993)

Appendix C – Weed species with priority for mapping (as at 2017)

Species	Priority Mapping	Date Mapped	Species	Priority Mapping	Date Mapped
Acetosella vulgaris			Lupinus angustifolius (narrow leaf lupin)		
Aira caryophyllea (Silvery Hairgrass)			Lupinus cosentinii		
Aira cupaniana (Silvery Hairgrass)			Lysimachia arvensis (pimpernel)		
Anthoxanthum odoratum (Sweet Vernal Grass)			Malva parviflora (marshmellow)		
Arctotheca calendula (cape weed)			Mentha pulegium (pennyroyal)		
Aristida ramosa (Purple Wire grass)			Mentha xpiperita		
Asparagus asparagoides (Bridal Creeper)	Yes		Monopsis debilis		
Briza maxima (Blowfly Grass)			Moenchia erecta (Erect Chickweed)		
Briza minor (Shivery Grass)			Ornithopus compressus (Yellow Serradella)		
Bromus diandrus (Great Brome)			Ornithopus pinnatus (Slender Serradella)		
Cardamine hirsuta (Common Bittercress)			Orobanche minor (lesser broomrape)		
Carduus pycnocephalus (slender thistle)			Oxalis glabra		
Cardamine hirsuta (Common Bittercress)			Oxalis pes-caprae (Soursob)		
Cerastium glomeratum (Mouse Ear Chickweed)			Oxalis purpurea (Largeflower Wood Sorrel)		
Cicendia filiformis			Parentucellia latifolia (common bartsia)		
Cirsium vulgare (Spear thistle)			Parentucellia viscosa (Sticky Bartsia)		
Conyza sumatrensis			Pelargonium capitatum (rose pelargonium)	Yes	
Centaurea melitensis (Maltese cockspur)			Pentameris airoides		
Corrigiola litoralis (Strapwort)			Phalaris angusta		
Crassula decumbens (Rufous stonecrop)			Phalaris paradoxa (paradoxa grass)		
Crassula natans			Petrorhagia dubia		
Cotula bipinnata (Ferny cotula)			Poa annua (winter grass)		
Cyperus congestus (Dense flat sedge)			Polycarpon tetraphyllum (fourleaf tetraphyllum)		
Cyperus tenellus (tiny flatsedge)			Paspalum distichum (Water Couch)		
Cynodon dactylon (Couch)			Ranunculus muricatus (Sharp Buttercup)		
Disa bracteata			Ranunculus trilobus (buttercup)		
Dittrichia graveolens (Stinkwort)			Ricinus communis (castor oil)		
Dysphania ambrosioides			Romulea rosea (Guildford Grass)		
Echinochloa crusgalli (barnyard grass)			Romulea rosea var. australis (Guildford Grass)		
Ehrartia calycina	Yes		Rubus ulmifolius (blackberry)		
Ehrharta longiflora (Annual Veldt Grass)			Rumex brownii (Swamp Dock)		
Euphorbia terracina (Geraldton Carnation Weed)	Yes		Rumex conglomeratus (Clustered Dock)		
Feraria crispa (black flag)	Yes	Jul-15	Rumex crispus (curled dock)		
Ficus carica (Common Fig)			Rumex pulcher (Fiddle Dock)		
Fumaria capreolata (Whiteflower Fumitory)			Silene gallica (french catchfly)		
Freesia alba x leichtlinii	Yes	Jul-15	Solanum americanum (Glossy Nightshade)		
Fumaria muralis subsp. muralis			Solanum linnaeanum		
Gamochaeta calviceps			Solanum nigrum (black berry nightshade)		
Galium divaricatus			Sonchus asper (Rough Sowthistle)		
Galium murale (Small Goose.g.,rass)			Spergula arvensis (corn spurry)		
Gamochaeta calviceps			Sonchus oleraceus (common sowthistle)		
Geranium molle (doves foot cranesbill)			Stachys arvensis (Staggerweed)		
Gladiolus angustus (Long Tubed Painted Lady)			Symphyotrichum squamatum (bushy starwort)		
Gladiolus undulatus (wild gladiolus)	Yes		Stellaria media (Chickweed)		
Gladiolus caryophyllaceus (wild gladiolus)	Yes		Trifolium campestre (Hop Clover)		
Glyceria declinata			Trifolium cernuum (drooping flower clover)		

Glyceria maxima (water meadowgrass)			Trifolium dubium (suckling clover)		
Gomphocarpus fruticosus (cotton bush)			Trifolium hybridum var. hybridum		
Hordeum leporinum (Barley Grass)			Trifolium golmeratum (cluster clover)		
Hypochaeris glabra (Smooth Catsear)			Trifolium repens		
Isolepis marginata (Coarse Club-rush)			Trifolium subterraneum (subterraneum clover)		
Juncus bufonius (toad rush)			Typha orientalis (bulrush)		
Juncus capitatus (Capitate Rush)			Ursinia anthemoides (Ursinia)		
Juncus polyanthemus			Verbascum virgatum (twiggy mullein)		
Lagurus ovatus (Hares tail grass)			Vellereophyton dealbatum (white cudweed)		
Lavandula stoechas (Italian Lavender)	Yes		Vicia sativa subsp. sativa		
Lolium multiflorum (Italian rye grass)			Vulpia bromoides (Squirrel Tail Fescue)		
Lolium rigidum (Winnwera rye grass)			Vulpia myuros (Rat's Tail Fescue)		
Lotus angustissimus (narrowleaf trefoil)			Wahlenbergia capensis (Cape Bluebell)		
Lotus subbiflorus			Watsonia meriana var. bulbillifera	Yes	
			Zantedeschia aethiopica (Arum Lily)	Yes	

(data obtained by Naturemap 2014, Keighery *et al* 1995, K Brown pers comm 2014)

Appendix D – Timeline of natural and cultural history of the Lowlands area

1840 – Originally called Serpentine Farm and was part of land originally granted to Thomas Peel in the largest land grant on the Swan Coastal Plain.

1859 - Much of Serpentine Farm was sold to John Wellard.

1876 – The property was sold to John Wellard's son in law, Alexender Richardson. Richardson renamed the farm Lowlands and developed it to carry large numbers of cattle, heavy horses and sheep.

1922 - Lowlands was divided between family members into two farms (Lowlands and Riverlea).

1946 - Riverlea was further divided into two farms (Riverlea and Kalga). The three properties were and continue to be managed by members of the Richardson family.

1970 - The family approached the government to consider purchasing the bushland area to ensure it remains conserved in perpetuity. However due to funding restrictions the proposal never was resolved.

1978 - Lowlands Heritage Precinct was included in the Register of the National Estate (non-statutory archive).

1983 - Environment Protection Authority listed the bushland in the System 6 Red Book

1990 - All stock on Lowlands was isolated from the pasture areas adjacent to the bushland.

1996 - Bushland on Lowlands was nominated for registration on the Register of the National Estate.

2000 - Two blocks of bushland on Lowlands and Riverlea property where listed as Bush Forever sites. Shire of Serpentine-Jarrahdale rezone parts of Lowlands and Riverlea property 'Conservation' and the development of the 'Lowlands Conservation Estate Management Plan'.

2010 - The Department of Parks and Wildlife approached the Richardson family for consideration of sale of the bushland area due to depleting areas of banksia woodland on the Swan Coastal Plain.

2013 - Main Roads Western Australia purchased the bushland area within both Lowlands and Riverlea properties for Department of Parks and Wildlife to manage as a Class A Nature Reserve.

MapsMap 1 – Regional values of Lowlands Nature Reserve (M105, bushforever, conservation category wetlands, EPP site)

Map 2 – Vegetation Associations

Map 3 – Vegetation Condition

Map 4 – Hydrology and threats

Map 5 – 1080 Fox baiting transect

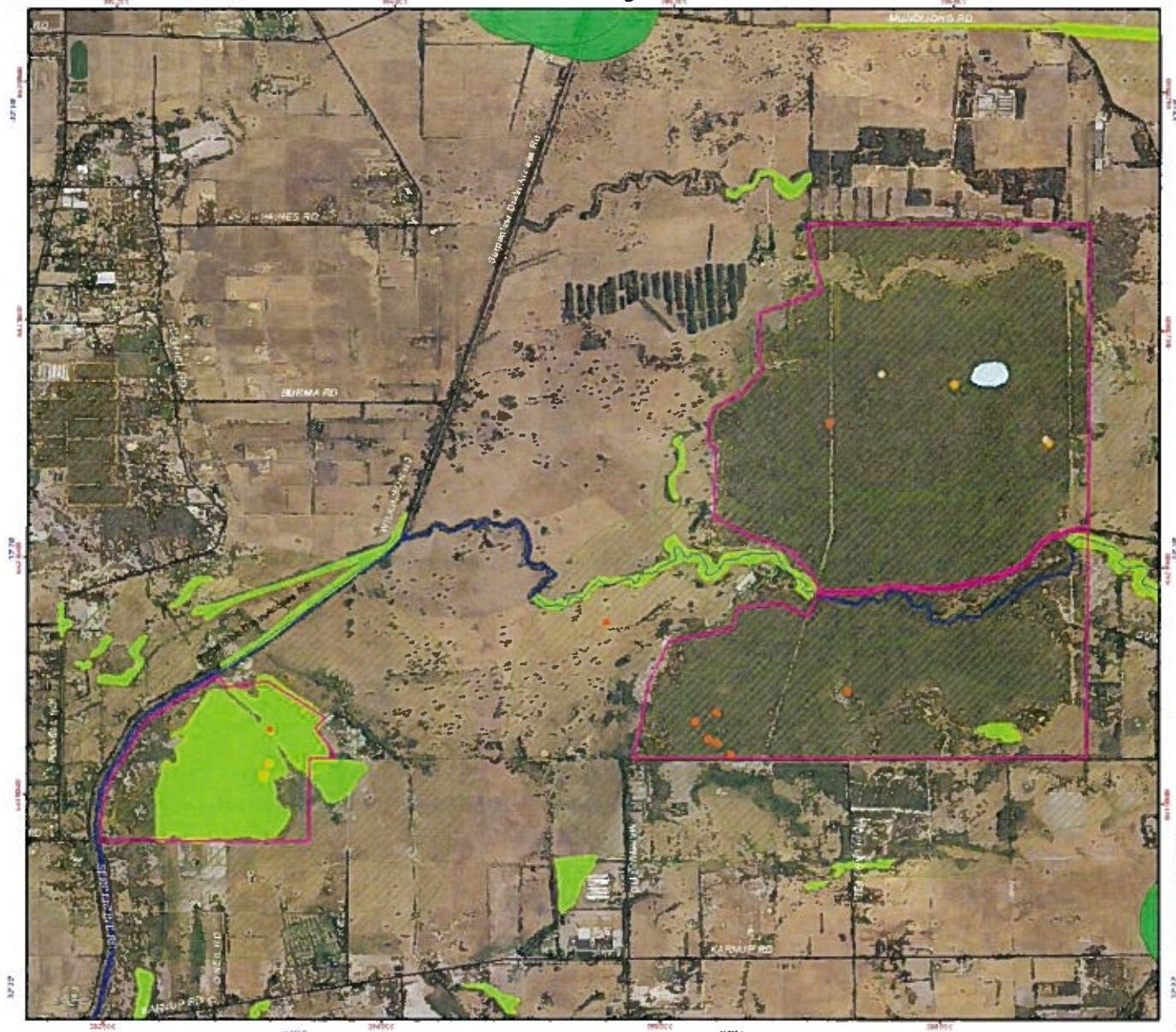
Map 6 – Vehicle access and water points

Map 7 – Historical references in Lowlands properties

Map 8- Dieback Interpretation Maps

Map 9- Fire Response Plan

Lowlands Nature Reserve- Regional Conservation Values



Legend

- EPP Lakes

EVALUATION

- Conservation
- Multiple Use
- Not Applicable
- Not Assessed
- Resource Enhancement
- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Threatened
- Extinct

Status

- Priority
- Threatened
- Swan Major Hydrography
- Bush Forever Sites
- Lowlands Nature Reserve

0 750 1,500 3,000 m

Projection: Universal Transverse Mercator
MGA Zone 50 Datum: GDA94

Produced by the Department of Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads

Produced on Jan 14, 2016

Lowlands Nature Reserve
Eastern Block

N

Lowlands Vegetation Associations

Lowlands_Veg_Associations_1995

Vegetation

- Banksia Woodland
- Banksia Woodland in poor condition
- Banksia Woodland over Kunzea ericifolia Closed Tall Scrub
- Banksia Woodlands to Forests with scattered emergent Eucalypts
- Banksia, Allocasuarina fraseriana, and or Melaleuca preissiana Woodlands to Forests
- Claypans
- Eucalyptus rudis Forest to Woodland
- Mixed Species Woodland & Plantation Woodland
- Melaleuca rhaphiophylla Woodland to Shrubland
- Pasture
- Pasture with scattered mature trees
- Scattered Eucalyptus rudis and Melaleuca preissiana Low Woodland to Open Low Woodland
- Sumplands
- Tuart Woodland
- Woodlands over Sedgelands
- Lowlands Nature Reserve
- Swan Major Hydrography

0 487.5 975 1,950 m

Projection: Universal Transverse Mercator
MGA Zone 50 Datum GDA94

Produced by the Department of Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads

Produced on: Jan 14, 2015

Lowlands Nature Reserve
Western Block

N

Lowlands Vegetation Associations

Lowlands_Veg_Associations_1995

Vegetation

- Banksia Woodland over Kunzea ericifolia Closed Tall Scrub
- Banksia and Melaleuca preissiana Woodland
- Banksia, Allocasuarina fraseriana and/or Melaleuca preissiana Woodlands to Forests
- Pasture with scattered trees (C. calophylla, E. rudis & Melaleuca)
- Regenerated Service Corridor 90% cover Regrets over sedges
- Regenerating Kunzea thicket
- Scattered Tuarts in pasture
- Woodlands over Sedgelands
- Lowlands Nature Reserve
- Swan Major Hydrography

0 187.5 375 750 m

Projection: Universal Transverse Mercator
MGA Zone 50 Datum: GDA94

Produced by the Department of Parks and Wildlife

Department of Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2500 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads

Produced on: Jan 14, 2015

Lowlands Nature Reserve Eastern Block

N

Lowlands Vegetation Conditions

Lowlands_Veg_Condition_mapping_April2012

Vegetation Condition

- Excellent to Very Good
- Very Good to Excellent
- Very Good
- Very Good to Good
- Good to Very Good
- Good
- Pasture with scattered mature trees
- Pasture with regenerating Kunzea thicket
- Regenerating service corridor
- Service corridor
- Lowlands Nature Reserve
- Swan Major Hydrography

0 487.5 975 1,950 m

Projection Universal Transverse Mercator
MGA Zone 50 Datum GDA94

Produced by the Department of Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced on Jan 14, 2016

Lowlands Nature Reserve
Western Block

N

Lowlands Vegetation Conditions

Lowlands_Veg_Condition_mapping_April2012

Vegetation Condition

- Excellent to Very Good
- Very Good to Excellent
- Very Good
- Very Good to Good
- Good to Very Good
- Good
- Pasture with scattered mature trees
- Pasture with regenerating Kunzea thicket
- Regenerating service corridor
- Service corridor
- Lowlands Nature Reserve
- Swan Major Hydrography

0 185 370 740 m

Projection: Universal Transverse Mercator
MGA Zone 50 Datum: GDA94

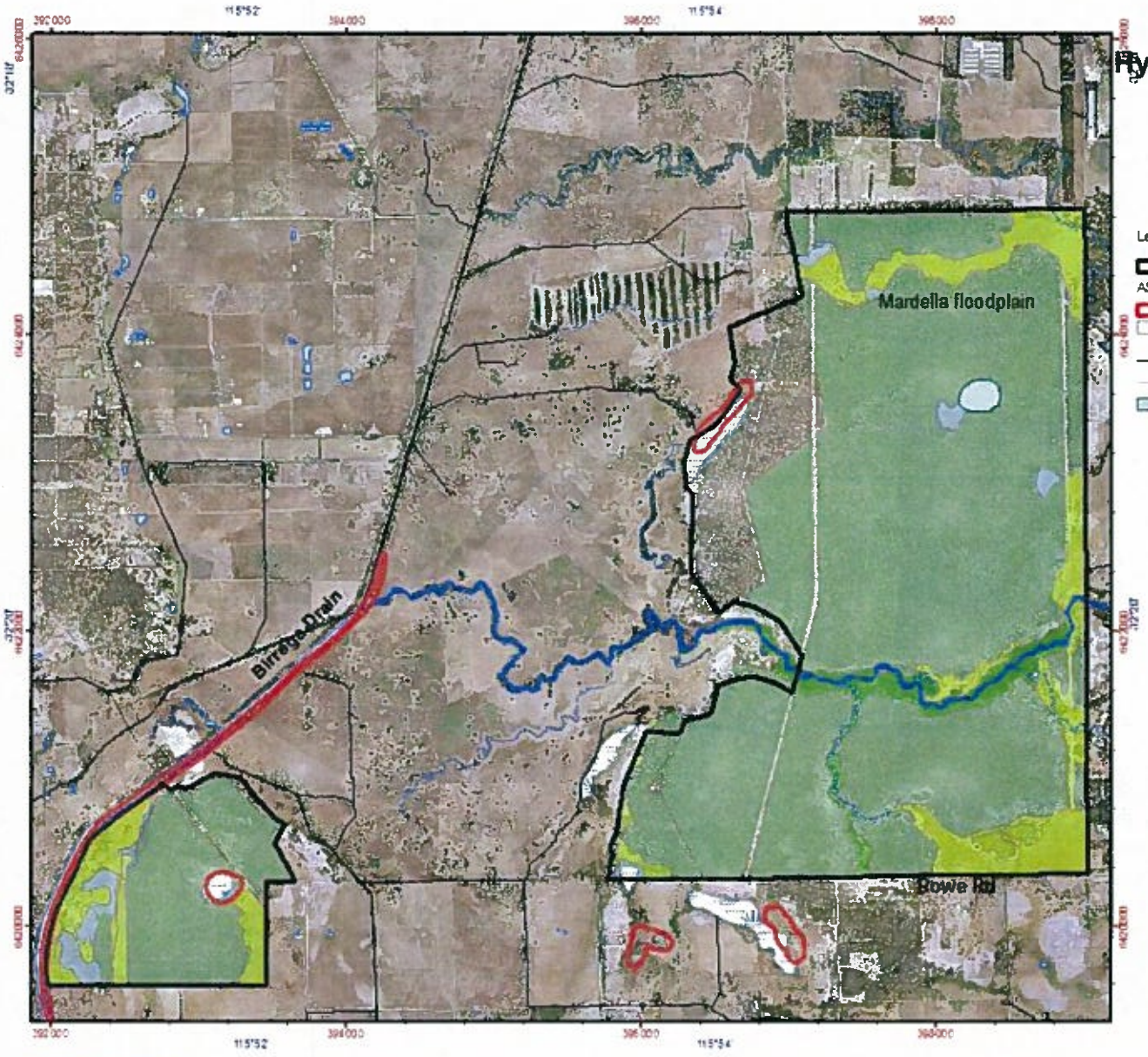
Produced by the Department of Parks and Wildlife

Grid shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced on Jan 14, 2016

Hydrology, wetlands and threats



Legend

- Boundary
- ASSRM Swan Coastal Plain
  - High to moderate risk of ASS
  - Moderate to low risk of ASS
- Swan Major Hydrography
- Minor Hydro
- EPP Lakes

Grouped vegetation associations

- Banksia Woodland
- Ephemeral wetlands
- River creekline
- other

(A4)

1:35,978

0 250 500 1,000 1,500 2,000

Metres

Projection: Universal Transverse Mercator
MGA Zone 50 Datum: GDA94

Produced by the Department of Parks and Wildlife

Produced at 1:26pm on August 25 2014

Lowlands Nature Reserve
1080 Baiting Transect
East - Dieback

Legend

Dieback Condition 2015

- Free
- Infested
- Uninterpretable
- Unprotectable

- Small 1080 sign
- Houses
- Large 1080 Sign
- Swan Tracks
- Swan Unsealed Roads
- Swan Sealed Roads
- Lowlands_1080_Transect
- Tethered_baits
- Lowlands Nature Reserve

Total length of transects (including tethered): 21.6Km
Total required baits for Lowlands East: 108 baits

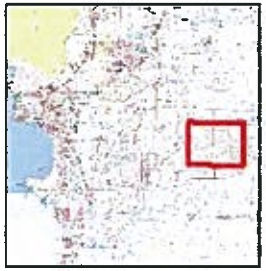
(A3)

1:18,412

0 120 240 480 720 960

Metres

Projection: Universal Transverse Mercator
MGA Zone 50. Datum: GDA94



Produced by M Verdouw,
Department of
Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced at 3:14pm, on Jan 6, 2017

Lowlands Nature Reserve
1080 Baiting Transect
West - Dieback

Legend

Dieback Condition 2015

- Free
- Infested
- Uninterpretable
- Unprotectable

- Small 1080 sign
- Houses
- Large 1080 Sign

- Swan Unsealed Roads
- Swan Sealed Roads
- Lowlands_1080_Transect
- Lowlands Nature Reserve

Total length of transects (including tethered): 6.6Km
Total required baits for Lowlands West: 34 baits

N

(A3)

1:6,918

0 45 90 180 270 360

Metres

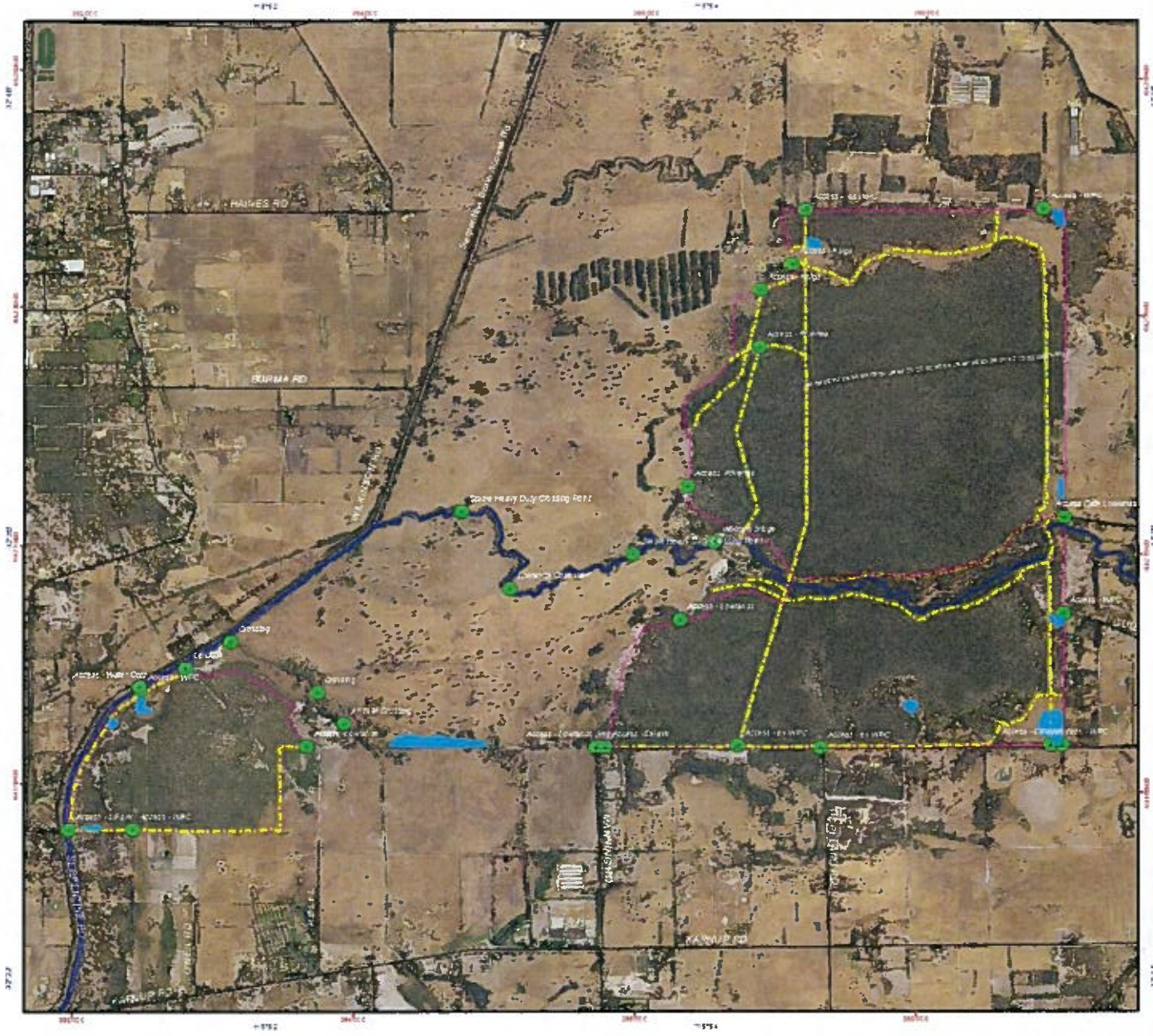
Projection: Universal Transverse Mercator
MGA Zone 50, Datum: GDA94

Produced by M.Verdouw,
Department of
Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced at 3:14pm, on Jan 6, 2017



Lowlands Nature Reserve
Vehicle Access & Water Points

N

Legend

- Lowlands_Infrastructure2014
- Vehicle_tracks
- Walk_tracks
- Lowlands boggy areas
- Swan Major Hydrography
- Lowlands Nature Reserve
- Roads_MRWA

0 750 1 500 3 000 m

Projection Universal Transverse Mercator
MGA Zone 50 Datum GDA94

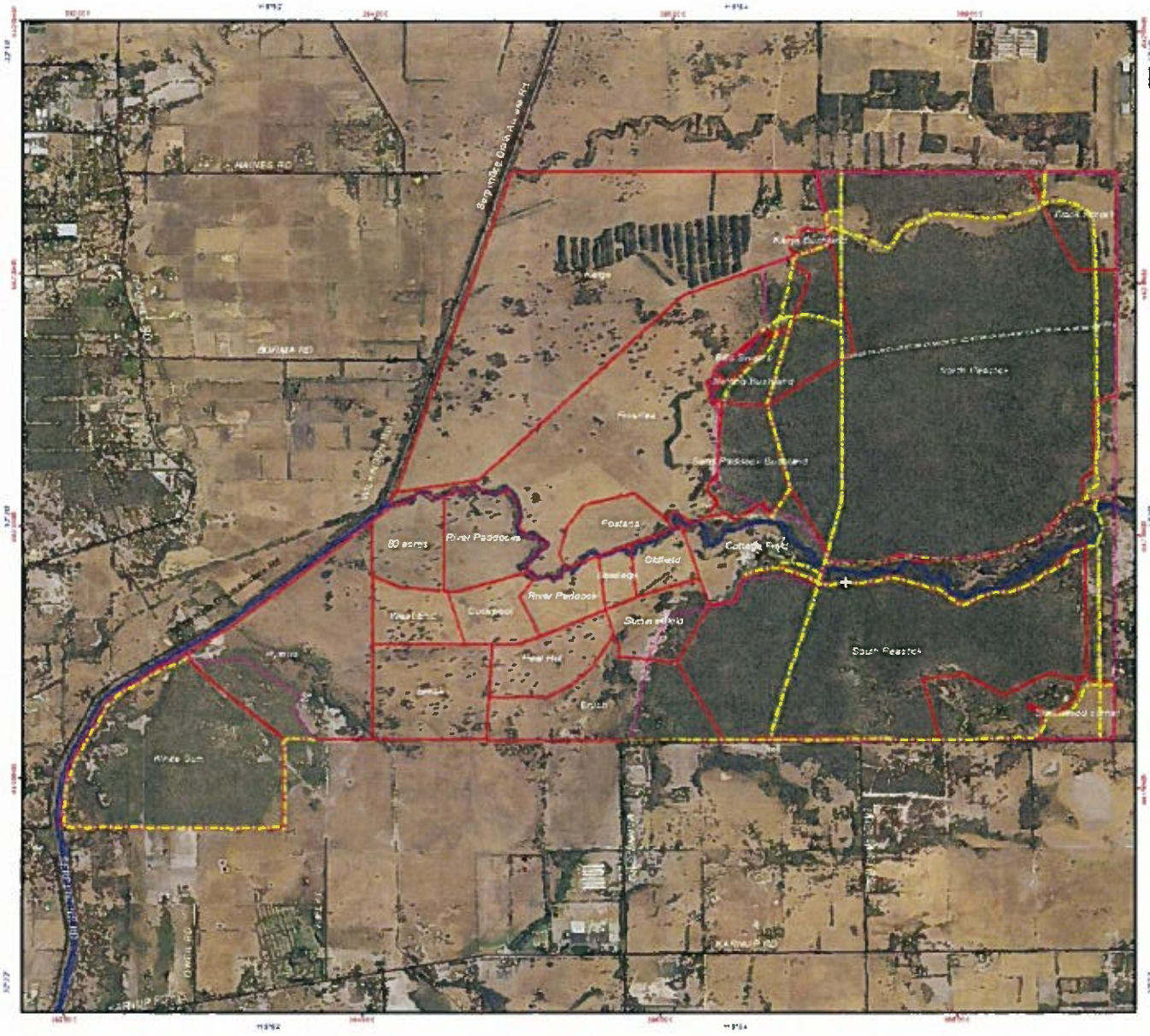
Produced by the Department of Parks and Wildlife

Department of Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced on Jan 14 2016



Lowlands Nature Reserve
Historical paddocks & gravesite

N

Legend

- Paddocks_Lowlands
- Gravesite
- Vehicle_tracks
- Walk_tracks
- Swan Major Hydrography
- Lowlands Nature Reserve
- Roads_MRWA

0 700 1,400 2,800 m

Projection Universal Transverse Mercator
MGA Zone 50 Datum GDA94

Produced by the Department of Parks and Wildlife

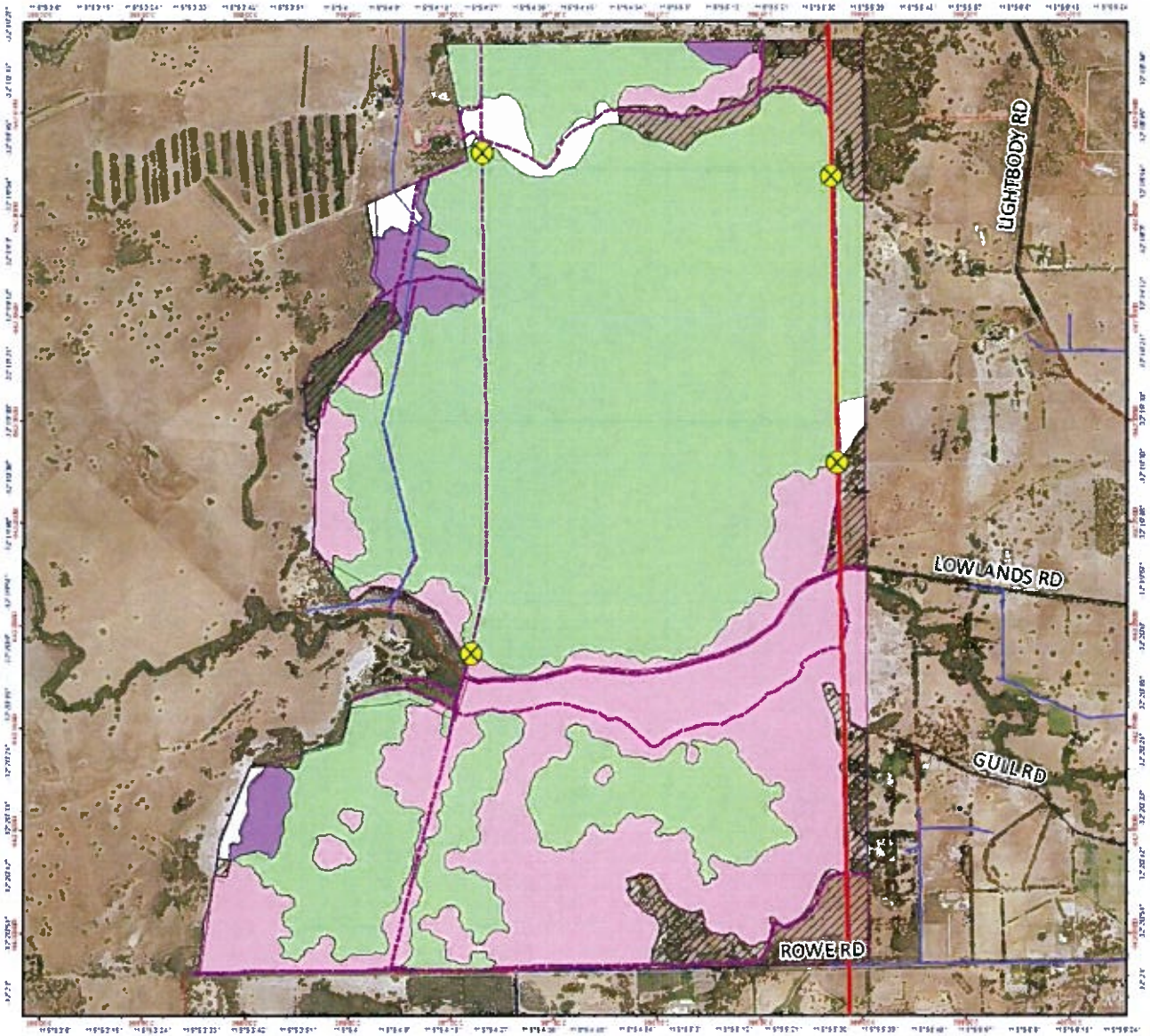
Department of Parks and Wildlife

Graticule shown at 2 minutes intervals
Grid shown at 2000 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced on Jan 14, 2016

Lowlands Block
(Lowlands Nature Reserve)
Dieback Hygiene Management Map



Legend

- Vehicle Wash Down Bays
- Vehicle_tracks

Lowlands_Dieback_Mapping_2015

- <all other values>

Dieback_Category

- Infested
- Uninfested
- Uninterpretable
- Other
- Unprotectable

N

1:25,000

0 190 380 760 1,140 1,520

Meters

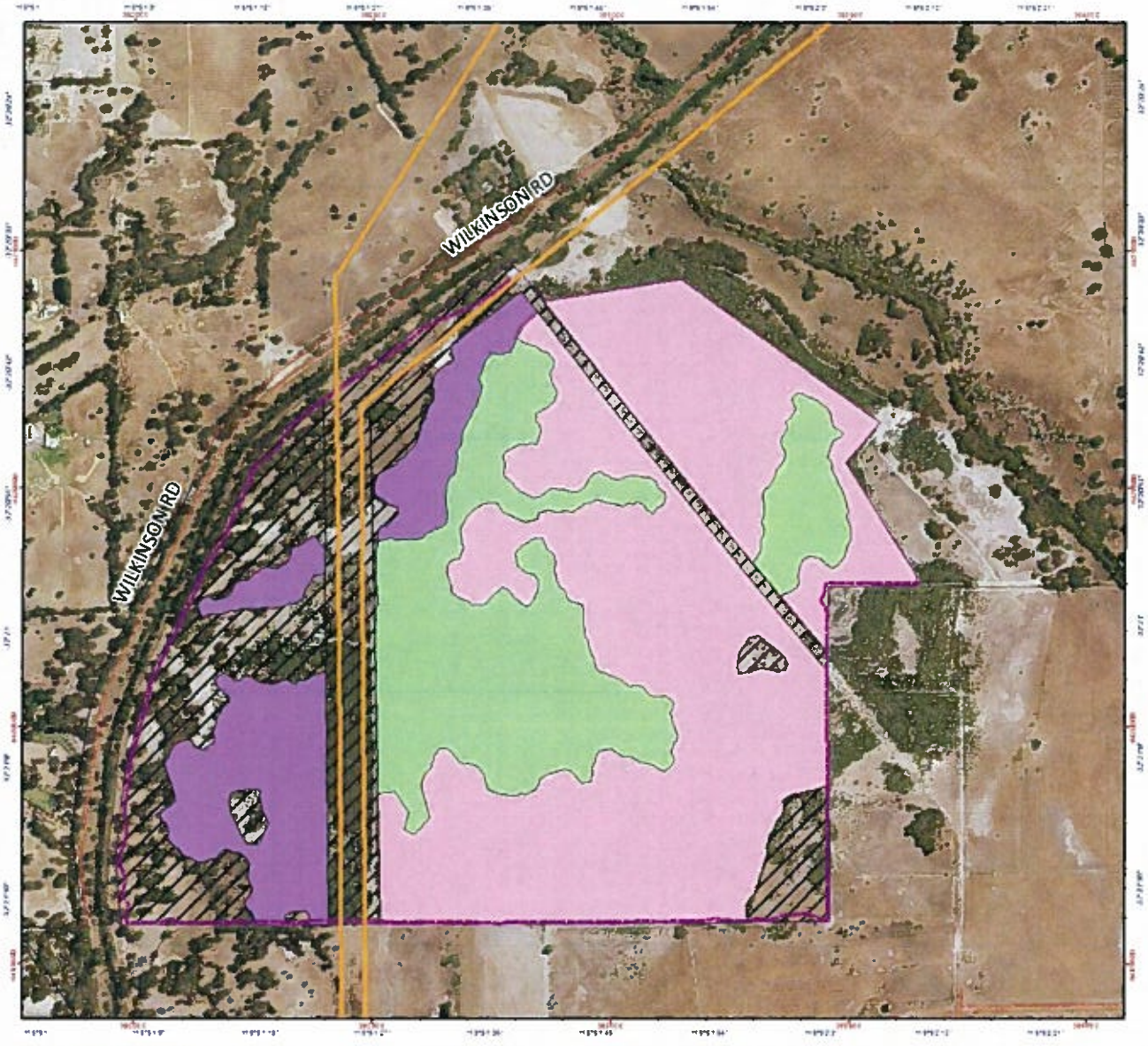
Projection: Universal Transverse Mercator
MGA Zone 50 Datum: GDA94

Produced by Megan Sheehan.
Department of
Parks and Wildlife

Graticule shown at 15 seconds intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced at 11:20am on Mar 29, 2017



Hymus Swamp Block (Lowlands Nature Reserve) Dieback Hygiene Management Map

Legend

- Vehicle Wash Down Bays
- Vehicle_tracks

Lowlands_Dieback_Mapping_2016

- <all other values>

Dieback_Category

- Infested
- Uninfested
- Uninterpretable
- Other
- Unprotectable

N

1 125 000

0 80 160 320 480 640

Meters

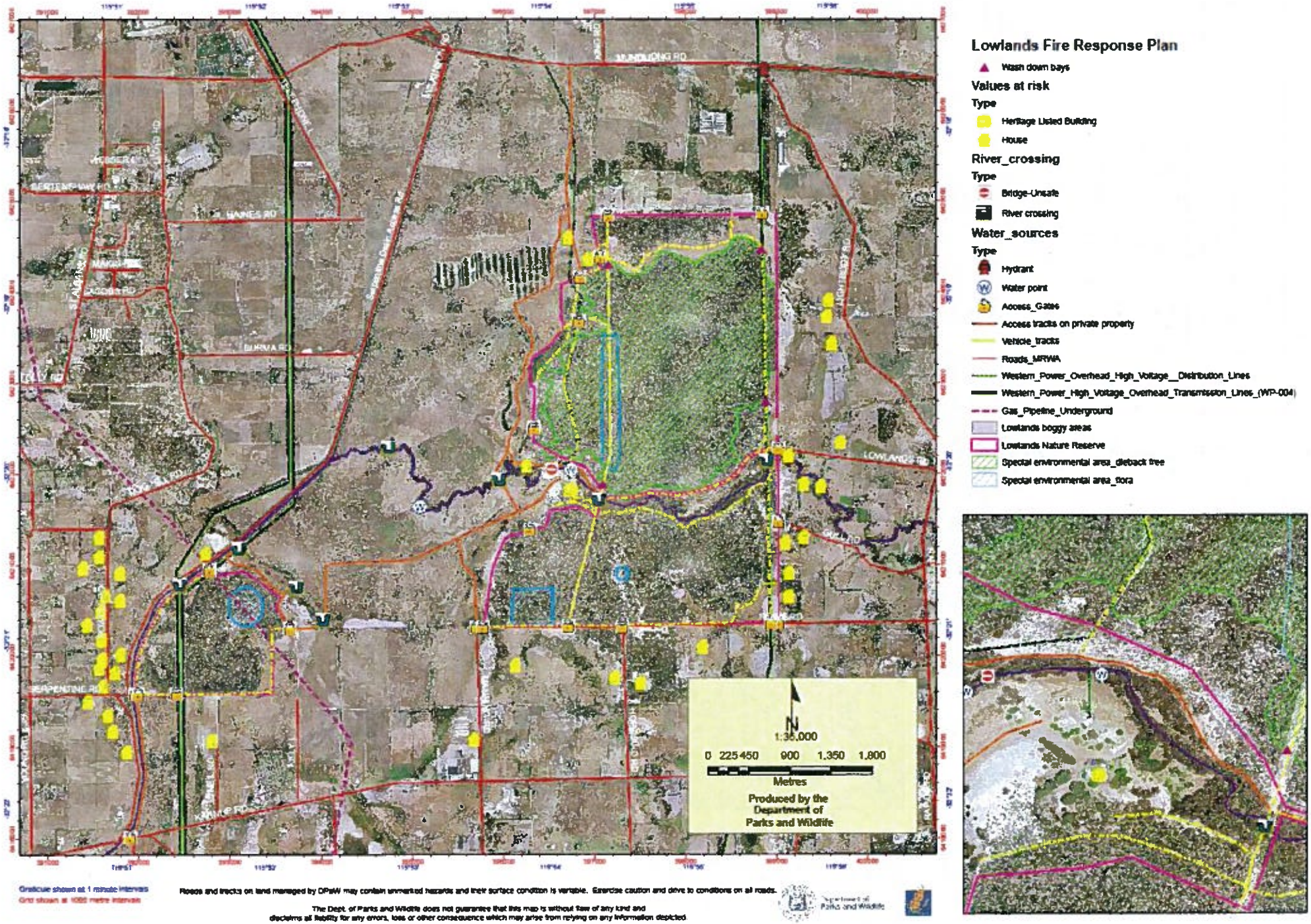
Projection: Universal Transverse Mercator
MGA Zone 50 Datum: GDA94

Produced by Megan Sheehan,
Department of
Parks and Wildlife

Graticule shown at 15 seconds intervals
Grid shown at 500 metre intervals

Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.

Produced at 11:20am on Mar 29, 2017


Lowlands Fire Response Plan
Wash down bays
Values at risk
Type
Heritage Listed Building
House
River_crossing
Type
Bridge-Unsafe
River crossing
Water_sources
Type
Hydrant
Water point
Access_Gates
Access tracks on private property
Vehicle_tracks
Roads_MRWA
Western_Power_Overhead_High_Voltage__Distribution_Lines
Western_Power_High_Voltage_Overhead_Transmission_Lines_(WP-004)
Gas_Pipeline_Underground
Lowlands boggy areas
Lowlands Nature Reserve
Special environmental area_dieback free
Special environmental area_flora
MUNDIJONG RD
HAINES RD
BURMA RD
LOWLANDS RD
SERPENTINE RD
KARNUP RD
N
1:35,000
0 225 450 900 1,350 1,800
Metres
Produced by the
Department of
Parks and Wildlife
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
Roads and tracks on land managed by DPaW may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.
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